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REGIONAL MULTIPLIERS ACROSS THE ITALIAN REGIONS

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Abstract. This paper estimates the multipliers of different types of government spending in the 20 Italian administrative regions throughout 1994–2016. To this end, we use a Bayesian random effect panel vector autoregressive model, which enables us to estimate region-specific multipliers. Our results highlight that the EU structural funds, compared to the other types of government spending, provide the largest and most widely spread GDP multipliers, whereas the effectiveness of nationally funded government investment and government consumption shocks is limited to certain regions. We also find that there exists a fair degree of substitutability between EU structural funds and other expenditure variables, which runs counter to the principle of additionality of the EU cohesion policy. Moreover, at least for some regions, private investment is crowded in by shocks to government consumption and EU structural funds and crowded out by shocks to nationally funded government investment. An exploratory analysis of the distribution of multipliers across regions and expenditure types suggests that multiplier values are positively associated with the amount of unused resources as well as with the region size.

Keywords: EU structural funds, government consumption, government investment, Bayesian Vector Autoregressive Model.

JEL classifications: C33, E62, H50

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1. Introduction

The onset of the Great Recession and the permanently low interest rates across the world have reintroduced the impact of fiscal shocks and its measurement to the fore of the economic debate. With rates of interest in many economies still close to zero, central banks are unable to adopt conventional monetary policies, and the study of the effects of fiscal policy has regained prominence in the economic debate. Much of the recent literature has focused on subnational analyses of fiscal policies because of the advantages to be obtained in terms of identification of fiscal shocks. Indeed, subnational bodies, such as states in the US or regions in European countries, are subjected to fiscal and monetary policies that are potentially 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 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 some a priori assumptions about the nature of their impact on GDP. Since at least Baxter and King (1993), scholars have widely presumed that the GDP multiplier of government investment is higher than that of

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government consumption. Yet, this hypothesis has never been tested in a subnational framework. Adding to the policy interest of the spending breakdown, it should be noted that Coppola et al. (2020) have recently found, in a different setup, a much stronger long-run impact for EU structural funds vis-à-vis nationally funded government investment (and other nationally funded policies) across the Italian regions.

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 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 (the official label is EU structural and investment 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, whose delays in development are relevant and have been perpetuated over time.[1]

The rest of the paper has the following structure. In section we survey both the old and new literature on regional multipliers, highlighting contributions that deal with the Italian economy. Section 3 describes the econometric specification and the data used. Section 4 is dedicated to the discussion of the baseline results, and some robustness checks are presented 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. Moreover, there has been considerable work (see Madden and Batey, 1983; Batey and Madden, 1999; Miyazawa, 2012) on 'extended' input–output models[2] that link economic and demographic models, modelling the so-called distributional multipliers with multiple categories of consumption spending and income recipients (distinguishing, e.g., between currently employed and currently unemployed workers). Yet, although multipliers based on input–output and 'extended' models yield very rich insights into the disaggregated behaviour of the economy, they are often based on highly restrictive assumptions about the behaviour of wages and prices. Going beyond the hypothesis of fixed wages and prices often requires making ad hoc assumptions. Once these adjustments are made, differences in terms of the size of the aggregate multiplier across these classes of models are not very great. Indeed, Gibson and Flaherty (2017) find an aggregate multiplier equal to 2.1 within a Computable General Equilibrium model (where consumption is consistent with rational behaviour and various types of price adjustment can be imposed a priori).

Keynesian multipliers are reviewed in the meta-analysis conducted by Gechert et al. (2015), as well as in the surveys carried out by Mineshima et al. (2014) and Ramey

[1] The Mezzogiorno includes the southern regions (Abruzzo, Molise, Campania, Apulia, Basilicata, and Calabria) and the isles (Sicily and Sardinia).

[2] These models are referred to as demo-economic or as eco-demographic. Strictly speaking, the demo-economic definition relates to inputs from various labour (household) groups, whereas the eco-demographic definition reflects the different consumption patterns by various household types.

(2019). Gechert et al. (2015), who carry out arguably the most thorough comparison across types of government spending, find that estimates for the fiscal multiplier are significantly higher during economic downturns than under ‘normal’ economic circumstances or during times of significant growth. 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. These values are in very much the same ballpark as the multipliers found for Italian regions in Faggian and Biagi (2003), with values ranging between 1 and 2. Hence, the use of ‘extended’ models does not seem to warrant a strong gain in terms of formulation of policy prescriptions, at least from the aggregate standpoint.

On the other hand, interest in Keynesian multipliers based on subnational data has undergone a renaissance in the literature, because of the advantages to be gained in terms of identification of fiscal shocks. Indeed, subnational bodies, such as states in the US or regions in European countries, are subjected to fiscal and monetary policies that are potentially unresponsive to their idiosyncratic conditions, facilitating the computation of fiscal multipliers based on exogenous shocks.

This literature has thrived mostly in the US. The first line of studies (Chodorow-Reich et al., 2012; Wilson, 2012; Conley and Dupor, 2013; Dupor and Mehkari, 2016) 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 spending. In particular, spending on infrastructure and other general purposes has a large positive impact, whereas spending on safety-net programmes, such as unemployment insurance and Medicaid, reduces employment.

Other papers (Fishback and Kachanovskaya, 2010; Hausman, 2016) rely on historical variations in public spending that occurred during the 1930s, finding multipliers ranging from 0.40 to 1.7. Yet, other studies develop different kinds of identification strategies, focusing on either US states (Clemens and Miran, 2012; Nakamura and Steinsson, 2014) or counties (Suarez Serrato and Wingender, 2016; Adelino et al., 2017). But for Clemens and Miran, who find a value of 0.29, the estimates for the local multiplier go from 1.4 to 2.

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 analysis 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. (2019) 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. (2019) 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 US is less abundant. There are only two extant studies of Italy.[3] Acconcia et al. (2014) use data on Italian provinces for the period 1990–1999. They instrument the growth rate in government investment with a binary variable for the dismissal of city councils due to Mafia infiltration. Indeed, upon evidence of Mafia infiltration, Law 164/1991 contemplates the dismissal of all elected local officials who are replaced by three external commissioners delegated by the central government. These commissioners, as soon as they are appointed, usually cut all public investment projects. Relying on these exogenous spending contractions, Acconcia et al. (2014) estimate a long-run multiplier of 1.9. On the other hand, Trezzi and Porcelli (2014) investigate all 305 municipalities located in the Abruzzo region over 2002–2011. As a source of exogenous variation in public spending, they exploit the reconstruction grants following the 2009 earthquake. Their estimates yield a local fiscal multiplier of 0.71.

