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Received: 31 October 2021 | Accepted: 22 February 2022

DOI: 10.1111/jors.12592

RESEARCH ARTICLE

JOURNAL OF REGIONAL SCIENCE WILEY

Regional multipliers across the Italian regions

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Funding information
DISES-Fondazione IFEL Campania

Abstract

This paper estimates the multipliers of different types of government spending in the 20 Italian administrative regions throughout 1994–2016. We derive region-specific multipliers through a Bayesian random effect panel vector autoregressive model. We find that the EU structural funds, compared to the other types of government spending, provide the largest and most pervasively significant GDP multipliers, whereas the effectiveness of nationally funded government investment and, especially, government consumption shocks is more limited. An exploratory analysis of the regional multipliers suggests that they are positively associated with the amount of unused resources and the size of the regional economy.

KEYWORDS

Bayesian panel vector autoregressive model, EU structural funds, fiscal multipliers, government consumption, government investment, Mezzogiorno, regional divides

1 | INTRODUCTION

With the onset of the Great Recession, the study of the effects of fiscal policy has regained prominence in the economic debate. Much of this recent literature has focused on subnational analyses of fiscal policies because of the advantages to be obtained in terms of the identification of fiscal shocks. Indeed, subnational bodies, such as states in the United States or regions in European countries, are subjected to demand management policies that are relatively unresponsive to their idiosyncratic conditions. In this literature, a key role has been played by the computation of fiscal multipliers, also central to the present analysis. Unlike most of these analyses, however, ours produces region-specific multipliers, which links our

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contribution to an older empirical literature on regional fiscal multipliers. Moreover, examining the 20 Italian administrative regions, we focus on the impact of shocks to three different public spending aggregates: EU structural funds, nationally funded government investment, and government consumption. This breakdown of the spending aggregates reflects a conjecture about the nature of their impact on gross domestic product (GDP). Since at least Baxter and King (1993), scholars have widely presumed that the GDP multiplier of government investment is higher than that of government consumption. Yet, this hypothesis has never been tested in a subnational framework.

This paper aims to fill these gaps in the literature by assessing the region-specific impact of shocks on EU structural funds, nationally funded government investment, and government consumption across the 20 Italian administrative regions. More specifically, we estimate a random effect panel vector autoregressive model (VAR) through Bayesian techniques from 1994 to 2016. The variables taken into consideration for the estimation of the model are EU structural funds, nationally funded government investment, government consumption, private investment, and GDP. Following a common procedure in the literature, all the variables are divided by potential GDP. EU structural funds are measured through the *Fondo di Rotazione*, the revolving fund through which these funds are actually disbursed to the regions. It should also be noted that Italy is a particularly interesting case study for region-specific policies because of the existence of an area of the country, the Mezzogiorno,[1] whose delays in development are relevant and have been perpetuated over time.

The rest of the paper has the following structure. In Section 2 we survey the literature on regional multipliers. Section 3 describes the econometric specification and the data used. Section 4 is dedicated to the presentation of the baseline results, and robustness checks are discussed in Section 5. Section 6 concludes the paper.

2 | THE LITERATURE

Faggian and Biagi (2003) report that the production and use of Keynesian multipliers based on regional accounting data were widespread until the end of the 1980s. Since then, their popularity waned in favour of multipliers based on input–output techniques, allowing the measurement of both intersectoral and interregional spillover effects. Multipliers based on regional input–output models (see Madden & Batey, 1983; Miyazawa, 1976) yield very rich insights into the disaggregated behaviour of the economy. Yet, these models are often based on strong economic assumptions (in particular about wage and price adjustment). What is more, their policy analysis relies on the a priori identification of policy shocks, which detracts from their value as a counterfactual evaluation tool.

On the other hand, interest in Keynesian multipliers based on the application of time series techniques to subnational data has undergone a renaissance in the literature, because of the advantages to be gained in terms of identification of fiscal shocks. The main idea is that subnational bodies are interested by fiscal policies that are relatively unresponsive to their idiosyncratic conditions, facilitating the identification of fiscal shocks and the computation of the multipliers related to them. We will take up again some considerations on the relative merits of these techniques vis-à-vis input–output based techniques when discussing the empirical results from our analysis.

This literature has thrived mostly in the United States. A first line of studies (Chodorow-Reich et al., 2012; Conley & Dupor, 2013; Dupor & Mehkari, 2016; Wilson, 2012) tracks exogenous variations of fiscal policy through the evolution of public spending immediately following the 2009 American Recovery and Reinvestment Act (ARRA). These studies obtain widely different values for the fiscal multiplier, ranging from 0 to 2. Wilson (2012) highlights substantial heterogeneity in the impact of ARRA spending across sectors and types of expenditure. Spending on infrastructure has a large positive impact, whereas spending on safety-net programmes, such as unemployment insurance and Medicaid, reduces employment. Other papers develop different kinds of identification strategies, focusing on either US states (Clemens & Miran, 2012; Nakamura & Steinsson, 2014) or counties (Adelino et al., 2017; Suárez Serrato & Wingender, 2016).

[1]The Mezzogiorno includes the southern regions (Abruzzo, Molise, Campania, Puglia, Basilicata, and Calabria) and the isles (Sicilia and Sardegna).

All these studies, as pointed out by Chodorow-Reich (2019), provide multiplier measures based on geographic cross-sectional fiscal spending. Relying on an updated analysis of the ARRA and a thorough examination of the literature, Chodorow-Reich (2019) provides a point estimate for the geographic cross-sectional multiplier of 1.8. He also discusses conditions under which the cross-sectional multiplier provides a rough lower bound for the country-level, no-monetary-policy-response multiplier, suggesting a value of 1.7 or above for this multiplier. Similarly, Auerbach et al. (2020) point out that translating local multipliers into national ones is not straightforward, because there is the potential for fiscal spillovers among entities that are strongly integrated with each other. Using city-level data on US Department of Defense contracts and income and employment outcomes for a period stretching from 1997 to 2016, Auerbach et al. (2020) estimate a state-level GDP multiplier effect of 1.5, which is consistent with the state-level estimates of Nakamura and Steinsson (2014). They also find strong positive spillovers across locations and industries, although geographic spillovers vanish above 50 miles of distance.

The empirical evidence outside the United States is less abundant. For Italy,[2] Acconcia et al. (2014) use data on Italian provinces for the period 1990–1999, instrumenting the growth rate in government investment with a binary variable for the dismissal of city councils due to Mafia infiltration, and finding a long-run multiplier of 1.9.

There is in this literature a relative dearth of recent evidence on the measurement of local multipliers differentiated across areas (the most conspicuous exception to this rule being the paper by Auerbach et al., 2020) and of different expenditure aggregates (here the main exception is arguably Wilson, 2012). Interestingly, the latter kind of disaggregation relates to a strand of macroeconomic literature that considers multipliers based on alternative types of government spending. Gechert et al. (2016), who carry out arguably the most thorough comparison across types of government spending, find that the typical multiplier effect for government investment is 1.5 under "normal" economic conditions and 1.9 during economic downturns. On the other hand, the multiplier effect for public transfers, which under "normal" economic conditions is 0.7, becomes 1.9 in economic downturns. Lower multiplier values are generally found in the surveys by Mineshima et al. (2015) and Ramey (2019). The latter, however, highlights the relative lack of recent evidence on this issue.

In this paper, we endeavour to fill the gaps in the literature, obtaining region-specific estimates for the multipliers of shocks to three different public spending aggregates—EU structural funds (which are basically a form of EU-funded investment), nationally funded government investment, and government consumption—across the 20 Italian administrative regions. Given the nature of our regional accounting data, our approach to the identification of shocks is in line with the procedures developed and adopted in country-level studies. Yet, relying on subnational data makes it possible to deal with administrative units that are subjected to macroeconomic policies relatively unresponsive to their idiosyncratic conditions, easing the task of exogenous shock identification. More details of our identification strategy are provided below.

We rely on the Bayesian random effect panel vector autoregressive (PVAR) model suggested in Canova and Ciccarelli (2013).[3] As we discuss in Section 3, the advantage of this model is basically related to the introduction of cross-sectional heterogeneity. In other words, coefficients of our PVAR model can vary across regions, although they derive from a distribution with a similar mean and variance. We avoid potential overfitting problems by implementing Bayesian methods and rely on the approach developed by Gordon and Krenn (2010) and Ramey and Zubairy (2018) to compute unbiased fiscal multipliers.

Our interest in obtaining multipliers differentiated across areas and expenditure aggregates calls for an analysis of the determination of these differences, which we carry out in Section 4. In this respect, Mineshima et al. (2015) list various country-specific characteristics that affect the size of the multiplier in developed countries: trade openness, size of the economy, size of the automatic stabilisers, level of activity (linked to the amount of available unused resources), level of public debt, financial market development, monetary policy stance, and exchange rate

[2]Other notable studies outside the United States include Brückner and Tuladhar (2014), who use Japanese prefecture data, and Corbi et al. (2019), who focus on Brazilian municipalities. They find values for the multiplier that range from slightly below 1 to 2.

[3]This model is also developed in Dieppe et al. (2016).

regime. The first four characteristics correspond almost exactly to the factors selected in Faggian and Biagi (2003) as determinants of Keynesian multipliers across Italian regions. On the other hand, exchange rate regime, a potential confounder of country-level studies of the fiscal multiplier, is not relevant in our cross-region setup.

3 | THE EMPIRICAL FRAMEWORK

3.1 | The model

We consider a PVAR model with cross-sectional heterogeneity, obtaining a unit-specific VAR model by means of a random coefficient model. For each region, the VAR model is described by Equation (1):

$$y_{it} = \Gamma_i z_i + A_1^1 y_{i,t-1} + \cdots + A_i^p y_{i,t-p} + \varepsilon_{i,t}, \tag{1}$$

with

$$\varepsilon_{i,t} \sim N(0, \Sigma_i),$$

where $t = 1, \ldots, T$ denotes the time dimension; $i = 1, \ldots, N$ denotes the region dimension; $y_{i,t}$ is an $n \times 1$ vector of endogenous variables; z_i collects deterministic components; A_i and Γ_i are matrices containing the slope and intercepts; and p is the number of lags.

