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Caterina Ferrario

Department of Economics and Management, University of Ferrara, via Voltapaletto 11, 44121 Ferrara (Italy)

Dondena Centre for research on social dynamics and public policy, via Röntgen 1, 20136 Milan (Italy)

Alberto Zanardi

Italian Parliamentary Budget Office, via del Seminario 76, Rome (Italy)

Dondena Centre for research on social dynamics and public policy, via Röntgen 1, 20136 Milan (Italy)

Department of Economics, University of Bologna, Piazza Scaravilli 2, 40126 Bologna (Italy)

Abstract

Public expenditure programmes allocate resources among beneficiaries on the basis of socio-demographic features of individuals or households, such as age, state of health, economic well-being or employment status ("personal" programmes), or of characteristics of territories such as level of economic development, infrastructural endowments, economic structure and morphological conditions ("territorial" programmes). These programmes may have interregional redistributive effects, either on purpose, this often happens for "territorial" programmes (e.g. equalising schemes), or as an unintended by-product of policies pursuing other objectives (public provisions, social security). This paper aims to measure the interregional redistribution by personal programmes and to develop a better understanding of how personal criteria driving the allocation of public expenditure programmes contribute to redistribution across territories. We estimate the regional distribution of public expenditure as if it was driven exclusively by personal factors, and territorial factors were negligible, for Italy in 1999-2010. Results show that, when the distribution of public expenditure across regions is exclusively driven by personal criteria, public programmes still produce a significant level of territorial redistribution, although for most public programmes, interregional redistribution falls slightly with respect to the one generated by the observed distribution of public expenditure.

Keywords: Territorial redistribution, Fiscal residua, Public expenditure

JEL: classification: H23, H50, H70

1. Introduction

The design of public expenditure programmes generally entails a clear, explicit identification of the criteria of eligibility for programme benefits. For some programmes these criteria are predominantly "personal", that is they relate to the socio-demographic features of individuals or households, such as age, state of health, economic well-being, employment status, etc. This is the case, for instance, of pension schemes, health care and social assistance programmes. In the case of other programmes, the normative design primarily identifies "territorial" criteria such as the level of economic development, infrastructural endowments, economic structure, and morphological conditions of different areas. Such programmes include interregional equalizing schemes and infrastructure investment programmes.

In this paper public expenditure programmes are considered from a particular perspective, namely their power to produce redistribution of resources across territories (regions, provinces, municipalities) within a country. All public expenditure programmes generate interregional flows whenever the allocation of public programme benefits across territories (or across individuals that reside in different territories) does not match the distribution of sources of funding for the same programme across territories or individuals. These flows of resources across territories result in positive redistribution every time that the net beneficiary of expenditure programmes is a relatively poor area, or negative redistribution when the opposite holds.

Some policies and programmes are specifically designed to engender territorial redistribution. This is the case, for example, of interregional equalisation schemes designed to reduce disparities in economic development across territories. Most often, however, resources are unintentionally redistributed across territories as a by-product of public measures specifically designed to achieve other objectives, such as the inter-personal redistribution of income (through cash or in-kind transfers) or the public provision of goods and services. For instance, social insurance systems designed to meet certain basic individual needs (old age, illness, poverty, unemployment, and so forth), may produce territorial redistribution as the result of the correlation between the interregional distribution of beneficiaries and that of taxpayers financing those programmes. As an extreme example, in a polarised country where the population of region A consists of elderly people only, and the population of region B is entirely made up of young workers, social support programmes for the elderly financed through payroll taxes, would result in a net transfer from region B (net contributor) to region A (net beneficiary), and therefore in a positive redistribution if average per capita GDP in region A were lower than in region B (or a negative redistribution in the opposite case). This paper focuses on the territorial redistributive power of personal public expenditure programmes. The paper aims at showing that personal programmes, that redistribute across individuals according to "socio-demographic" features, may well produce territorial redistribution. Intuitively, this happens when the personal features that drive

the allocation of public expenditure are negatively correlated with income. This is of particular significance for countries characterised by stark economic differences, where personal programmes, besides redistributing across individuals, may also provide a significant contribution to accomplish the territorial redistributive objectives of public policies.