The examination of this literature reveals 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., 2019) and of different expenditure aggregates (here the main exception is arguably Wilson, 2012). Interestingly, however, the latter kind of disaggregation relates to a strand of macroeconomic literature that considers multipliers based on alternative types of government spending. These analyses broadly refer to the 'Golden Rule', the idea that government investment, given a sufficiently strong impact on income, could be self-financed. The aforementioned meta-analysis by Gechert et al. (2015) finds some support for this idea, whereas this support is much less pronounced in the surveys by Mineshima et al. (2014) and Ramey (2019). The latter, however, laments the relative lack of recent evidence on this issue. More specifically, studies based on the calibration of theoretical macroeconomic models (Baxter and King, 1993; Leeper et al., 2010; Cwik and Wieland, 2011; Coenen et al., 2012) usually find that the marginal productivity of public capital is the key parameter in bringing about conditions favourable to the fulfilment of the Golden Rule. Another group of studies (Mittnik and Neumann, 2001; Perotti, 2004, Tenhofen et al., 2010; Auerbach and Gorodnichenko, 2012; Ilzetzki et al., 2013), which are based on the estimation of Structural VAR models and apply Cholesky ordering identification strategies at the country level, find little evidence of a stronger role for government investment vis-à-vis government consumption, let alone in favour of the Golden Rule.

In this paper, we endeavour to fill the gaps in the literature regarding the measurement of local multipliers differentiated across areas and expenditure aggregates, 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, we cannot employ any innovative technique of shock identification, such as the ones proposed in many of the recent subnational analyses. Our identification approach is more in line with the procedures developed and adopted in country-level studies. However, relying on subnational data makes it possible to deal with administrative units that are subjected to fiscal and monetary policies potentially unresponsive to their idiosyncratic conditions, easing the task of exogenous shock identification. More details of our identification strategy are provided below.

[3] Other notable studies outside the US 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.

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

Finally, note that 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. (2014) 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 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, monetary policy stance and exchange rate regime, two potential confounders of country-level studies of the fiscal multiplier, are not relevant in our cross-region setup.

3. The Empirical Framework

3.1 The model

We consider a PVAR model with cross-subsectional heterogeneity, obtaining a unit-specific vector autoregressive (VAR) model by means of a random coefficient model. For each region, the VAR model is

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

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

$$Y_i = X_i \beta_i + \epsilon_i$$

Using the random coefficient model, we assume that for each unit i, β_i can be expressed as

$$\beta_i = b + b_i$$

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 $\beta_i(i=1,2,\ldots,N)$, the set of residual covariance matrix $\Sigma_i(i=1,\ldots,N)$, 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,

$$\beta=\{\beta_1,\beta_2,\ldots,\beta_N\} \quad \text{and} \quad \Sigma=\{\Sigma_1,\Sigma_2,\ldots,\Sigma_N\}$$

we can write the complete posterior distribution as

$$\pi(\beta,\Sigma,b,\Sigma_b|y) \propto \pi(y|\beta,\Sigma)\pi(\beta|b,\Sigma_b)\pi(b)\pi(\Sigma_b)\pi(\Sigma)$$

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

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

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

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

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

$$\pi(b) \propto 1$$

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

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

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

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

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

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

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

$$\Sigma_b = (\lambda_1 \otimes I_q) \Omega_b$$

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 mean b, 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:

$$\lambda_1 \sim IG\left(\frac{s_0}{2}, \frac{v_o}{2}\right)$$

which implies

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

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

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

we have all the elements required to build the full posterior, substituting in equation ( ) the likelihood function (equation) and the priors (equations , , , and). However, this posterior does not allow for any analytical derivations of the marginal posteriors, but 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 ( ) for all 20 Italian regions, using annual data from 1994 to 2016. Our vector of endogenous variables is

$$Y_{it} = [GC_{i,t}, GI_{i,t}, RF_{i,t+1}, I_{i,t}, GDP_{i,t}]$$

where GC, GI, RF, I, and GDP represent nationally funded government investment, government consumption, revolving fund (our measure of EU structural funds), private investment, and GDP, respectively.

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. It comprises all types of structural funds (European regional development fund, European social fund, European agricultural fund for rural development, European maritime and fisheries fund) and is inclusive of the so-called national cofinancing. Indeed, the EU supports 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 nationally funded government investment and revolving fund are not allocated to any single region, but to multiregional aggregates. In the following analysis, we assume that these funds are spread across 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 revolving fund (RF) variable forwarded by one 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 one year. This effectively means that the revolving fund expenditures written down for year t have already been spent in year t-1.[4]

All variables are at constant prices. Furthermore, as we discuss in section , in order to minimise potential biases in the computation of multipliers, we follow the approach of Gordon and Krenn (2010) and Ramey and Zubairy (2018), by dividing all the variables by a measure of the real regional potential GDP.

Finally, in order to implement a parsimonious model and avoid problems of over-parameterisation, we estimate our PVAR model with a lag structure of 1 year (p=1).

3.3 Identification and computation of cumulated government spending multipliers

As described in subsection 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

[4] 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 model-based measure of the 'expenditures taking place on the ground'. For Italian regions, this measure closely follows 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.

identification strategy is very common in the VAR research on government spending shocks. As argued in a prominent study by Blanchard and Perotti (2002), there are two important reasons for this ordering. The first is that fiscal variables vary due to various causes and, among them, output stabilisation rarely play a dominant role. Moreover, due to implementation and legislation lags,[5] 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. 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 on request, are qualitatively and quantitatively very similar to the findings described in section .

Once we have identified three separate shocks for RF, government consumption, and nationally funded government investment, 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.

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:

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

[5] 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).

[6] For example, among the papers we have listed in section , Mittnik and Neumann (2001), Ilzetzki et al. (2013), Auerbach and Gorodnichenko (2012), Perotti (2004), and Tenhofen et al. (2010) also rely on Cholesky ordering to identify the shock. In their settings, fiscal variables are always ordered before the other variables of interest.

where h=0,1,…,H represents the time horizon over which the 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 is obtained using the Hodrick and Prescott (1997) filter on regional GDP data.