Stacking over the T time periods and writing in compact form, we have Equation (2):

$$y_i = X_i \beta_i + \epsilon_i. \tag{2}$$

Using the random coefficient model, we assume that for each unit, β_i can be expressed as in Equation (3):

$$\beta_i = b + b_i, \tag{3}$$

where $b_i \sim N(0, \Sigma_b)$, from which it follows that $\beta_i \sim N(b, \Sigma_b)$. This implies that coefficients will differ across units although parameters will be drawn from a distribution with a similar mean and variance. From this setting, in a Bayesian fashion, we follow the hierarchical prior approach developed by Jarociński (2010).

In the hierarchical prior identification strategy, the set of vectors β_i ($i = 1, 2, \ldots, N$), the set of residual covariance matrix Σ_i ($i = 1, \ldots, N$), and the common mean and covariance of the VAR coefficients b and Σ_b are all treated as random variables and included in the estimation process. Denoting β_i and Σ_i by β and Σ, that is, $\beta = \left\{\beta_1, \beta_2, \ldots, \beta_N\right\}$ and $\Sigma = \{\Sigma_1, \Sigma_2, \ldots, \Sigma_N\}$, we can write the complete posterior distribution as follows:

$$\pi(\beta, \Sigma, b, \Sigma_b | y) \propto \pi(y | \beta, \Sigma) \pi(\beta | b, \Sigma_b) \pi(b) \pi(\Sigma_b) \pi(\Sigma). \tag{4}$$

In practice, the posterior is equal to the likelihood function $\pi(y|\beta, \Sigma)$, the priors for β and Σ_b, respectively $\pi(\beta|b, \Sigma_b)$ and $\pi(\Sigma)$, and the hyperpriors $\pi(b)$ and $\pi(\Sigma_b)$.

Without aggregating the data, the likelihood functions obtain as

$$\pi\left(y \middle| \beta, \Sigma\right) \propto \prod_{i=1}^{N} |\bar{\Sigma}_i|^{-\frac{1}{2}} \exp\left(-\frac{1}{2}(y_i - \bar{X}_i \beta_i)'(\bar{\Sigma}_i)^{-1}(y_i - \bar{X}_i \beta_i)\right) \tag{5}$$

As previously stated, β_i follow a normal distribution with common mean b and common variance Σ_b, from which the prior density for β is

$$\pi\left(\beta|b, \sum_b\right) \propto \prod_{i=1}^{N} |\sum_b|^{-\frac{1}{2}} \exp\left(-\frac{1}{2}\left(\beta_i - b\right)'\left(\sum_b\right)^{-1}(\beta_i - b)\right). \tag{6}$$

For the hyperparameter b, the hyperprior will be a diffuse (improper) prior:

$$\pi(\mathrm{b}) \propto 1. \tag{7}$$

The principles followed to build an hyperprior for Σ_b are those that replicate the VAR coefficient covariance matrix of a Minnesota prior (see Litterman, 1986), which relies on a covariance matrix Ω_b, which is diagonal of dimension $q \times q$, where $q = n(np + q)$, that is, the total number of coefficients in each unit. It is diagonal because it is assumed that no covariance exists between parameters. For parameters in β, which relates endogenous variables to its own lags, the variance will be equal to Equation (8):

$$\sigma_{a_{ii}}^2 = \left(\frac{1}{l^{\lambda_3}}\right)^2, \tag{8}$$

where l represents the lag considered and λ_3 is a scaling coefficient that controls the speed with which increasing lags converge to zero with greater certainty.

For cross-lag coefficients the variance is given by Equation (9):

$$\sigma_{ij}^2 = \left(\frac{\sigma_i^2}{\sigma_j^2}\right)\left(\frac{\lambda_2}{l^{\lambda_3}}\right)^2, \tag{9}$$

where σ_i^2 and σ_j^2 are scaling parameters that control for the relative coefficient sizes on variables i and j, which are obtained by fitting an autoregressive model pooling the data of all units for each endogenous variable, because the variance is assumed to be constant across units. λ_2 represents a cross-variable specific variance parameter.

For the intercepts (and eventually exogenous variables) the variance is given by Equation (10):

$$\sigma_{z_i}^2 = \sigma_i^2(\lambda_4)^2, \tag{10}$$

where σ_i^2 is the residual variance of the autoregressive model for variable i, and λ_4 is a large variance parameter.

The full covariance matrix is then defined as in Equation (11):

$$\Sigma_b = (\lambda_1 \otimes i_q)\Omega_b, \tag{11}$$

where $(\lambda_1 \otimes I_q)$ is a$q \times q$ diagonal matrix. Considering Ω_b as fixed and known and treating λ_1 as a random variable implies that the full prior for Σ_b reduces to the determination of the prior only for λ_1. When the prior variance is null, that is, λ_1 is 0, all the β_is will take the value of the own meanb, and we obtain the pooled estimator. With $\lambda_1 \to \infty$, the prior becomes uninformative on b, there is no sharing of information between units, and the coefficients for each unit become their own estimates. Ideally, λ_1 should take intermediate values that balance individual and pooled estimates. In this study, the prior distribution for λ_1 is an inverse gamma distribution expressed by Equation (12):

$$\lambda_1 \sim IG\left(\frac{s_0}{2}, \frac{v_0}{2}\right) \tag{12}$$

which implies

$$\pi\left(\lambda_1 | \frac{s_0}{2}, \frac{v_0}{2}\right) \propto \lambda^{\frac{s_0}{2}-1} \exp\left(-\frac{v_0}{2\lambda_1}\right) \tag{13}$$

with values for s_0, $v_0 \leq 0.001$, which is a weakly informative prior that avoids sensitivity of the results to the choice of this prior.

Finally, considering the classical diffuse prior for Σ_i, whose full density is given by

$$\pi(\Sigma) \propto \prod_{i=1}^{N} |\Sigma_i|^{-\frac{(n+1)}{2}} \tag{14}$$

we have all the elements required to build the full posterior, substituting in Equation (4) the likelihood function (Equation 5) and the priors (Equations 6, 7, 13, and 14). However, as this posterior does not allow for any analytical derivations of the marginal posteriors, one needs to rely on the numerical methods provided by the Gibbs sampler (for further details, see Jarociński, 2010). Specifically, we take 20,000 samples from Gibbs sampling, discarding the first 10,000 as burn-in draw.

3.2 | The data and the baseline specification

We estimate the model described in Equation (1) for all 20 Italian regions, using annual data from 1994 to 2016. Our vector y of endogenous variables is

$$y_{it} = [GC_{i,t}, GI_{i,t}, RF_{i,t+1}, I_{i,t}, GDP_{i,t}] \tag{15}$$

where GC, GI, RF, I, and GDP represent government consumption, nationally funded government investment, the revolving fund (our measure of EU structural funds), private investment, and GDP, respectively. To implement a parsimonious model and avoid problems of over-parameterisation, we consider a lag structure of 1 year ($p = 1$), while the time varying country-level factors are controlled through year fixed effects.[4]

Government consumption, private investment, and GDP are downloaded from the I.Stat database of the Italian Statistical Office (ISTAT), whereas nationally funded government investment and the revolving fund are taken from the database *Spesa statale regionalizzata* of the General Accounting Office (*Ragioneria Generale dello Stato*) at the Italian Ministry of Economy and Finance, the only source that allows one to distinguish between these two kinds of public expenditure. More specifically, the revolving fund (*Fondo di Rotazione*) is the fund through which the Italian government distributes the EU structural funds to the regions. This series also includes the so-called national cofinancing. Indeed, EU funds support only a share of total project costs, the rest being financed by national or regional resources. This procedure aims to ensure that EU regional policy does not become merely a substitute for member states' regional policies and to provide a check on project feasibility. In Italy, national cofinancing covers up to 50% of the total project cost. Note also that a substantial proportion of GI and RF are not allocated to any single region, but to multiregional aggregates. In the following analysis, we assume that these funds are spread across

[4]The inclusion of these year fixed effects in our model allows us to control for potential nationwide structural changes that might have affected the Italian economy during the period covered by our analysis. Due to the shortness of our sample, we cannot model these potential structural changes through a time-varying parameter VAR.

regions proportionally to the shares of regionally allocated funds. This is the hypothesis most often maintained in the literature (see Coppola et al., 2020) as making sense from an a priori standpoint. Also following Coppola et al. (2020), we include in our model the RF variable forwarded by 1 year. In our view, this dynamic specification well describes the institutional mechanism in which regions, after having engaged in their spending decisions, demand reimbursement from the revolving fund. Funds from the EU are then paid out to the regions with a lag of approximately 1 year. This effectively means that the revolving fund expenditures written down for year t have already been spent in year $t-1$.[5] All variables are at constant (2010) prices.

3.3 | Identification and computation of cumulated government spending multipliers

As described in Section 3.1, once we estimate the model and derive, through Gibbs sampling, the marginal posteriors, we collect 10,000 draws from the posterior distribution. However, for each draw, we need to recover structural shock from estimated residuals. This requires imposing identifying assumptions on Σ_i. Specifically, we apply the Cholesky identification scheme, which transforms Σ_i to a lower triangular matrix. The application of this scheme imposes a causal ordering on the endogenous variables: we suppose that a shock to a specific variable of our PVAR affects previously ordered variables with a lag and following variables contemporaneously. In our case, we assume that a shock to one of the three public expenditure aggregates affects GDP contemporaneously but that a shock to the latter affects the other variables with a lag. This identification strategy is very common in the VAR research on government spending shocks. As argued in a prominent study by Blanchard and Perotti (2002), due to decision and implementation lags (the implementation of the public policies is subjected to lags due to the time needed to take a decision—decision lag—and to make the decision operational—implementation lag), the responses of fiscal variables tend to lag behind changes in the real economy. This is particularly true for high-frequency data, but it is reasonable to assume that, albeit to a lesser extent, these lags are also present for annual data, especially if taken at subnational level. Thus, in line with Blanchard and Perotti (2002), as well with most of the literature on fiscal policy,[6] we consider our expenditure aggregates exogenous to GDP and assume that GDP reacts contemporaneously to public expenditure aggregates. With respect to the ordering of fiscal variables, we consider government consumption as the "truly exogenous" variable. Hence, nationally funded government investment and the revolving fund are assumed to react contemporaneously to a government consumption shock. On the other hand, government consumption reacts with a lag to shocks on nationally funded government investment, whereas government consumption and nationally funded government investment react with a lag to shocks on the revolving fund. Therefore, the ordering of variables of interest is as follows: (1) government consumption, (2) nationally funded government investment, (3) the revolving fund, (4) private investment, (5) GDP. As is customary in this literature, we performed a robustness check, swapping the orderings of our public expenditure aggregates. The results, which are available in the appendix (Table A.1), are very similar to the findings described in Section 4, especially from the qualitative standpoint. This robust identification of exogenous fiscal shocks is a feature that we expected a priori in our regional setup, given the belief that fiscal policies are relatively unresponsive to regional idiosyncratic shocks.