In this paper, this general issue is analysed with reference to the case of Italy, a country characterised by a strong North-South divide as well as by a polarisation of its socio-demographic structure. Due to data availability, the analysis will address the redistributive properties of public functions, consisting in aggregates of expenditure programmes defined on the basis of the COFOG – Classification of the functions of government[1] (e.g. education, health, social security, defence, …). Therefore, we shall conduct our analysis at a higher level of aggregation than single public programmes. At this level of aggregation, public programmes however may be either territorial, personal, or mixed. Therefore, before measuring territorial redistribution, we isolate the component of each public expenditure programme that is only related to personal criteria. This is done by estimating the effects of territorial criteria in allocating expenditure across regions, and then by neutralising these effects. This generates a new distribution of public expenditure programmes across regions, where the allocation of benefits is driven by personal factors only, as if territorial factors were neglected. On this basis, the interregional redistribution produced by public expenditure programmes when only personal factors are considered is then measured.

Our analysis focuses on the interregional redistributive properties of the expenditure side of the budget for each programme we take into consideration. We investigate how interregional redistribution changes when we move from the observed distribution of expenditure across territories to the one that is driven by personal factors only. Although we recognize that also public revenue redistribute resources across regions, the interregional redistributive impact of the revenue side is kept constant under the two scenarios. Therefore, in our analysis, revenue is "neutral": it remains unchanged whether calculating "observed" redistribution or "personal" redistribution. This allows us to isolate the redistributive impact of the expenditure side alone.

This line of research is interesting from several perspectives. First, it enables to show that public expenditure programmes produce differing levels of territorial redistribution depending on whether the actual interregional distribution of benefits, or the distribution reflecting personal criteria only, is taken into consideration. In other terms,

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[1] The COFOG provides an international standard to describe the objectives of general government action. Developed in 1999 by OCSE and published by the UN Statistical Division, it defines a three-level structure of government expenditure (divisions, groups, classes). Divisions classify general government expenditure according to their broad objectives. Divisions are then split into groups, in turn broken down into classes. Groups and classes are the activities by which the broad government objectives are pursued (OECD, 2021; European Commission, 2019; Istat, 2009).

there may be programmes that poorly redistribute across regions, but this outcome accounts for strong redistributive powers when the effects of personal criteria are considered in isolation, but which are offset by territorial factors. However, the opposite may also be the case: that is, territorial redistribution due to the allocation of benefits driven by personal criteria only is somehow supplemented by an effect in the same direction that can be ascribed to the impact of territorial factors. Secondly, even with pure personal programmes, which are designed to allocate benefits according to personal criteria only, some territorial differences may arise at the implementation stage, due to local political/administrative discretion. For these programmes, by considering the redistributive effect as if only personal criteria for benefits allocation were operating, the territorial 'noise' usually deriving from the implementation phase is neutralized and therefore the measure of their territorial redistributive power more accurately reflects the normative design of these programmes.

The paper is organised as follows. Section 2 examines previous studies relevant for our analysis, in particular those focusing on personal versus territorial public expenditure programmes, and on measuring territorial redistribution. Section 3 puts forward a methodological approach to isolate the contribution of personal allocation criteria to redistribution. This approach is set out in three steps. Section 4 applies this methodological approach to the analysis of public expenditure programmes in Italy. Section 5 offers some concluding remarks.

2. "Personal" vs. "territorial" public expenditure programmes and interregional redistribution

The role of the public budget in redistributing income across different areas of a country has been analysed in a number of studies (Italianer and Pisany-Ferry, 1992; Sala-i-Martin and Sachs, 1992; Von Hagen, 1992; Bayoumi and Masson, 1995; Obstfeld and Peri, 1998; Decressin, 2002; Mélitz and Zumer, 2002; Padovano, 2007; Arachi *et al.*, 2010), either for the public sector as a whole (Petraglia and Scalera, 2019), or by focusing on specific public programmes (Decressin, 2002) or levels of government (Arachi *et al.*, 2010;). The degree of territorial redistribution differs across different countries, for cultural, institutional, historical, and socio-economic reasons. According to Pauly (1973), citizens' interdependent utility functions may contribute to the explanation of these observed differences, and redistribution may be seen as a "local public good": individual preferences for redistribution are higher when beneficiaries are closer (i.e. preferences for "solidarity" are higher locally). This is consistent also with some evidence that redistribution is lower in highly decentralised countries (Beramendi, 2007).