4. Baseline Results

All figures and tables related to our evidence are presented in the Appendix. Figure 1a and Figure 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 barely above zero. For Valle D'Aosta only, the response of GDP is negative and significant. These results could reflect the response of nationally funded government investment and government consumption to an RF shock. The former reacts negatively and significantly for all regions except Piedmont, Lombardy, Liguria, Friuli-Venezia Giulia, Campania, Apulia, and Sicily, where responses are mostly negative but not significant. Government consumption reacts negatively but not significantly for all the regions. This behaviour suggests a fair degree of substitutability between RF and other expenditure variables, squarely contradicting 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. Interestingly, private investment reacts positively in most regions, and sometimes significantly, to an RF shock, highlighting that a shock to RF implies a slight crowding-in effect on private investment.

Figure and Figure show the impulse responses following a shock to nationally funded government investment. This shock seems to have a positive and significant impact on GDP only for Piedmont, Marche, Lazio, Abruzzo, Campania, and Sicily. Even in this case, there is a slight substitution effect at least between nationally funded government investment and RF. Following a nationally funded government investment shock, RF reacts negatively and significantly for Piedmont, Trentino-Alto Adige, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany and not significantly for the other regions. Moreover, the government consumption response is positive but not significant for all the regions. For most regions, the response of private investment is not different from zero. Yet, at least Piedmont, Valle d'Aosta, Trentino-Alto Adige, Abruzzo, Campania, and Sicily experience a rather strong crowding-out effect of private investment. The response of private investment is positive and significant only in Liguria.

Figure and Figure show the responses of variables of interest to a government consumption shock. This shock leads to a very persistent increase in government consumption and nationally funded government investment for all regions. RF also reacts positively and significantly for all the regions, with the exceptions of Lazio, where its response is not significant, and Molise, where its response is negative and slightly significant. Nonetheless, the impact on GDP of a government spending shock is not extremely strong, being positive and significant for only seven regions (Liguria, Tuscany, Abruzzo, Campania, Apulia, Basilicata, and Sicily) and negative and significant for three regions (Trentino-Alto Adige, Umbria, and Molise). Moreover, the behaviour of private investment is very heterogenous: it reacts positively and significantly for Liguria, Umbria, Marche, Lazio, Basilicata, and Calabria, negatively and marginally significantly for Sardinia, and not significantly for the remaining regions.

Table 1 shows the RF, nationally funded government investment, and government consumption multipliers for each region. They are computed using equation for horizons of one, three, and five 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. However, none of those studies report multipliers differentiated across regions and types of expenditure. It is also evident that although the RF multipliers turn out to be the largest, 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. This is particularly true for shocks to nationally funded government investment and government consumption, where the five-year effects are positive and significant only for a small group of regions belonging mainly to Central and Southern Italy. However, comparing nationally funded government investment and consumption multipliers for regions where the shocks have positive and significant effects, our results support the presumption of a higher government investment multiplier in the medium run. Specifically, the government consumption multiplier decreases over time and becomes insignificant in most of the bolded cases, whereas the (nationally funded) government investment multiplier increases significantly. At the five-year horizon, the nationally funded government investment multiplier is greater than one for five of the eight bolded regions, whereas the government consumption multiplier does not reach one in any case. On the other hand, RF multipliers are positive and significant for many regions, increasing their magnitude over time. Always considering a five-year horizon, the cumulated RF multiplier is greater than one for 6 of the 14 bolded regions.

The marked heterogeneity of multiplies across areas and expenditure types warrants further discussion. First, not only we are able to rank the multipliers (in terms of size) from the one attached to the RF, to the nationally funded investment one and finally to the government consumption one, but systematic differences in multiplier sizes also occur across areas. The Mezzogiorno multipliers are larger 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. Furthermore, 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, size of the economy, size of the automatic stabilisers, and amount of available unused resources. On the other hand, there are no synthetic regional indicators of financial market development and level of public debt (especially for the last indicator, it is also an open question whether they would be conceptually appropriate). In Table 3, we provide some prima facie analysis of the relationships between our (five-year-horizon) multipliers for RF, nationally funded government investment, and government consumption and a set of their potential determinants (measured in 1994[7]). We rely on Kendall's rank correlation coefficients between the various multipliers and their potential determinants (rank correlation coefficients are robust to the presence of outliers among the variables under scrutiny). According to the evidence in Table 3, there is definitely some correlation between the size of multipliers and the amount of available unused resources. All five-year multipliers are positively related to the rate of unemployment and negatively related to the rate of employment. This relationship is particularly significant for the RF and (to a lesser extent)

[7] In all cases but for the trade openness indicators (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.

for the government consumption multiplier. 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 Biagi and Faggian (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. There is a more definite role for the region size. GDP and population are both positively correlated with the multipliers. 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 robust relationship shows up between any multiplier and two different indicators of foreign trade openness (the ratio of foreign imports over GDP and the ratio of *the sum of foreign imports plus foreign exports* over GDP). It could be argued that one must allow for some measures of interregional imports and exports to make sense of this relationship, but unfortunately they are not readily available.

More tentatively, our analysis also sheds some light on the reasons why RF multipliers are much higher and more significant than the other ones. First of all, we should stress that this result echoes the evidence obtained by Coppola et al. (2020), who find that EU funds are much more significant than nationally funded policies (including government investment) in promoting the steady-state level of GDP per capita. Coppola et al. (2020) also suggest some possible reasons for the greater significance of EU funds. Rejecting explanations based on the sectoral composition of EU vs. nationally funded expenditures, they find some support for the idea that the governance of EU cohesion policy is better than that of nationally funded policies. They state, however, that a full-fledged analysis of the impact of nationally funded government investment should fully allow for interregional spillover effects. In this respect, it must be stressed that regional size (in terms of GDP and especially of population) is the only factor from Table 3 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 nationally funded government investment will be.[8]

5. Robustness

In subsection 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 on request, is qualitatively and quantitatively very similar to the findings described in the previous section. There is, however, another important check to be carried out. As discussed in section 3, in order 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 filter proposed by Mohr (2005). Thus, we divide all endogenous variables (see equation) by the alternative potential GDP measure and re-estimate the model as described in section 4.

[8] Auerbach et al. (2019) find that geographic spillovers vanish above 50 miles of distance. This is not, however, a negligible distance for many Italian regions.

shows the multipliers obtained through our robustness check.[9] In general, these multipliers are qualitatively similar to the baseline multipliers but are slightly lower from the quantitative standpoint. One can still find a ranking across multipliers from the RF one to the government consumption one, as well as larger values for the Mezzogiorno, although in both cases differences are quantitatively smaller.