Once we have identified three separate shocks for RF, GC, and GI, for each draw from the posterior, we derive impulse response functions for a time horizon of 10 years. Then, we compute the median response across the 10,000 draws and save the 16th and 84th percentile of their distribution as confidence bands.

[5]This time pattern between the EC payments to the member states and the dates on which expenditures take place on the ground is also noted in EU Commission (2018), which provides a measure of the "expenditures taking place on the ground" closely following the evolution over time of our forwarded RF. The EU Commission's measure, however, does not include national cofinancing and is available for fewer years than our RF.

[6]Notable examples from this literature, who rely on Cholesky ordering for shock identification, include Mittnik and Neumann (2001), Perotti (2004), Tenhofen et al. (2010), Auerbach and Gorodnichenko (2012), Ilzetzki et al. (2013). In their settings, fiscal variables are always ordered before the other variables of interest.

Regarding the computation of multipliers, we follow the approach of Gordon and Krenn (2010) and Ramey and Zubairy (2018). They argue that the common method of transforming variables in logarithms can lead to biased estimates of multipliers. It implies an ex post conversion from elasticities that is based on a factor representing the sample average of the ratios between the fiscal variable and GDP. This ratio may vary widely over time, and the resulting multipliers may not be representative of any period in the sample. Conversely, relating the fiscal variable and GDP to the potential GDP enables us to compute multipliers directly without the need to make any ex post conversion. Thus, having normalised the variables of interest by real potential GDP, we compute multipliers directly using the following formula:

$$M_H = \frac{\sum_{h=0}^{H} dGDP(h)}{\sum_{h=0}^{H} dG(h)} \tag{16}$$

where $h = 0, 1, \ldots, H$ represents the time horizon over which the cumulated multiplier is computed, $\sum_{h=0}^{H} dGDP(h)$ is the discrete approximation of the integral of the median impulse response function (IRF), and $\sum_{h=0}^{H} dG(h)$ is the discrete approximation of the integral of the median IRF of the considered public expenditure aggregate. Our baseline measure of real potential GDP, which follows common practice in the macroeconomic literature, is obtained using the Hodrick and Prescott (1997) filter on regional GDP data.

4 | BASELINE RESULTS

Tables and figures related to our evidence are presented at the end of the main text. Figure 1a,b show the impulse responses deriving from a shock to RF. For virtually all regions of southern Italy, as well as for some other regions, GDP reacts quite strongly and significantly. On the other hand, for Trentino-Alto Adige, Veneto, Liguria, Marche, and Abruzzo (the only Southern region in this list), the response of GDP is zero or near zero. For Valle D'Aosta only, the response of GDP is negative and significant. The impulse responses following a shock to nationally funded government investment are shown in Figure 2a,b. This shock seems to have a positive and significant impact on GDP only for Piemonte, Marche, Lazio, Abruzzo, Campania, and Sicilia. Finally, Figure 3a,b depict the impulse responses to a government consumption shock. The impact on GDP of this kind of shock is not very strong, being positive and significant for only seven regions (Liguria, Toscana, Abruzzo, Campania, Puglia, Basilicata, and Sicilia) and negative and significant for three regions (Trentino-Alto Adige, Umbria, and Molise).[7]

Table 1a shows the RF, nationally funded government investment, and government consumption cumulative multipliers for each region. They are computed using Equation (16) for horizons of 1, 3, and 5 years. Multipliers derived from impulse responses that are significantly different from zero are highlighted in bold.

Multiplier values are clearly in the neighbourhood of the previous studies reviewed in Section 2 (they may be a bit toward the low end of that range, but we will come back to this below). However, none of those studies simultaneously report multipliers differentiated across regions and types of expenditure. In general, multipliers vary widely across regions, clearly replicating the patterns we have already discussed for the impulse responses. This heterogeneity means that public spending decisions may not have the intended effects for all regions. Specifically, the government consumption multiplier decreases over time and becomes insignificant in most cases, never being greater than unity, whereas at the 5-year horizon, the nationally funded government investment multiplier is

[7]From the perusal of Figures 1–3 one can gather a fair degree of substitutability between RF and nationally funded government investment. This behaviour squarely contradicts the principle of additionality (EU Regulations 4253-4256/1988), according to which EU resources should be additional and not a substitute to other national and/or regional funding sources. Furthermore, in most regions, private investment reacts positively to RF shocks, while there is evidence of some crowding out between nationally funded government investment and private investment. Both these findings are of potentially high interest for policy purposes, although drifting away from the focus of this paper on the estimation of fiscal GDP multipliers.

greater than one for five of the eight bolded regions. On the other hand, RF multipliers are positive and significant for 14 regions, mostly increasing their magnitude over time. Always considering a 5-year horizon, the RF multiplier is greater than one for six of the 14 bolded regions (Umbria's multiplier, not counted among the six, is 0.96). On the whole, our results strongly support the presumption of a higher government investment multiplier, especially if one —reasonably—considers EU structural funds as a form of EU-funded investment.

The marked heterogeneity of multipliers across areas and expenditure types warrants further discussion. The Mezzogiorno multipliers are larger in size than those for the rest of the country, and this is particularly true for the RF ones. These findings have obvious implications for the setup of policies aimed at reducing territorial inequalities in Italy. However, when testing, in Table 2a, the equality of medians or winsorised means across North-Centre and Mezzogiorno (we adopt these robust tests because some outliers are apparent among the variables under scrutiny), we can reject the null hypothesis of equality at the customary significance levels only in one case for the government consumption multiplier.

The analysis must proceed further to gain further insights about the factors driving the heterogeneity of multipliers. In Section 2, we pointed out some characteristics of the economy that could drive the determination of the multiplier size. From available data sources, we can construct some regional indicators for trade openness and competitiveness, size of the economy, size of the automatic stabilisers, amount of available unused resources, and financial market development. On the other hand, there are no synthetic regional indicators of public debt (it is also an open question whether they would be

(a)

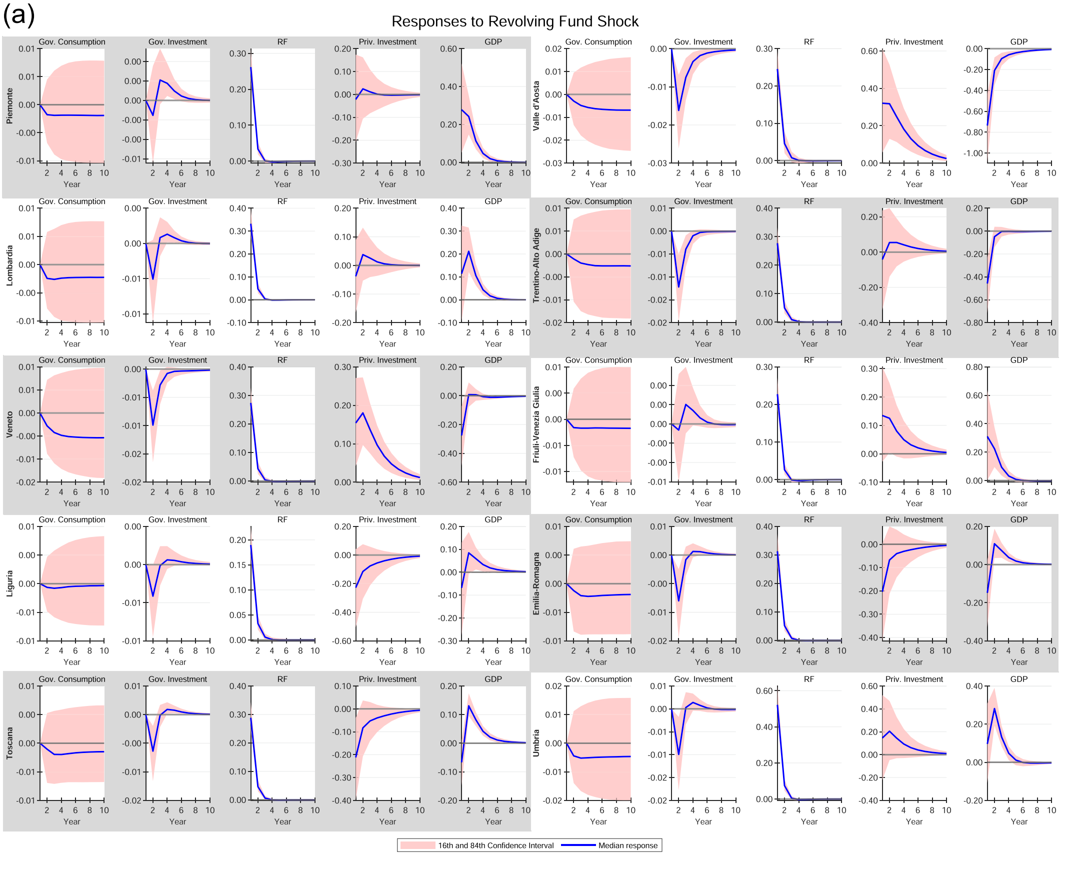

FIGURE 1 (a) Impulse responses to revolving fund shock for Piemonte, Valle d'Aosta, Lombardia, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Toscana, and Umbria. (b) Impulse responses to revolving fund shock for Marche, Lazio, Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia, and Sardegna. [Color figure can be viewed at wileyonlinelibrary.com]