With reference to measures of interregional redistribution, a number of scholars specifically focused on Italy (Giannola *et al.*, 2016; Petraglia *et al.*, 2018; Vittorino, 2019), partly due to the significant territorial inequalities that characterize this country (to

name some of the most recent contributions: Bank of Italy, 2018; Bordignon, 2017; Brandolini and Torrini, 2010; Cannari *et al.*, 2019; Ciani and Torrini, 2019; Daniele and Malanima, 2011; D'Onofrio and Giordani, 2019).

However, to the best of the authors' knowledge, no study has focused on the relative role played by personal and territorial drivers of public expenditure in determining the observed territorial redistributive outcome of public programmes, although the dichotomy between these two drivers is clearly acknowledged by public policy and public administration scholars.

From a policy-cycle perspective, the initial stage of public expenditure programmes includes the establishment of the criteria to be used to identify potential recipients and to allocate expenditure benefits to them. These criteria may primarily entail socio-demographic features (personal programmes), or topo-geographic ones (territorial programmes). This dichotomy may be simplified by considering persons or places as the fundamental drivers of public expenditure and may be thought of in terms of programmes pursuing different equity targets (Bordignon *et al.*, 2006).

However, while a distinction between personal and territorial programmes is often found in the economic and public policy literature, it is also true that mostly this distinction is made on the basis of a quite different criterion from the one adopted here. Generally, the distinction is based on the nature of the recipient of public expenditure, either individuals (persons, households, firms, …) or decentralised governments (municipalities, provinces, regions, or states in federal countries).

For instance, studies of federal systems often classify public spending programmes according to whether federal grants are allocated to decentralised governments (States, regions or local governments), or to individuals (e.g. Kinkaid, 2011, on the USA; Dafflon, 2015, on Switzerland; Dept. of Finance-Canada, 2021; Ahmad and Thomas, 1996; Clemens and Veldhuis, 2013). For instance, Kinkaid (2011) classifies US federal grants into two distinct groups. The first group is aid to places, and includes grants for infrastructure, highways, economic development, and criminal justice. The second group is seen as aid to persons, and includes grants for social welfare (Medicare, Temporary assistance for needy families, etc), food stamps, social security (for senior citizens), and so on. Similarly, in Canada Federal support to the nation's Provinces and Territories is organized into four main transfer programs: the Canada Health Transfer, the Canada Social Transfer, Equalization, and Territorial Formula Financing (Department of Finance, Canada, 2021; Clemens and Veldhuis, 2013). The first two are primarily directed to persons, the latter two to places. Finally, the 2007 reform of Swiss intergovernmental financial arrangements (updated in 2020) has identified three lines of funding for Switzerland's Cantons by the Confederation: revenue equalization, expenditure equalization and a cohesion fund. As regards the second channel of funding, expenditure equalization transfers from the Swiss Confederation to the Cantons are driven either by topo-geographic needs or by socio-demographic needs (Swiss Confederation, 2007; Dafflon, 2004; Dafflon, 2015). Such a dichotomy mirrors the

dualism of public expenditure programmes, which are driven either by personal criteria or by territorial criteria.

Conversely, in the EU, regional policy is financed through the European Structural Funds, which encompass the European Social Fund (ESF) and the European Regional Development Fund (ERDF). This arrangement clearly exemplifies the dichotomy between persons and places as targets of transfers. The ERDF supports programmes for regional development, economic restructuring, enhanced competitiveness, and territorial co-operation, that is, programmes aimed at specific places. The ESF, on the other hand, targets persons, by focusing on increasing the adaptability of workers and enterprises, on enhancing access to employment and participation in the labour market, and on reinforcing social inclusion. Moreover, EU regional policy also includes the Cohesion Fund, which again targets places by focusing on the environment and on trans-European transport networks (Evans, 1999).