More specifically, considering multipliers deriving from a shock to RF, the magnitude of multipliers seems to be slightly lower in comparison to the baseline ones. Nevertheless, five-year cumulated RF multipliers are still above one for three regions. From a qualitative point of view, RF multipliers continue to be significant for all regions of Southern Italy, except Abruzzo (as was already the case in the baseline analysis). Considering the regions of Central and Northern Italy, the most marked differences between baseline and robustness multipliers concern Emilia-Romagna and Lazio, where multipliers (previously significant) are now insignificant for all three horizons considered.

Turning to nationally funded government investment shocks, the magnitude of multipliers is also very similar to the baseline specification. However, only a few regions retain a significant multiplier. Specifically, Marche, Abruzzo (only up to a three-year horizon), and Campania still have significant multipliers, whereas the multipliers of Lazio and Sicily are not significant. Valle d'Aosta and (to a slightly less significant extent) Lombardy retain their negative multipliers. At any rate, for Marche and Campania the baseline behaviour is confirmed: multipliers increase over time horizons, and although the magnitude is slightly lower, at the five-year horizon they are greater than one.

Finally, government consumption multipliers confirm on the whole the baseline results: the magnitude is generally lower than baseline multipliers and decrease over time. At the five-year horizon, they approach zero or become negative (if they did not previously attain this level). From a qualitative point of view, only four regions now have a positive and significant multiplier at a one-year horizon. The significance also decreases over time. When considering a five-year horizon, no region has a positive and significant multiplier.

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-subsectional heterogeneity in our model enables us to estimate region-specific multipliers, which grafts our study to a decade-long literature about local Keynesian multipliers. More specifically, we use a Bayesian random effect panel vector autoregressive model (with cross-subsectional heterogeneity) to provide estimates of fiscal policy effects for the 20 Italian administrative regions throughout the 1944–2016 period. We use various Cholesky ordering to identify fiscal policy shocks and rely on the potential-GDP normalisation proposed by Gordon and Krenn (2010) and Ramey and Zubairy (2018) to compute unbiased multipliers. Our evidence is robust across different orderings of fiscal variables and is qualitatively unchanged for two different measures of potential GDP.

We obtain results that are very heterogenous across regions and shocks, supporting the idea that spending decisions may have widely different effects within a given country.

[9] Because IRFs are very similar to baseline specification, we do not report them. However, the full set of IRFs is available upon request.

However, a shock to the revolving fund, our indicator of EU structural funds, seems to have a positive impact on GDP in most regions, with multipliers that increase over the time horizon and exceed unity for six regions. On the other hand, responses of GDP to nationally funded government investment and government consumption are positive and significant only for some regions of Central and Southern Italy. When these regions are considered in greater detail, government consumption multipliers decrease over time horizons and become insignificant in most of the cases, whereas nationally funded government investment multipliers increase over time horizons and exceed one for five regions. Overall, the behaviour of the public consumption multiplier and public investment multiplier supports the presumption of a higher government investment multiplier. Obviously, this conclusion gains strength if EU structural funds are included in the definition of public investment.

Moreover, our results highlight that there is a fair degree of substitutability between the revolving fund and other expenditure variables, especially nationally funded government investment. This behaviour somehow contradicts the principle of additionality under which EU resources should be additional and not a substitute for other national and/or regional funding sources. Conversely, when the economy is hit by a government consumption shock, we find a moderate complementarity effect between government consumption and other expenditure variables.

The response of private investment to fiscal shocks is also very heterogeneous, but in general, a crowding-in effect emerges in the case of shocks to government consumption and the revolving fund, whereas there is crowding out in the case of shocks to nationally funded government investment.

Finally, we produce an exploratory analysis of the differences of multipliers across regions and expenditure types. When testing the rank correlations between five-year multipliers and a set of their potential determinants, we 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 noted 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 reduction of territorial disparities in Italy.

Tables

Table 1: Baseline Multipliers. In bold multipliers deriving from impulse response significantly different from zero.

	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*
Piedmont	**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
Lombardy	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
Tuscany	-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
Apulia	**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
Sicily	**1.07**	**2.05**	**2.22**	0.07	**0.95**	**1.32**	**0.72**	0.31	0.19
Sardinia	0.27	**0.76**	0.70	-0.81	-0.63	-0.71	0.31	0.19	0.15

Table 2: Robustness Check Multipliers. In bold multipliers deriving from impulse response significantly different from zero.

	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*
Piedmont	0.49	**0.82**	**0.86**	0.35	0.58	0.75	0.33	0.09	0.04
Valle d'Aosta	**-2.07**	**-2.30**	**-2.45**	**-5.70**	**-6.67**	**-6.75**	-0.51	-0.23	-0.14
Lombardy	0.16	**0.42**	**0.45**	**-2.09**	**-2.47**	-2.51	0.20	0.09	0.05
Trentino-Alto Adige	**-1.20**	-1.18	-1.20	-0.82	-0.94	-0.89	**-0.77**	**-0.37**	**-0.23**
Veneto	**-0.99**	-1.00	-1.04	1.17	1.36	1.40	-0.35	-0.16	-0.10
Friuli-Venezia Giulia	0.98	**1.40**	**1.45**	-0.43	-0.61	-0.62	-0.02	-0.01	-0.01
Liguria	0.02	0.29	0.35	0.07	-0.23	-0.39	0.36	0.15	0.07
Emilia-Romagna	-0.46	-0.30	-0.27	1.01	0.98	0.98	-0.61	-0.29	-0.19
Tuscany	-0.15	**0.07**	**0.11**	0.20	0.08	0.06	**1.31**	**0.58**	0.35
Umbria	**0.31**	**0.57**	**0.60**	-0.93	-0.81	-0.75	**-0.45**	**-0.26**	**-0.18**
Marche	**-0.86**	-0.81	-0.83	**1.27**	**1.57**	**1.64**	-0.25	-0.16	-0.11
Lazio	-0.25	-0.10	-0.10	0.77	0.92	0.96	0.35	0.11	0.05
Abruzzo	-0.05	0.12	0.12	0.08	**0.17**	0.18	**1.61**	**0.80**	0.49
Molise	-0.07	**0.13**	**0.14**	0.31	0.41	0.44	**-1.07**	**-0.59**	**-0.38**
Campania	**0.61**	**0.96**	**1.02**	**1.72**	**2.13**	**2.31**	0.30	0.13	0.07
Apulia	**0.59**	**0.94**	**0.99**	0.16	0.17	0.18	**0.68**	0.27	0.16
Basilicata	-0.05	**0.17**	**0.20**	-0.02	0.00	0.02	0.29	0.21	0.12
Calabria	-0.10	**0.11**	**0.15**	-0.27	-0.25	-0.25	-0.15	-0.06	-0.05
Sicily	**0.78**	**1.15**	**1.18**	-0.22	0.00	0.11	**0.59**	0.24	0.14
Sardinia	0.11	**0.25**	0.19	-0.78	-0.89	-0.95	0.10	0.04	0.03

Table 3: 5-Year Baseline Multipliers and their Relationships with a Set of Potential Determinants. Kendall's rank correlation coefficients.