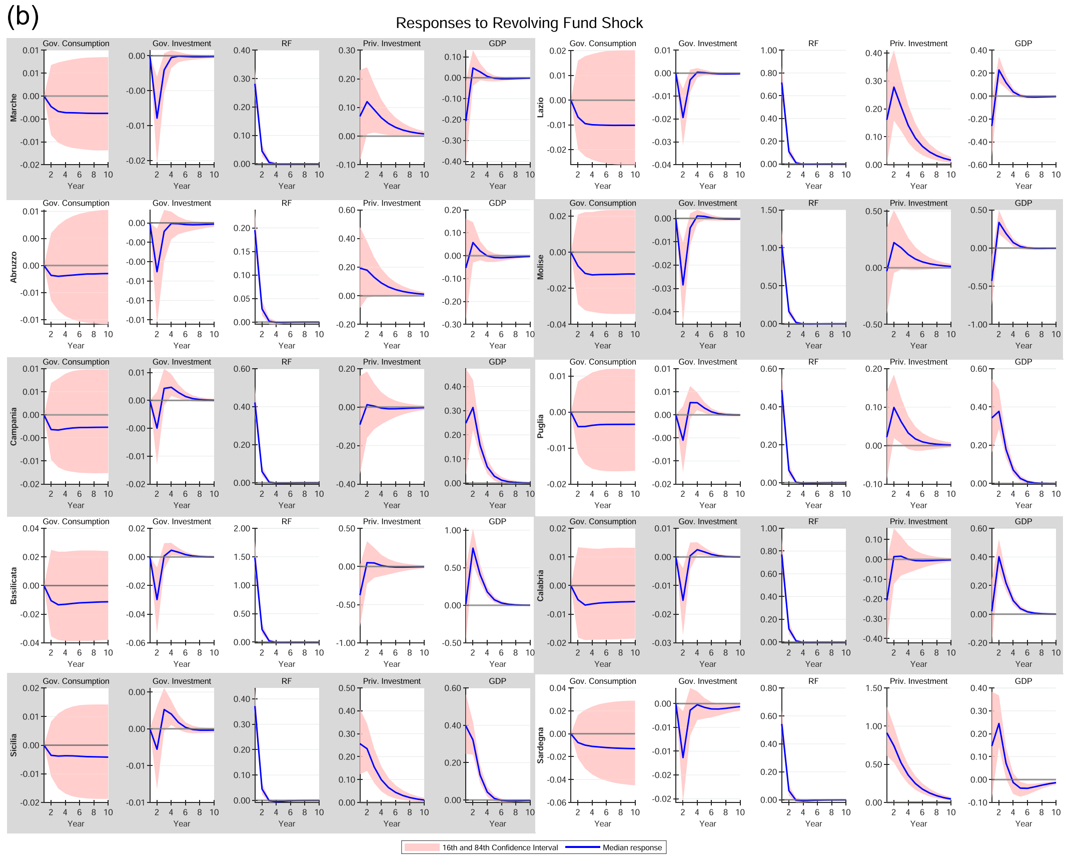

FIGURE 1 Continued

conceptually appropriate in a cross-region setup). From the literature on regional economic development, one can also surmise that indicators of the completeness of the structure of the economy and of the quality of government could be relevant determinants of the multipliers' size.[8] In Table 3a, we provide some prima facie analysis of the relationships between our (5-year-horizon) multipliers for RF, nationally funded government investment, and government consumption and a set of their potential determinants (measured in 1994, with the exception of the European Regional Competitiveness Index calculated by the European Commission and the European Quality of Government Index—EQI—from the University of Gothenburg, whose earliest value are available in 2010[9]). We calculate two different robust correlation coefficients between the multipliers and their potential determinants. Remarkably, these correlation coefficients tell much the same story about any given potential determinant. We also used other robust correlation coefficients, that is Kendall's rank and the percentage bend correlation coefficients, with virtually no modification of the evidence obtained. These results are available upon request.

According to the evidence in Table 3a, there is definitely a correlation between the size of multipliers and the amount of available unused resources. All 5-year cumulated multipliers are positively related to the rate of unemployment and

[8]We thank two anonymous referees for these suggestions.

[9]See respectively: https://ec.europa.eu/regional_policy/en/information/maps/regional_competitiveness; https://www.gu.se/en/quality-government/qog-data/data-downloads/european-quality-of-government-index for details. In all cases but for these indexes (whose data were not available throughout the sample period), the potential determinants of multiplier values were also taken as sample-period averages. This left virtually unchanged the evidence reported in the text. Results are available upon request.

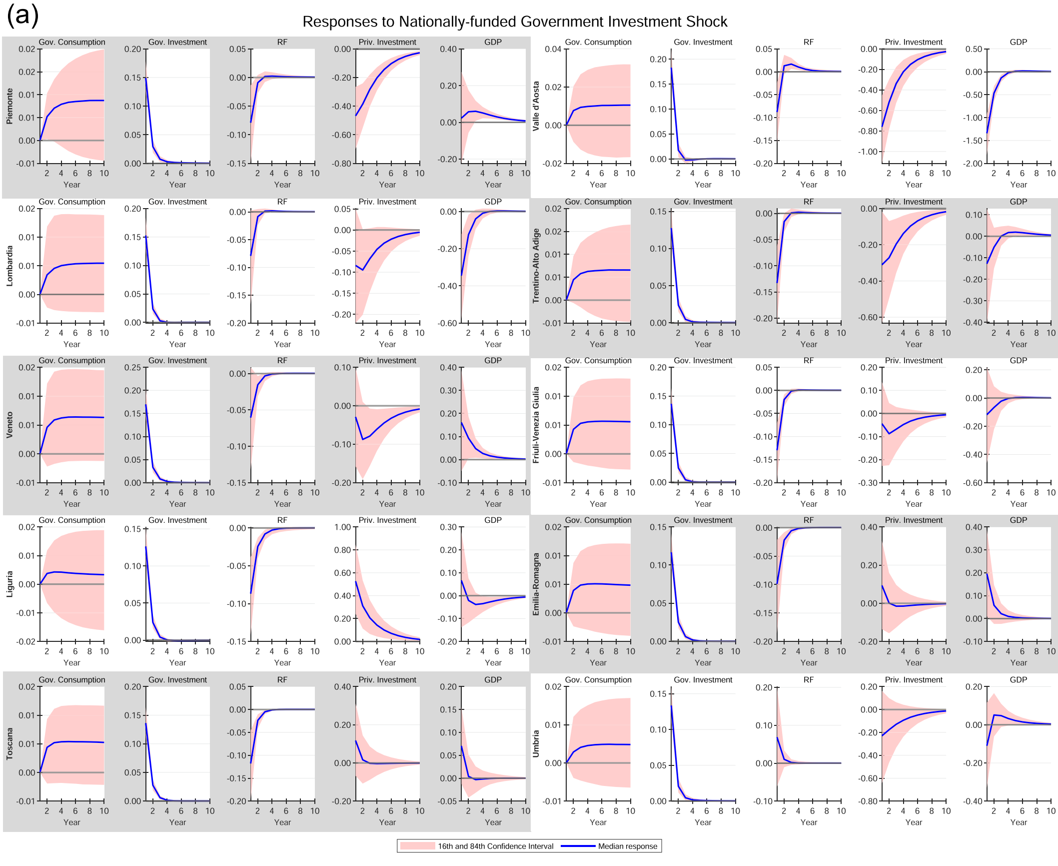

FIGURE 2 (a) Impulse responses to nationally funded government investment shock for Piemonte, Valle d'Aosta, Lombardia, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Toscana, and Umbria. (b) Impulse responses to nationally funded government investment shock for Marche, Lazio, Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia, and Sardegna. [Color figure can be viewed at wileyonlinelibrary.com]

negatively related to the rate of employment. This relationship is particularly significant for the RF and (to a lesser extent) for the government consumption multiplier. This evidence is rather important from the policy point of view, as it clearly suggests that public expenditure would be particularly effective in areas with an ailing labour market. To some extent, it is also a novel finding, as the resource slack is usually measured across time rather than geographical units. The relationship between multipliers and the private saving/GDP ratio (a rough measure of the propensity to save) is negative, as expected, although not significant. On the other hand, we find a more significant negative relationship between the multiplier size and GDP per capita, which, according to Faggian and Biagi (2003), can be rationalised in terms of the propensity to save via Engel's Law (a negative relationship between consumption and level of development). Unfortunately, we do not have finer measures of the propensity to save, let alone of other automatic stabilisers, but this evidence points again to the policy expediency of funding the less developed areas. There is a more definite role for the size of the regional economy. GDP and population are both positively correlated with the multipliers.[10] Correlation is particularly strong between the multiplier on nationally funded government investment and population, a point to which we return below. On the other hand, no

[10]A possible implication could be that relatively small regions may be inefficient in using resources. Some regional analyses of the impact of infrastructure spending (e.g., Di Giacinto et al., 2012) have similar implications. On the other hand, these lower multiplier values may be explained also by the higher GDP per capita and lower slack in the labour market that characterize several small regions in our sample.

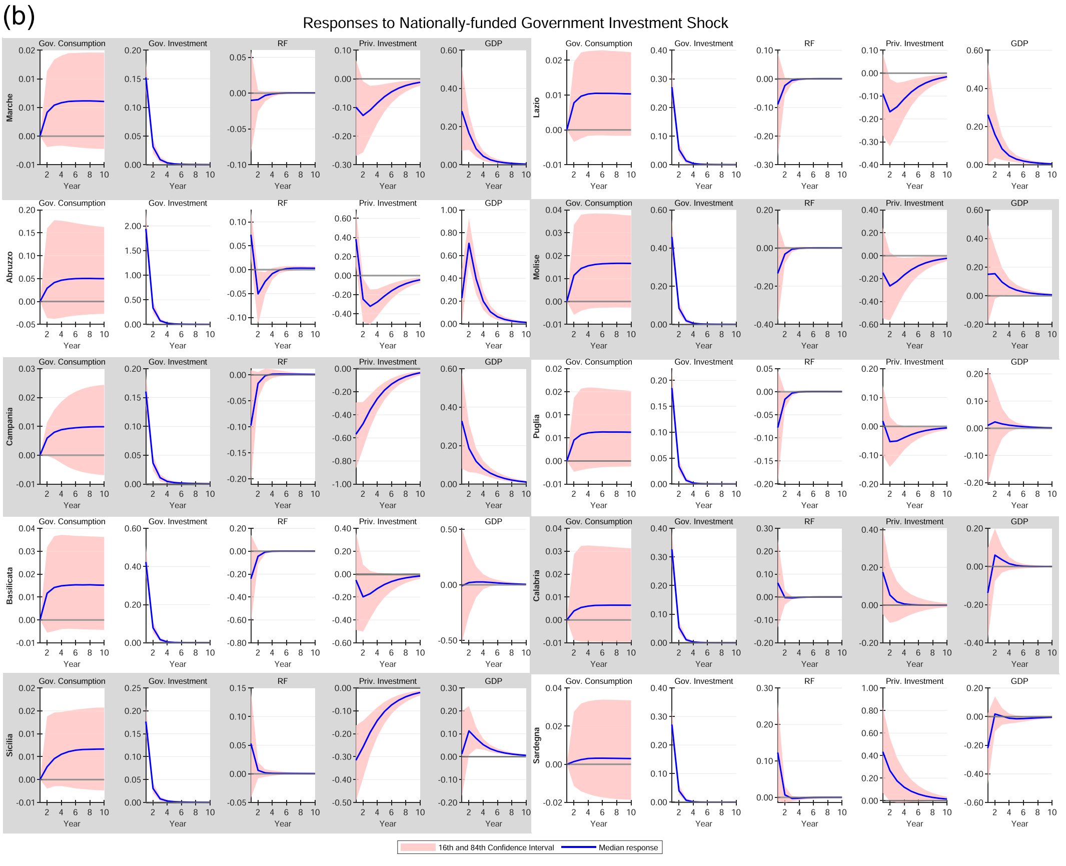

FIGURE 2 Continued

greatly significant role seems to be played by population density, which proxies for a number of factors mainly linked to the degree of urbanisation of a region.