The balance between programmes primarily targeting persons or places, as well as their overall dimensions, differ across countries and time. For instance, Kinkaid (2011, 14) provides evidence of a shift of US federal aid from "places to persons". After nearly thirty years of federal grants to places being financially higher than federal grants to persons, in the late 1980s this ratio was reversed, and the percentage of total US federal grants consisting of grants to persons has been increasing ever since. When the levels of economic development are highly polarised across the States (or regions) of a country, such a shift raises the question of whether public programmes remain capable of achieving some degree of redistribution across regions, and consequently, of reducing interregional economic disparities.

3. Methodology

This section proposes a methodology to isolate the relative contribution of personal allocation criteria to territorial redistribution by public expenditure programmes. This method involves three stages. First, a formal definition is given of personal and territorial expenditure programmes. This is then followed by a description of a way of reconstructing the territorial distribution of expenditure that would be observed if expenditure was driven by personal criteria alone (i.e. the simulated "personal" distribution of public expenditures). This second step initially requires an assessment of the role of territorial allocation criteria in producing the observed interregional distribution of expenditure, followed by the neutralization of territorial factors, so that an interregional distribution of expenditure that reflects personal features only is derived. Thirdly, a method to measure interregional redistribution by the public budget is devised. This method is then applied to measure redistribution by the observed programmes and by the simulated "personal" programmes. The results are compared

to derive conclusions on the interregional redistributive properties of personal programmes.

3.1. Public expenditure programmes

As mentioned, this paper is focused on the territorial redistributive power of public expenditure programmes when the allocation of benefits across recipients is driven by personal criteria only. For our purposes, we take the funding of public programmes (revenue side) as given.

On the expenditure side, each public programme may be conceived of as an assignment rule that distributes either monetary or in-kind benefits to beneficiaries (individuals, households, firms, public bodies such as regional or municipal administrations, and so forth). Formally, $n = 1,...,N$ are the potential beneficiaries of each one of the existing public expenditure programmes $j=1,...,J$.

Each recipient n of a public programme is characterized by a couple of attributes (r^n, g_j^n) defined as follows:

1) a territorial attribute, that is, the relevant region for the recipient, such as the region where an individual or household resides, or where a firm carries out its business. For the *n-th* beneficiary, the relevant region is denoted by $r^n \in R^*$, and the set of regions by $R^*=(1,...,R)$.

2) a public benefit attribute, given by the amount of public resources assigned to the recipient by each public expenditure programme, denoted by g_j^n.

In more detail, g_j^n is a function of a set A of variables (hereinafter, the "drivers"), which drive the allocation of public expenditure. Set *A* may include either personal features (age, state of health, employment status, family status, etc) or attributes of the territory relevant for the recipient (structure of the economy, GDP, morphology, climate, transport connections, infrastructures, etc). Therefore, set *A* of all drivers of the allocation of public expenditure may be divided into two subsets, *P* and *T*, where *P* includes all personal variables (personal drivers) and *T* includes all territorial variables (territorial drivers). The following proposition holds for the sets of drivers *A*, *P* and *T*:

Proposition 1. The set of all drivers of public expenditure *A* is separable into two subsets, *P* and *T*, comprising the personal and the territorial drivers of public expenditure, respectively, for which the following properties hold:

1) $P = (p_1, p_2, ..., p_k) \subset A$
2) $T = (t_1, t_2, ..., t_w) \subset A$
3) $P \cap T = \varnothing$
4) $A = P \cup T = (p_1, p_2,..., p_k, t_1, t_2,..., t_w)$

Therefore, the expenditure allocated to each recipient, g_j^n, may be defined as follows:

(1) $g_j^n = g_j^n(p_1, p_2, \ldots, p_k, t_1, t_2, \ldots, t_w)$, for each $n =1, \ldots, N$, for each $j = 1,\ldots,J$

It is worth noting that not all the drivers in set *A* are relevant to the distribution of expenditure under each programme. Conversely, for each programme *j*, only a subset A_j of drivers is relevant to the distribution of expenditure, where: $A_j = (P_j, T_j) \subseteq A$, and $P_j \subseteq P$, $T_j \subseteq T$.