Multipliers / Determinants	**5-year multiplier, RF**	**5-year multiplier, Nationally-funded Government Investment**	**5-year multiplier, Government Consumption**
Rate of unemployment	0.37**	0.12	0.27*
Rate of employment	-0.40**	-0.11	-0.25*
Propensity to save (Private Saving / GDP)	-0.16	-0.06	-0.06
GDP per capita	-0.27**	-0.21	-0.20
GDP	0.16	0.30*	0.15
Population	0.25*	0.36**	0.24*
Foreign Imports / GDP	-0.03	-0.01	0.04
(Foreign Exports + Foreign Imports) / GDP	-0.12	-0.01	0.04

Determinants are taken for year 1994.
Stars denote coefficient significances. * means a p-value < 0.1; ** a p-value < 0.05; *** a p-value < 0.01.

Figures

Figure 1a: Impulse Responses to Revolving Fund shock for Piedmont, Valle d'Aosta, Lombardy, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria. The red shaded area represent the 16th and 84th credible interval. The

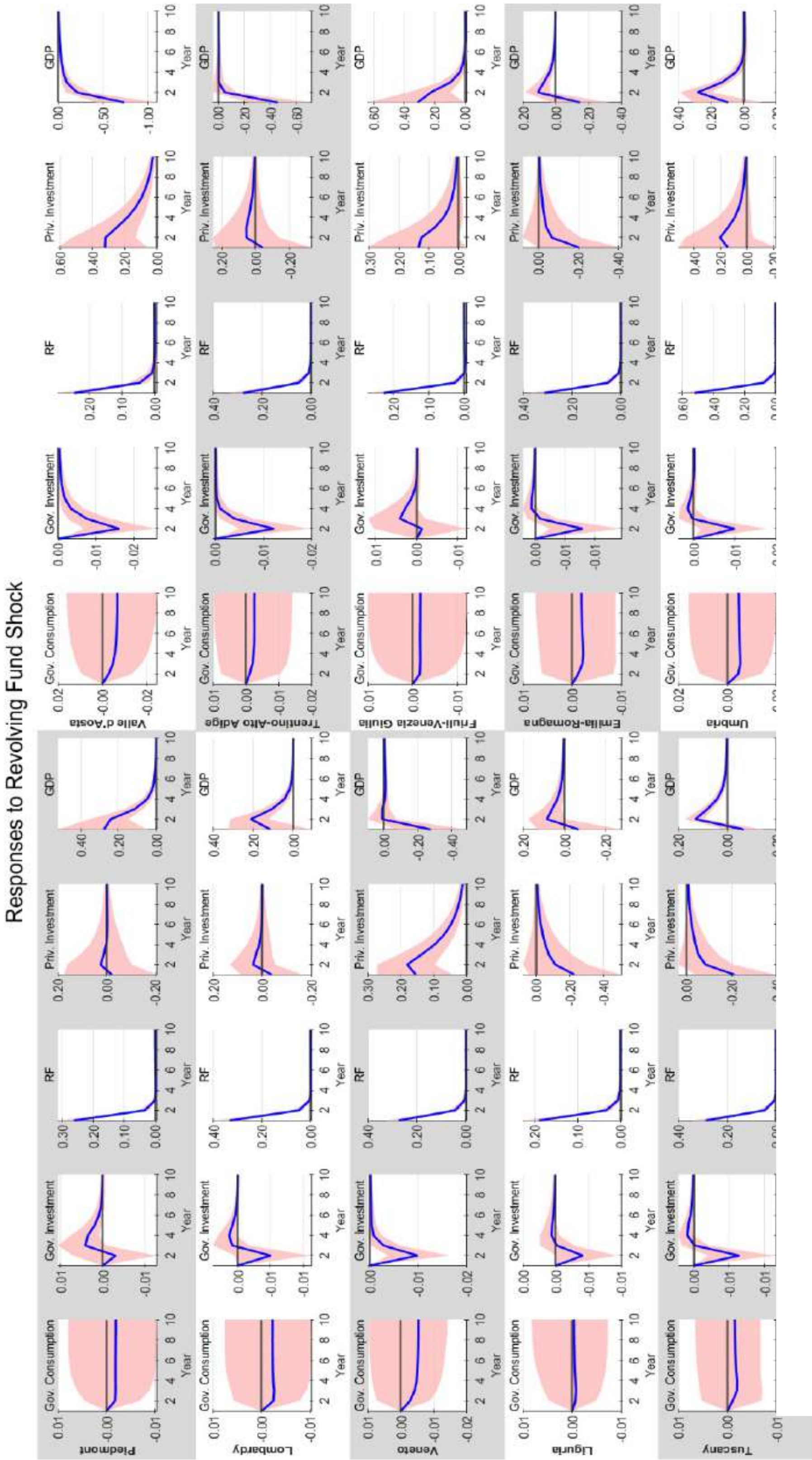


Figure 1b: Impulse Responses to Revolving Fund shock for Marche, Lazio, Abruzzo, Molise, Campania, Apulia, Basilicata, Calabria, Sicily, Sardinia. The red shaded area represent the 16th and 84th credible interval. The blue solid line represent the median response.