No robust relationship shows up between any multiplier and three available indicators of trade openness (the ratio of total—domestic plus foreign—*net* imports over GDP, the ratio of foreign imports over GDP and the ratio of the sum of foreign imports plus foreign exports over GDP). No relationship seems to exist either among the multipliers and the competitiveness index. Perhaps a more precise indicator of the regional propensity to import, such as the ratio of total—domestic plus foreign—imports over GDP, would get better results, but, unfortunately, this indicator is not readily available. On the other hand, it could be argued that trade openness and competitiveness act upon the determination of multipliers in a complex way, which may not be captured adequately by our simple bivariate correlations.

We attempted several indicators of regional financial development (bank branches per inhabitant or divided by GDP, bank loans per inhabitant or divided by GDP, rates of interest on loans). We only report results for bank branches that adequately sum up the gist of this evidence. There is a negative correlation between the size of multipliers and bank branches per inhabitant, which can be rationalised in terms of the association between the latter and GDP per capita.[11] The correlations with bank branches divided by GDP are, on the other hand, very weak. We come back to the role of financial markets in the robustness checks.

[11]A further explanation of this negative correlation, possibly deserving further research, could be that a lower number of bank branches per capita signals a larger share of financially constrained consumers, whose propensity to consume is larger (Galí et al., 2007).

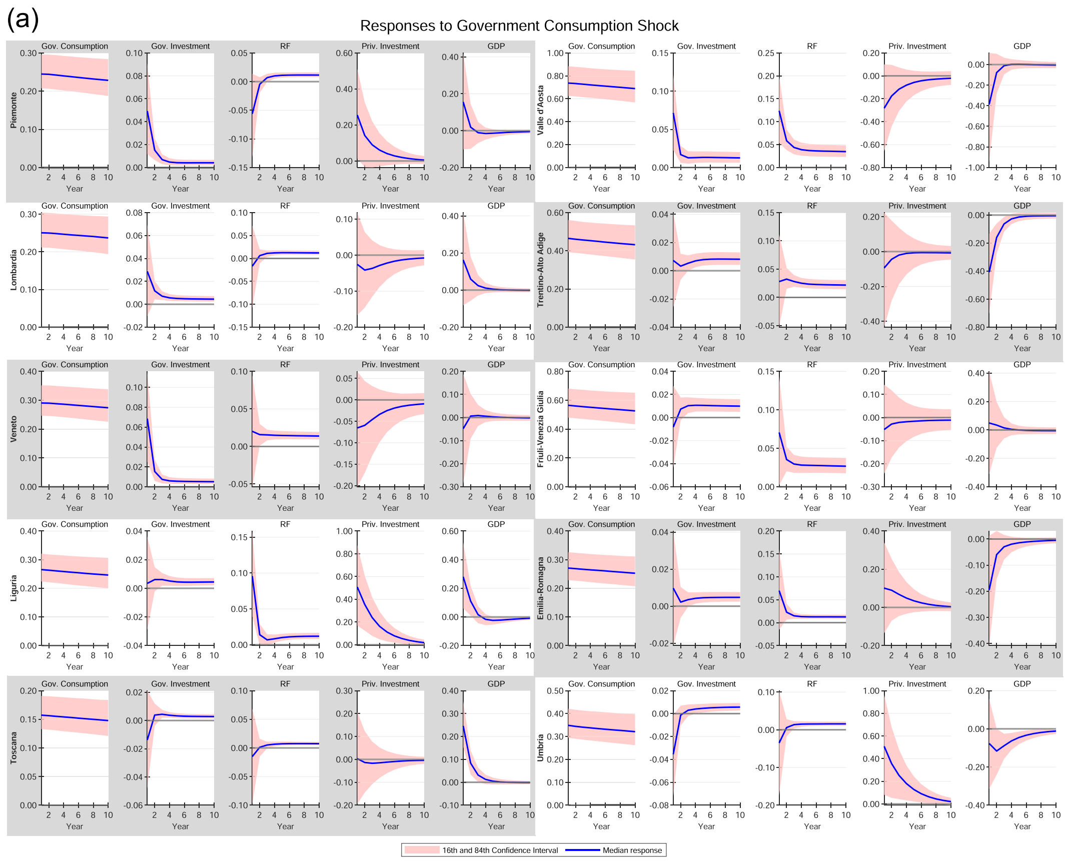

FIGURE 3 (a) Impulse responses to government consumption shock for Piemonte, Valle d'Aosta, Lombardia, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Toscana, and Umbria. (b) Impulse responses to government consumption shock for Marche, Lazio, Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia, and Sardegna. [Color figure can be viewed at wileyonlinelibrary.com]

The negative correlation that shows up between multipliers and the EQI is likely to reflect the strong association of EQI with a strong labour market and GDP per capita across the Italian regions. Finally, the share of R&D expenditures, an indicator of the completeness of the regional economy at least in terms of the presence of hi-tech industries, is positively correlated with the size of multipliers, especially for RF and government consumption.[12]

We believe that our analysis brings to the fore some significant policy implications. Perhaps paramount among them, there is the role of the amount of unused resources in determining policy effectiveness. It must also be stressed that regional size (especially in terms of population) is the only factor from Table 3a that significantly drives the determination of the size of the nationally funded government investment. This suggests that the larger the region and the smaller the spillover from a given project outside the region, the more effective investment projects will be within a given region.[13]

[12]Measures of the share of high-tech sectors over the regional economy were not significant, likely due to the lack of properly disaggregated data from regional accounting. Unfortunately, indicators of completeness based on input-output matrixes were not readily available.

[13]Auerbach et al. (2020) find that geographic spillovers vanish above 50 miles of distance. This is not, however, a negligible distance for many Italian regions. This does not mean that smaller regions should be deprived of spending resources, but rather that cross-region coordination in the management of these resources should be improved.

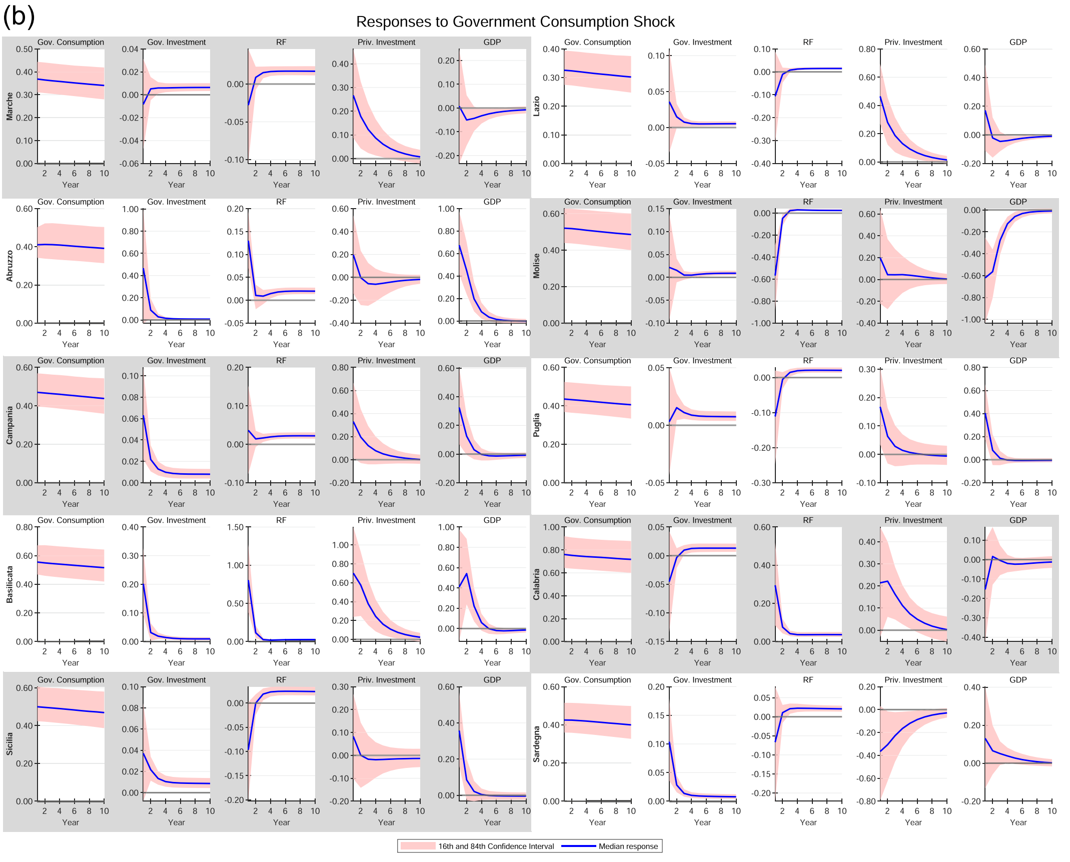

FIGURE 3 Continued

Also, while translating local multipliers into national ones is not straightforward, and we will not attempt here this exercise, the role of size in the determination of multipliers may also explain why we get multiplier values that are, on average, lower than those obtained for Italy as a whole (see e.g., Giordano et al., 2007, who find a cumulative multiplier for their benchmark model between 1.7 and 2.4), or for the US states.

Finally, when considering the size of the multipliers that we have obtained, it is also useful to compare them with similar multipliers that proceed from the application of input–output techniques. Arguably, the closest comparison can be carried out with Pérez et al. (2009), who estimate the impact of EU structural funds received by the Spanish NUTS2 regions between 1995 and 1999. They find a median value of 0.72, while our corresponding statistic for the 5-year cumulated multiplier of the RF is 0.66. Comparable figures are unfortunately not available in the literature for Italian NUTS2 regions. This comparison, however, highlights that input–output and VAR-based models may yield similar information with respect to the aggregate multiplier values. The actual advantages of input–output models reside in the rich insights they yield into the disaggregated behaviour of the economy. On the other hand, we believe that our analysis showed that VAR-based models yield very useful policy information not only about the identification of exogenous shocks and the dynamic responses of the economy to them, but also about the dynamic interrelationships between these shocks.

TABLE 1 One-, three- and five-year cumulated multipliers

(a) Baseline model	Shock to RF			Shock to nationally funded government investment			Shock to government consumption		
	1-year	3-year	5-year	1-year	3-year	5-year	1-year	3-year	5-year
Piemonte	**1.06**	**2.14**	**2.39**	0.15	**0.76**	**1.22**	0.64	0.22	0.11
Valle d'Aosta	**−3.00**	**−3.49**	**−3.82**	**−7.33**	**−9.79**	−9.94	−0.52	−0.22	−0.13
Lombardia	0.34	**1.13**	**1.30**	**−2.26**	**−2.84**	−2.88	0.65	0.33	0.21
Trentino-Alto Adige	**−1.65**	−1.52	−1.54	−1.00	−1.14	−0.89	**−0.88**	**−0.46**	−0.29
Veneto	**−1.01**	−0.81	−0.88	0.95	1.43	1.60	−0.17	−0.04	−0.02
Friuli-Venezia Giulia	**1.37**	**2.49**	**2.70**	−0.86	−1.25	−1.24	0.09	0.06	0.04
Liguria	−0.36	0.33	0.56	0.53	0.05	−0.36	**1.06**	0.52	0.28
Emilia-Romagna	−0.47	**0.09**	**0.24**	1.68	1.86	1.93	−0.72	−0.35	−0.24
Toscana	−0.23	**0.43**	**0.61**	0.52	0.42	0.40	**1.57**	**0.77**	0.49
Umbria	0.18	**0.85**	**0.96**	−0.82	−0.07	0.27	−0.22	**−0.27**	**−0.23**
Marche	−0.74	−0.40	−0.39	**1.84**	**2.75**	**3.04**	0.02	−0.08	−0.08
Lazio	−0.37	**0.10**	**0.15**	**0.97**	**1.49**	**1.69**	0.53	0.11	0.02
Abruzzo	−0.27	0.11	0.07	**0.12**	**0.56**	**0.68**	**1.64**	**1.07**	0.70
Molise	−0.41	**0.08**	**0.16**	0.33	0.71	0.88	**−1.19**	**−0.94**	**−0.64**
Campania	**0.59**	**1.48**	**1.70**	**2.05**	**3.04**	**3.58**	**0.69**	0.34	0.20
Puglia	**0.70**	**1.62**	**1.81**	0.06	0.22	0.31	**0.93**	0.38	0.23
Basilicata	0.01	**0.69**	**0.84**	−0.02	0.07	0.16	0.74	**0.71**	0.45
Calabria	0.03	**0.71**	**0.87**	−0.42	−0.11	−0.06	−0.20	−0.06	−0.05
Sicilia	**1.07**	**2.05**	**2.22**	0.07	**0.95**	**1.32**	**0.72**	0.31	0.19
Sardegna	0.27	**0.76**	0.70	−0.81	−0.63	−0.71	0.31	0.19	0.15

(b) Robustness check, generalised impulse response functions	Shock to RF			Shock to nationally funded Government Investment			Shock to government consumption		
	1-year	3-year	5-year	1-year	3-year	5-year	1-year	3-year	5-year
Piemonte	0.80	**1.66**	1.85	0.40	0.80	**1.10**	0.77	0.29	0.15
Valle d'Aosta	−1.32	−1.37	−1.50	**−6.98**	**−9.08**	−8.99	−0.50	−0.21	−0.13
Lombardia	0.53	**1.32**	**1.47**	**−1.96**	−2.52	−2.57	0.70	0.37	0.23
Trentino-Alto Adige	**−1.28**	−1.17	−1.22	−1.17	−1.46	−1.29	**−0.86**	**−0.45**	−0.29
Veneto	**−1.08**	−0.94	−1.02	0.66	1.01	1.11	−0.14	−0.03	−0.02
Friuli-Venezia Giulia	**1.21**	**2.06**	2.13	−0.95	−1.45	−1.51	0.11	0.07	0.04
Liguria	0.10	**0.76**	0.92	0.48	−0.09	−0.54	**1.04**	0.52	0.29
Emilia-Romagna	−0.69	−0.25	−0.15	1.49	1.55	1.54	−0.78	−0.39	−0.27
Toscana	−0.33	**0.24**	**0.40**	0.38	0.15	0.07	**1.54**	**0.74**	0.47
Umbria	0.17	**0.87**	**1.00**	−0.79	0.11	0.54	−0.22	**−0.26**	**−0.22**

(Continues)

TABLE 1 (Continued)

(b) Robustness check, generalised impulse response functions

	Shock to RF			Shock to nationally funded Government Investment			Shock to government consumption		
	1-year	3-year	5-year	1-year	3-year	5-year	1-year	3-year	5-year
Marche	−0.76	−0.41	−0.40	**1.87**	**2.80**	**3.08**	0.06	−0.06	−0.07
Lazio	**−0.43**	**0.01**	**0.06**	**1.01**	**1.42**	1.53	0.45	0.07	0.00
Abruzzo	**1.46**	**3.83**	**4.12**	**0.18**	**0.57**	**0.64**	**1.65**	**1.07**	0.69
Molise	−0.11	**0.50**	**0.63**	0.15	0.40	0.50	**−1.01**	**−0.87**	**−0.60**
Campania	0.48	**1.25**	**1.40**	**2.46**	**3.43**	**3.75**	**0.66**	0.31	0.18
Puglia	**0.49**	**1.31**	**1.49**	0.04	0.09	0.13	**0.95**	0.40	0.24
Basilicata	0.11	**0.77**	**0.89**	0.34	0.82	0.87	0.80	**0.75**	0.47
Calabria	−0.04	**0.57**	**0.67**	−0.37	−0.16	−0.14	−0.20	−0.06	−0.05
Sicilia	**0.80**	**1.77**	**1.98**	0.49	**1.32**	**1.62**	**0.70**	0.30	0.18
Sardegna	0.14	**0.60**	0.51	−0.56	−0.41	−0.47	0.35	0.22	0.16

(c) Robustness check, potential output computed with cubic trend

	Shock to RF			Shock to nationally funded government investment			Shock to government consumption		
	1-year	3-year	5-year	1-year	3-year	5-year	1-year	3-year	5-year
Piemonte	**1.38**	**3.06**	**3.76**	−0.02	0.58	1.11	0.63	0.37	0.24
Valle d'Aosta	**−2.99**	**−5.37**	**−6.48**	**−7.77**	**−12.74**	**−14.57**	−0.35	−0.19	−0.12
Lombardia	0.50	**1.37**	**1.73**	**−2.43**	**−3.86**	−4.41	0.93	0.67	0.50
Trentino-Alto Adige	**−1.54**	−2.41	−2.76	−1.65	−2.44	−2.53	−0.38	−0.25	−0.17
Veneto	**−1.31**	**−2.10**	**−2.48**	0.84	1.79	2.28	−0.06	0.02	0.04
Friuli-Venezia Giulia	1.14	2.54	3.07	−1.31	−2.10	−2.39	0.04	0.04	0.04
Liguria	−0.83	−0.91	−0.85	0.60	0.71	0.52	0.69	0.44	0.29
Emilia-Romagna	−0.47	−0.33	−0.24	0.40	0.74	0.91	−0.55	−0.33	−0.23
Toscana	−0.14	**0.30**	**0.54**	0.28	0.53	0.66	**1.76**	**1.18**	**0.86**
Umbria	0.15	**0.68**	**0.85**	−0.80	−0.47	−0.21	−0.21	−0.27	−0.23
Marche	−0.22	−0.01	0.04	1.38	**2.88**	**3.65**	0.32	0.16	0.09
Lazio	−0.03	0.33	0.45	1.17	**2.35**	**2.94**	0.64	0.34	0.21
Abruzzo	0.34	0.96	1.12	**0.17**	**0.78**	**1.08**	**1.73**	**1.62**	**1.25**
Molise	−0.39	−0.30	−0.29	−0.03	0.39	0.64	**−1.28**	**−1.06**	**−0.79**
Campania	**0.73**	**1.83**	**2.30**	**2.06**	**4.14**	**5.37**	**0.74**	**0.49**	0.35
Puglia	**0.87**	**2.08**	**2.58**	0.59	1.33	1.71	**1.18**	**0.75**	**0.54**
Basilicata	0.07	**0.61**	**0.86**	−0.25	−0.39	−0.40	**1.96**	**1.65**	**1.24**
Calabria	−0.11	**0.29**	**0.48**	0.63	**1.59**	**1.98**	−0.21	−0.13	−0.10
Sicilia	**1.31**	**2.86**	**3.46**	0.37	**1.49**	**2.15**	**0.69**	**0.44**	0.32
Sardegna	0.44	**1.04**	1.11	−0.73	−0.77	−0.85	0.41	0.34	0.27

TABLE 1 (Continued)