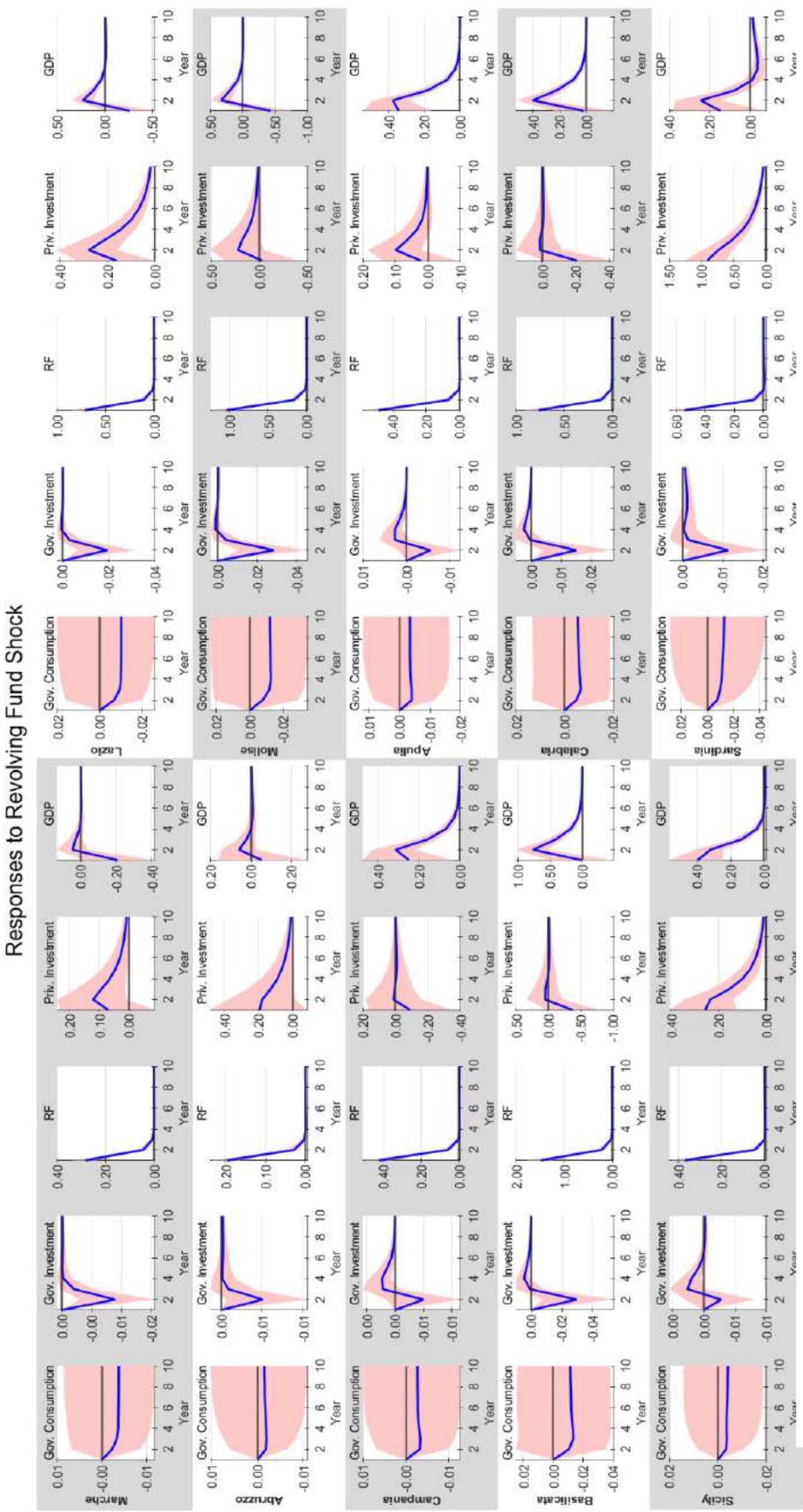


Figure 2a: Impulse responses to nationally-funded government investment shock for Piedmont, Valle d'Aosta, Lombardy, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria. The red shaded area represent the 16th and 84th credible interval. The blue solid line represent the median response.

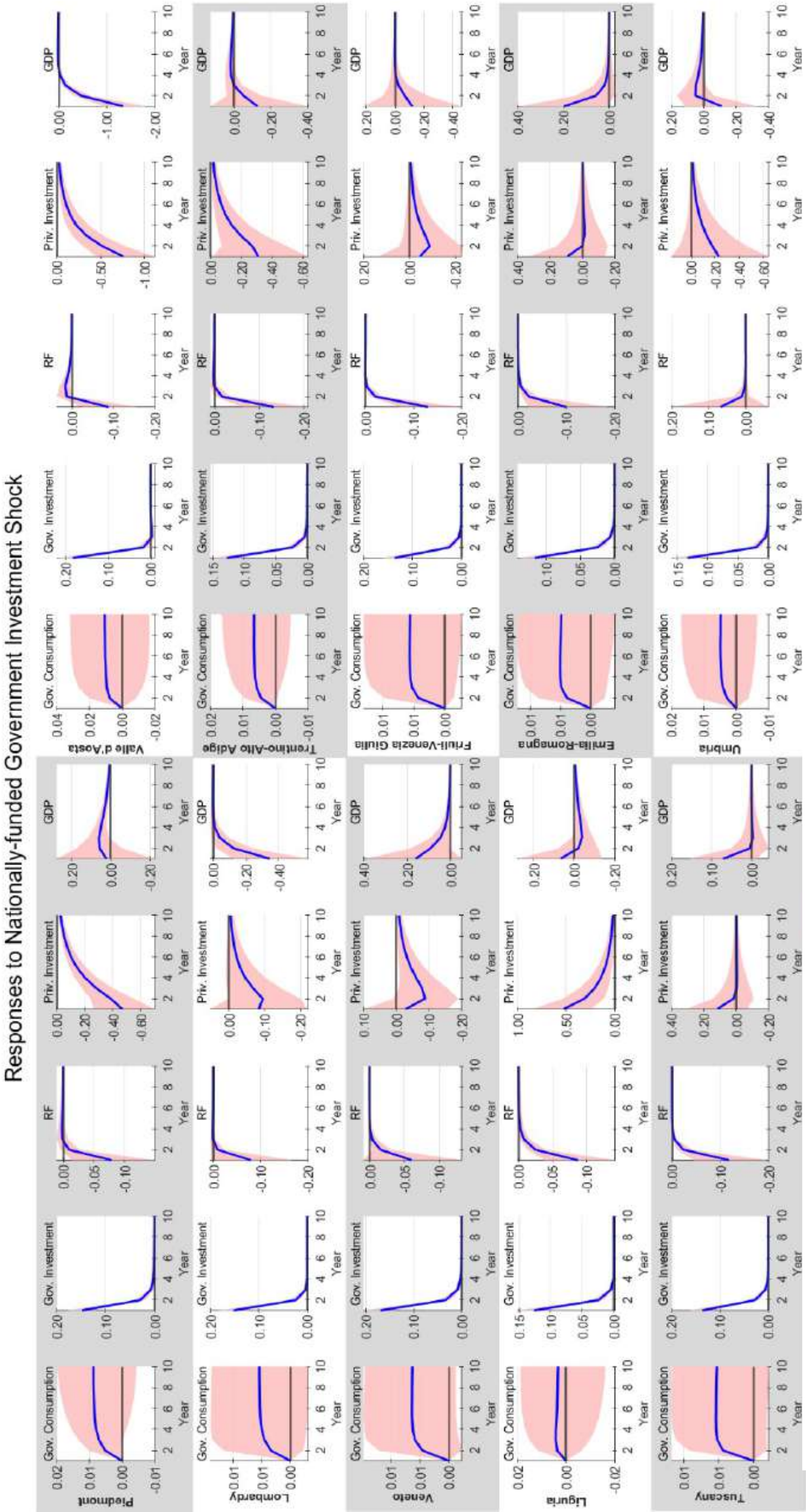


Figure 2b: Impulse responses to nationally-funded government investment shock for Marche, Lazio, Abruzzo, Molise, Campania, Apulia, Basilicata, Calabria, Sicily ,Sardinia. The red shaded area represent the 16th and 84th credible interval. The blue solid line