(d) Robustness ceck, specification with rate of interest	Shock to RF			Shock to nationally funded government investment			Shock to government consumption		
	1-year	3-year	5-year	1-year	3-year	5-year	1-year	3-year	5-year
Piemonte	0.80	**1.46**	**1.67**	−0.33	−0.30	−0.31	0.47	0.24	0.15
Valle d'Aosta	**−4.05**	**−4.86**	**−5.07**	**−6.29**	**−9.91**	**−10.95**	−0.63	−0.32	−0.21
Lombardia	0.17	0.49	0.58	**−2.30**	**−3.21**	−3.41	0.66	0.34	0.21
Trentino-Alto Adige	**−1.80**	**−2.49**	−2.90	−1.14	−1.60	−1.71	**−0.86**	**−0.46**	−0.30
Veneto	**−1.21**	−1.47	−1.56	0.49	0.89	0.95	−0.25	−0.11	−0.07
Friuli-Venezia Giulia	1.23	**1.87**	1.93	−2.06	−2.91	−3.12	0.12	0.06	0.04
Liguria	−0.37	−0.30	−0.29	0.71	1.11	1.19	**0.89**	**0.50**	0.32
Emilia-Romagna	−0.73	−0.80	−0.84	0.44	0.67	0.72	−0.80	−0.42	−0.27
Toscana	−0.32	−0.23	−0.21	0.38	0.58	0.62	**1.82**	**0.83**	0.50
Umbria	0.31	**0.63**	**0.68**	−0.96	−0.97	−0.97	−0.17	−0.12	−0.08
Marche	−0.75	−0.84	−0.89	**1.47**	**2.46**	**2.65**	0.22	0.10	0.06
Lazio	−0.24	−0.11	−0.08	1.07	**1.74**	**1.86**	0.68	0.35	0.22
Abruzzo	−0.70	−0.78	−0.82	0.09	**0.42**	**0.47**	**1.65**	**0.96**	0.60
Molise	−0.23	−0.12	−0.11	0.16	0.45	0.50	**−1.23**	**−0.75**	−0.50
Campania	**0.65**	**1.16**	**1.28**	**2.15**	**3.13**	**3.29**	0.23	0.13	0.08
Puglia	**0.52**	**0.99**	**1.11**	0.14	0.31	0.33	**0.86**	**0.43**	0.27
Basilicata	0.06	**0.32**	**0.37**	0.56	0.98	1.06	0.49	**0.42**	0.28
Calabria	−0.06	0.14	0.19	0.01	0.31	0.36	−0.06	−0.01	−0.01
Sicilia	**0.98**	**1.74**	**1.98**	0.11	0.54	0.62	**0.74**	**0.36**	0.22
Sardegna	−0.10	0.11	0.19	−0.91	−0.92	−0.90	0.04	0.03	0.02

Note: (a)–(d) In bold multipliers deriving from impulse response significantly different from zero.
Source: (a)–(d) Own elaborations on data from *Spesa statale regionalizzata* and ISTAT.

5 | ROBUSTNESS

In Section 3.3, we mentioned that as a robustness check on our results, we swapped the orderings of our public expenditure aggregates. The resulting evidence, available in the appendix (Table A.1), is qualitatively very similar to the findings described in the previous section. The option also exists, of course, to rely on a completely different identification scheme. In the VAR literature, there has been a growing use of the sign restriction approach.[14] However, the relatively short time span of our sample cannot support adequately the inclusion of further variables in the model, which is required to implement this approach. On the other hand, we consider the local projection approach, developed by Jordà (2005), as not particularly suitable for our purpose. By implementing this approach in a panel data context, we would only be able to derive a single average multiplier, consequently losing the option to derive region-specific multipliers. There is yet another

[14]The sign restrictions approach is developed in Canova and De Nicolò (2002), and Uhlig (2005).

TABLE 2 Five-year cumulated multipliers across macro-areas (North-Centre vs. Mezzogiorno)

(a) Baseline model			
Multipliers/tests	**5-year multiplier, RF**	**5-year multiplier, nationally funded government investment**	**5-year multiplier, government consumption**
North-Centre, median	0.4000	0.3350	0.0000
Mezzogiorno, median	0.8550	0.4950	0.1950
Kruskal-Wallis test (equality of medians across macroareas)	0.2472	0.6434	0.1897
North-Centre, w. mean	0.3400	0.4345	−0.0300
Mezzogiorno, w. mean	1.0463	0.3686	0.2671
t test (equality of w. means across macroareas)	0.1505	0.7389	0.0173
(b) Robustness check, generalised impulse response functions			
Multipliers/tests	**5-year multiplier, RF**	**5-year multiplier, nationally funded government investment**	**5-year multiplier, government consumption**
North-Centre, median	0.2309	0.3029	−0.0096
Mezzogiorno, median	1.1432	0.5690	0.1787
Kruskal–Wallis test (equality of medians across macroareas)	0.0896	0.3961	0.1649
North-Centre, w. mean	0.4595	0.2779	0.0177
Mezzogiorno, w. mean	1.0810	0.4492	0.1679
t test (equality of w. means across macroareas)	0.1931	0.7987	0.1795
(c) Robustness check, potential output computed with cubic trend			
Multipliers/tests	**5-year multiplier, RF**	**5-year multiplier, nationally funded government investment**	**5-year multiplier, government consumption**
North-Centre, median	0.2418	0.5862	0.0642
Mezzogiorno, median	1.1186	1.3951	0.3335
Kruskal-Wallis test (equality of medians across macro-areas)	0.1052	0.3159	0.1228
North-Centre, w. mean	0.3736	0.2291	0.1258
Mezzogiorno, w. mean	1.1671	0.9009	0.4359
t–test (equality of w. means across macro-areas)	0.3513	0.5140	0.1297

TABLE 2 (Continued)

(d) Robustness check, specification with rate of interest			
Multipliers/tests	**5-year multiplier, RF**	**5-year multiplier, nationally funded government investment**	**5-year multiplier, government consumption**
North-Centre, median	−0.2504	0.1516	0.0525
Mezzogiorno, median	0.2802	0.4870	0.1540
Kruskal-Wallis test (equality of medians across macro-areas)	0.1227	0.5118	0.4177
North-Centre, w. mean	−0.1729	−0.1395	0.0775
Mezzogiorno, w. mean	0.3156	0.3483	0.0540
t – test (equality of w. means across macro-areas)	0.4070	0.5374	0.8474

Note: (a)–(d) The North-Centre regions are Piemonte, Valle d'Aosta, Lombardia, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Toscana, Umbria, Marche, Lazio. The Mezzogiorno regions are Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia and Sardegna). The statistics provided for Kruskal–Wallis and *t* tests are *p* values.

Source: (a)–(d) Own elaborations on data from *Spesa statale regionalizzata* and ISTAT.

Abbreviation: w. mean, winsorised mean (amount of winsorisation = 0.1).

approach that is more suitable for our data set, and that can produce estimated multipliers that do not depend on the contemporaneous correlation among shocks. The generalised impulse response function (GIRF) approach developed by Koop et al. (1996) can provide unique multipliers that are not affected by the reordering of the vector of endogenous variables.

There is a further important check to be carried out. As discussed in Section 3, to minimise potential biases in the computation of multipliers, we divided all endogenous variables by an estimate of potential GDP. In the baseline specification, we used the filter proposed by Hodrick and Prescott (1997) to obtain this estimate. However, because the resulting potential GDP series is an estimate entailing some degree of uncertainty, we also estimate an alternative potential GDP series, based on the polynomial trend filter utilised by Ramey and Zubairy (2018). Thus, we divide all endogenous variables (see Equation 15) by the alternative potential GDP measure (in our case, we used a cubic trend of GDP) and re-estimate the model as described in Section 4.

Finally, since one may argue that in our baseline specification we do not control for the interaction between monetary and fiscal policy, as a further robustness check, we consider in our specification a short-term loan rate of interest available from the Bank of Italy as a proxy for the monetary policy stance. Given the short time span of our analysis, to preserve the parsimony of our model and to avoid problems related to degrees of freedom, we substitute in our baseline specification private investment with the Bank of Italy's rate of interest. Since this rate is available at regional level, the estimated multipliers potentially allow for the influence of local financial markets on the interaction between monetary and fiscal policy.

Table 1b–d show the cumulated multipliers obtained through these robustness checks. As can be seen from Table 2b–d, although there are slight variations in the magnitude of the multipliers, we can conclude that the baseline results are confirmed from a qualitative point of view. One can still find a ranking across multipliers from the RF one to the government consumption one, although now multipliers for RF and nationally funded government investment are close to each other. Also, just as in the baseline case, one can find larger values for the multipliers of the Mezzogiorno regions.

TABLE 3 Five-year cumulated multipliers and their correlations with a set of potential determinants

(a) Baseline model

Determinants	Correlation coefficients	5-year multiplier, RF	5-year multiplier, nationally funded government investment	5-year multiplier, government consumption
Rate of unemployment	a)	0.48**	0.22	0.38*
	b)	0.44*	0.15	0.25
Rate of employment	a)	−0.47**	−0.17	−0.40*
	b)	−0.48**	−0.16	−0.40*
Propensity to save (Private saving/GDP)	a)	−0.18	−0.06	−0.11
	b)	−0.20	−0.05	−0.20
GDP per capita	a)	−0.35*	−0.30	−0.29
	b)	−0.39*	−0.23	−0.32
GDP	a)	0.25	0.43*	0.22
	b)	0.21	0.46*	0.11
Population	a)	0.37+	0.44*	0.33
	b)	0.38*	0.47**	0.22
Population density	a)	0.35+	0.18	0.06
	b)	0.29	0.03	0.00
Total Net Imports/GDP	a)	0.04	−0.19	−0.01
	b)	0.00	−0.18	0.02
Foreign Imports/GDP	a)	−0.05	0.03	0.09
	b)	0.01	−0.01	0.09
(Foreign Exports+Foreign Imports)/GDP	a)	−0.08	−0.01	0.05
	b)	−0.03	0.01	−0.01
Regional Competitiveness Index	a)	−0.05	0.21	−0.02
	b)	−0.06	0.22	0.05
Bank branches/GDP	a)	−0.23	−0.14	−0.29
	b)	−0.21	−0.09	−0.19
Bank branches per inhabitant	a)	−0.41*	−0.25	−0.31
	b)	−0.36+	−0.22	−0.34+
EQI	a)	−0.35+	−0.26	−0.45**
	b)	−0.36+	−0.32	−0.39*
R&D expenditures/GDP	a)	0.38*	0.10	0.52**
	b)	0.42*	0.05	0.43*

TABLE 3 (Continued)

(b) Robustness Check, generalised impulse response functions.