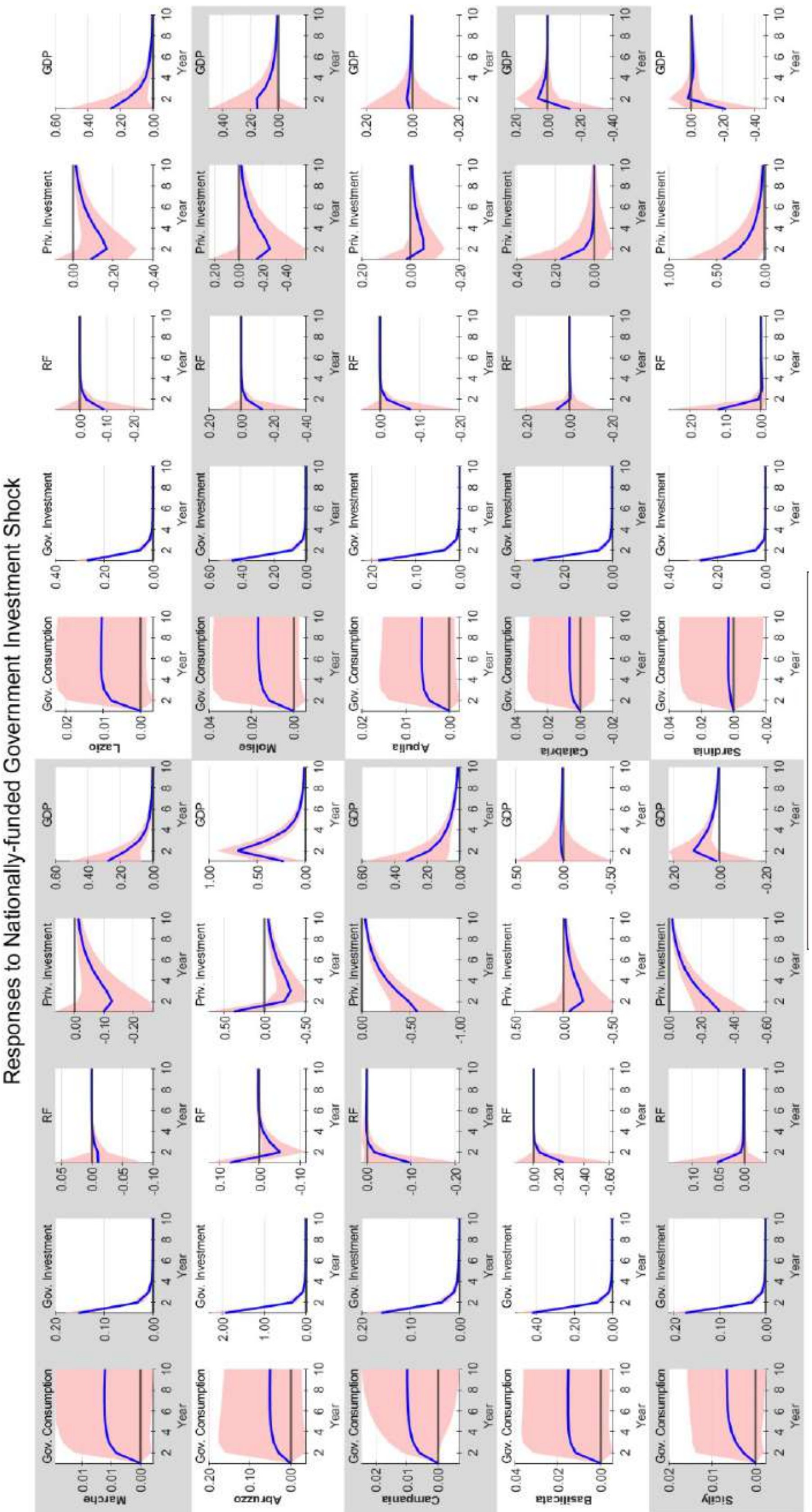


Figure 3a: Impulse responses to government consumption shock for Piedmont, Valle d'Aosta, Lombardy, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Tuscany, Umbria. The red shaded area represent the 16th and 84th credible interval. The blue solid line represent the median response.

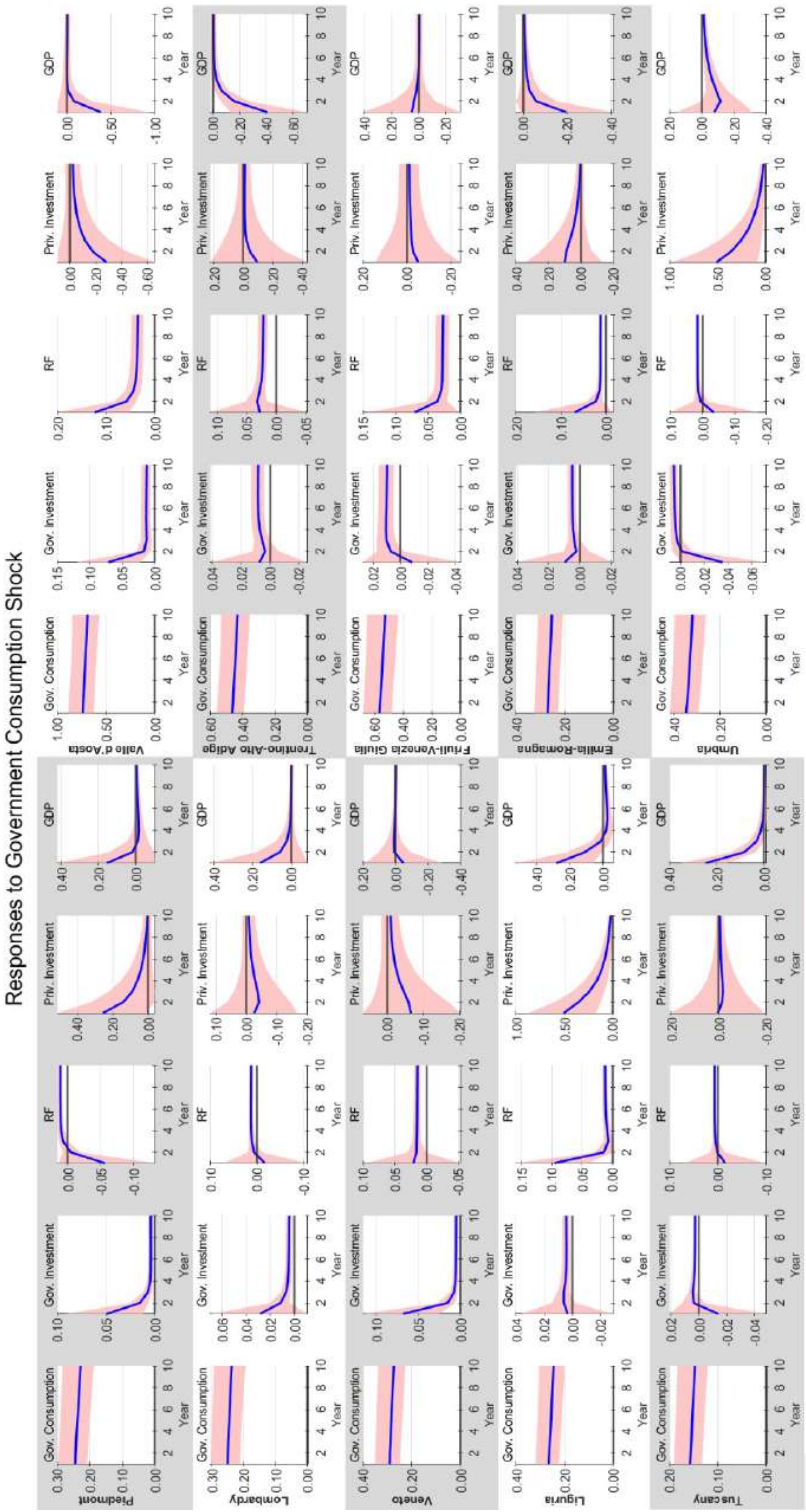
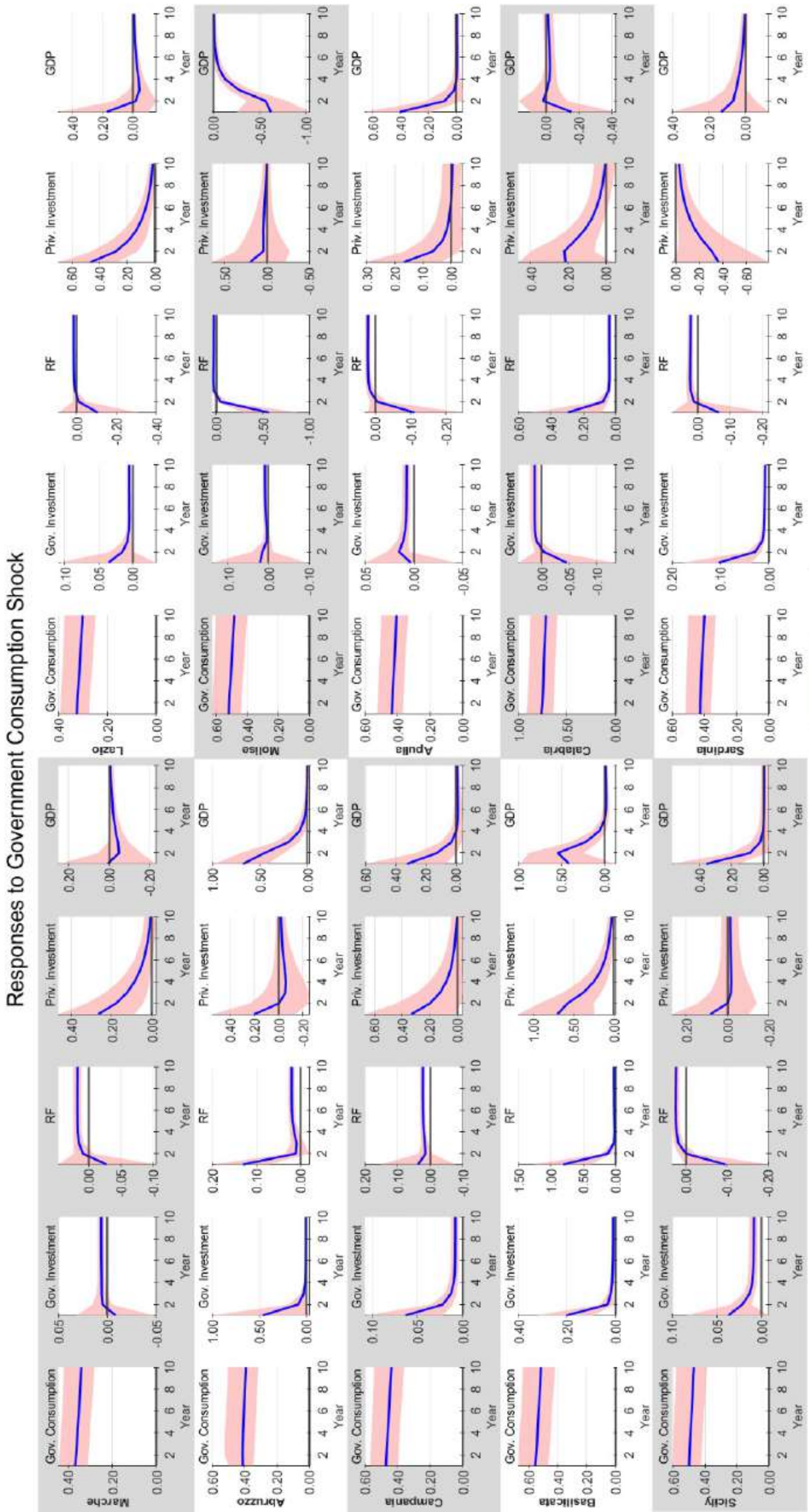


Figure 3b: Impulse responses to government consumption shock for Marche, Lazio, Abruzzo, Molise, Campania, Apulia, Basilicata, Calabria, Sicily, Sardinia. The red shaded area represent the 16th and 84th credible interval. The blue solid line represent the median response.



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