Determinants	Correlation coefficients	5-year multiplier, RF	5-year multiplier, Nationally-funded Government Investment	5-year multiplier, Government Consumption
Rate of unemployment	a)	0.46**	0.31	0.39*
	b)	0.38*	0.27	0.22
Rate of employment	a)	−0.49**	−0.26	−0.41*
	b)	−0.50**	−0.31	−0.37+
Propensity to save (Private saving/GDP)	a)	−0.17	−0.17	−0.12
	b)	−0.21	−0.17	−0.17
GDP per capita	a)	−0.35+	−0.41*	−0.30
	b)	−0.43*	−0.38+	−0.30
GDP	a)	0.07	0.35+	0.20
	b)	0.04	0.36+	0.11
Population	a)	0.23	0.39*	0.31
	b)	0.21	0.41*	0.20
Population density	a)	0.27	0.14	0.04
	b)	0.18	−0.06	−0.02
Total Net Imports/GDP	a)	0.00	−0.05	0.01
	b)	0.01	−0.04	0.00
Foreign Imports/GDP	a)	−0.10	−0.06	0.07
	b)	−0.08	−0.10	0.11
(Foreign Exports +Foreign Imports)/GDP	a)	−0.06	−0.12	0.03
	b)	−0.11	−0.13	0.02*
Regional Competitiveness Index	a)	−0.07	0.09	−0.04
	b)	−0.10	0.10	−0.04
Bank branches/GDP	a)	−0.25	−0.04	−0.26
	b)	−0.23	−0.08	−0.18
Bank branches per inhabitant	a)	−0.39*	−0.31	−0.31
	b)	−0.41*	−0.34+	−0.32
EQI	a)	−0.35+	−0.31	−0.46**
	b)	−0.38+	−0.42*	−0.36+
R&D expenditures/GDP	a)	0.44**	0.09	0.50**
	b)	0.47**	0.04	0.43*

(Continues)

TABLE 3 (Continued)

(c) Robustness check, potential output computed with cubic trend				
Determinants	**Correlation coefficients**	**5-year multiplier, RF**	**5-year multiplier, Nationally-funded Government Investment**	**5-year multiplier, Government Consumption**
Rate of unemployment	a)	0.46**	0.39*	0.36+
	b)	0.41*	0.38**	0.16
Rate of employment	a)	−0.45**	−0.49*	−0.38*
	b)	−0.49**	−0.45**	−0.32
Propensity to save (Private saving/GDP)	a)	−0.20	−0.24	−0.16
	b)	−0.23	−0.28	−0.17
GDP per capita	a)	−0.39*	−0.47**	−0.32
	b)	−0.44*	−0.44*	−0.30
GDP	a)	0.26	0.45**	0.25
	b)	0.20	0.36+	0.13
Population	a)	0.40*	0.55**	0.38*
	b)	0.38*	0.47**	0.22
Population density	a)	0.36+	0.14	0.13
	b)	0.30	0.02	0.03
Total Net Imports/GDP	a)	0.03	−0.04	−0.03
	b)	0.00	−0.04	0.02
Foreign Imports/GDP	a)	−0.04	−0.09	0.10
	b)	−0.02	−0.14	0.10
(Foreign Exports +Foreign Imports)/GDP	a)	−0.01	−0.14	0.04
	b)	−0.04	0.19	0.02
Regional Competitiveness Index	a)	−0.07	0.10	−0.06
	b)	−0.06	0.05	−0.02
Bank branches/GDP	a)	−0.27	−0.34+	−0.25
	b)	−0.25	−0.36+	−0.14
Bank branches per inhabitant	a)	−0.44*	−0.45**	−0.32
	b)	−0.44*	−0.49**	−0.31
EQI	a)	−0.40*	−0.45**	−0.51**
	b)	−0.42*	−0.57***	−0.37+
R&D expenditures/GDP	a)	0.44*	0.03	0.43*
	b)	0.44*	−0.02	0.39*

TABLE 3 (Continued)

(d) Robustness Check, specification with rate of interest				
Determinants	**Correlation coefficients**	**5-year multiplier, RF**	**5-year multiplier, Nationally-funded Government Investment**	**5-year multiplier, Government Consumption**
Rate of unemployment	a)	0.59***	0.36+	0.36+
	b)	0.49**	0.37+	0.19
Rate of employment	a)	−0.56***	−0.35+	−0.38*
	b)	−0.53**	−0.45**	−0.39*
Propensity to save (Private saving/GDP)	a)	−0.23	−0.13	−0.05
	b)	−0.21	−0.28	−0.10
GDP per capita	a)	−0.45**	−0.39*	−0.28
	b)	−0.44*	−0.44*	−0.26
GDP	a)	0.20	0.32	0.26
	b)	0.15	0.22	0.22
Population	a)	0.36+	0.32	0.34+
	b)	0.35+	0.27	0.33
Population density	a)	0.35+	0.08	0.15
	b)	0.28	−0.07	0.16
Total Net Imports/GDP	a)	0.13	−0.05	−0.09
	b)	0.06	0.00	−0.14
Foreign Imports /GDP	a)	−0.11	−0.11	0.08
	b)	−0.05	−0.23	0.11
(Foreign Exports +Foreign Imports) /GDP	a)	−0.19	−0.18	0.05
	b)	−0.11	−0.28	−0.01
Regional Competitiveness Index	a)	−0.13	0.08	0.09
	b)	−0.11	−0.00	0.11
Bank branches/GDP	a)	−0.25	−0.13	−0.23
	b)	−0.22	−0.24	−0.25
Bank branches per inhabitant	a)	−0.52**	−0.30	−0.28
	b)	−0.42*	−0.45**	−0.33
EQI	a)	−0.43*	−0.39*	−0.42*
	b)	−0.39*	−0.54**	−0.39*

(Continues)

TABLE 3 (Continued)

(d) Robustness Check, specification with rate of interest				
Determinants	**Correlation coefficients**	**5-year multiplier, RF**	**5-year multiplier, Nationally-funded Government Investment**	**5-year multiplier, Government Consumption**
R&D expenditures/GDP	a)	0.36+	0.16	0.57***
	b)	0.37+	−0.02	0.53**

Note: (a)–(d) Correlation coefficients: a) Spearman's rank correlation coefficients; b) Winsorised correlation coefficient (amount of winsorisation = 0.1). Determinants are taken for year 1994, except for the competitiveness and the EQI indexes, whose earliest available values are from 2010.

**Significance at the 5% level; *Significance at the 10% level; +Significance at the 15% level.

Source: (a)–(d) Own elaborations on data from *Spesa statale regionalizzata*, ISTAT, https://ec.europa.eu/regional_policy/en/information/maps/regional_competitiveness, https://www.gu.se/en/quality-government/qog-data/data-downloads/european-quality-of-government-index.

Finally, in Table 3b–d, we consider the correlations between the robustness check (5-year) multipliers for RF, nationally funded government investment and government consumption, and their potential determinants. The only difference worth noticing vis-à-vis the baseline case is that rates of employment and unemployment, as well as GDP per capita, are in two cases (Table 3c,d) significantly correlated with the nationally funded government investment multiplier. Qualitatively, however, we find the same relationships as before, and the policy implications also remain the same.

6 | CONCLUDING REMARKS

This paper contributes to a recent line of research on estimating government spending multipliers at the local level. However, its analysis of three different types of government expenditure—government consumption, nationally funded government investment, and EU structural funds (basically a form of EU-funded investment)—links it to a wider literature, mostly developed at the country level. Even more importantly, the introduction of cross-sectional heterogeneity in our model enables us to estimate region-specific multipliers. More specifically, we use a Bayesian random effect PVAR model (with cross-sectional heterogeneity) to provide estimates of fiscal policy effects for the 20 Italian administrative regions throughout the 1994–2016 period. We rely on the potential-GDP normalisation proposed by Gordon and Krenn (2010) and Ramey and Zubairy (2018) to compute unbiased multipliers. Our baseline model is based on a Cholesky ordering reminiscent of Blanchard and Perotti (2002) to identify fiscal policy shocks. At any rate, the evidence remains basically untouched across different orderings of fiscal variables and when the GIRF approach is adopted for the identification of fiscal shocks. Further robustness checks include the use of a different measure of potential GDP with respect to that used in the baseline and the estimation of a model where private investment is substituted by a short-term loan rate of interest. In either case, our results change very little, especially from the qualitative standpoint.

The multipliers that we obtain are very heterogenous across regions and shocks, supporting the idea that spending decisions may have widely different effects within a given country. Shock multipliers are generally higher in the Mezzogiorno, although differences across macroareas are almost never statistically significant. Overall, the behaviour of the public consumption multiplier and public investment multiplier supports the presumption of a higher government investment multiplier. This conclusion gains strength if EU structural funds are included in the definition of public investment.

Finally, we produce an exploratory analysis of the differences of multipliers across regions and expenditure types. When testing the correlation between 5-year multipliers and a set of their potential determinants, we consistently find a positive and significant association of the value of multipliers with the amount of unused resources and with the region size (especially in terms of population).

In terms of the decade-long debate on the divide between the Mezzogiorno and the rest of the country, it should be reiterated that multipliers, especially those relating to EU structural funds, are larger in the Mezzogiorno. This finding has obvious policy relevance. We believe that our evidence is sufficiently robust to imply that reductions of EU-funded investments could have dire consequences for the level of economic activity in southern Italy. More generally, the evidence from this study is likely to be relevant in the post-Covid era, in light of the huge wave of public investments undertaken within the Next Generation EU and germane programmes.

ACKNOWLEDGEMENTS

we would like to thank Gianluigi Coppola for generously sharing his research materials with us, and Roberto Zotti for useful comments on a previous draft. The usual disclaimer applies. Mario Di Serio gratefully acknowledges funding provided by a DISES—Fondazione IFEL Campania contract. Open Access Funding provided by Universita degli Studi di Salerno within the CRUI-CARE Agreement.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the authors subject to permission of Gianluigi Coppola, who generously made available some of his research material.

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How to cite this article: Destefanis, S., Di Serio, M., & Fragetta, M. (2022). Regional multipliers across the Italian regions. *Journal of Regional Science*, 1–27. https://doi.org/10.1111/jors.12592