In particular, programmes can be defined as follows:

a) *personal* programme: when $T_j = \varnothing$ and $P_j \neq \varnothing$;
b) *territorial* programme: when $P_j = \varnothing$ and $T_j \neq \varnothing$;
c) *mixed* programme if $P_j \neq \varnothing$ and $T_j \neq \varnothing$.

Now, when the case of mixed programmes is considered, variable $r^n \in R^*$ allows one to move from the distribution of public resources (stemming from each public expenditure programme) across recipients to the distribution across regions. As a matter of fact, given the recipients of each programme, defined by the pair (r^n, g_j^n), the total amount of resources allocated to region *r* by the *j*-th expenditure programme, is given by equation 2, for every region and every programme.

(2) $G_j^r = \sum_{n:r^n=r} g_j^n(p_1, p_2, \ldots, p_k, t_1, t_2, \ldots, t_w)$, for each *j=1 and J, r=1, …, R*

The total amount of resources allocated to region *r* by all public expenditure programmes is given by:

(3) $G^r = \sum_{j=1}^{J} G_j^r = \sum_{j=1}^{J} \sum_{n:r^n=r} g_j^n(p_1, p_2, \ldots, p_k, t_1, t_2, \ldots, t_w)$, for each *r=1,…,R*

Therefore, the following holds:

(4) $G^r = G^r(p_1, p_2, \ldots, p_k, t_1, t_2, \ldots, t_w)$

That is, the total amount of public expenditure benefitting a given region is a function of a set of both personal and territorial drivers.

3.2. The simulated "personal" distribution of public expenditures

For each mixed expenditure programme, the distribution that would result if the territorial drivers ($t_1, t_2, \ldots, t_w$) were totally neglected, can be derived from the distribution of public resources across recipients given by (1), that is:

(5) $\overline{g_j^n} = g_j^n(p_1, p_2, \ldots, p_k)$

under the constraint that:

(6) $\qquad \sum_n \overline{g_j^n} = \sum_n g_j^n$

Distribution (5) is a simulated personal public expenditure programme, in addition to those that are already 'personal' *ab origine* (case a) above).
Now, as before, the distribution of the personal programme across regions is given by:

(7) $\qquad \overline{G_j^r} = \sum_{n:r^n=r} \overline{g_j^n} = \sum_{n:r^n=r} g_j^n(p_1, p_2, \ldots, p_k)$, for each *j=1,…,J* and , *r=1, …, R*

and summing across different expenditure programmes:

(8) $\qquad \overline{G^r} = \sum_{j=1}^{J} \overline{G_j^r} = \sum_{j=1}^{J} \sum_{n:r^n=r} \overline{g_j^n}(p_1, p_2, \ldots, p_k)$

Therefore, by comparing the across-region distribution of public resources that is actually observed (equations (2) and (3), respectively, for the individual programme and for the total public budget) with the distribution when the territorial drivers ($t_1, t_2, \ldots, t_w$) are neutralised (equations (7) and (8)), we can derive a measure of the territorial redistribution generated by expenditures driven by personal allocation criteria only, which indeed is the key issue of this paper.

3.3. A summary measure of territorial redistribution

The measurement of territorial redistribution by the public budget is the object of several empirical works. Essentially, in all studies a summary measure of interregional redistribution can be derived by regressing a regional economic activity variable (per-capita output or income) inclusive of net transfers from the public sector, on the same regional variable prior to any such transfers (for a review of the methodologies adopted, see Arachi *et al.*, 2010).
Following the approach proposed by Bayoumi and Masson (1995), as later developed by Mélitz and Zumer (1998, 2002), applied to Italy by Decressin (2002), and then partially modified by Arachi *et al.* (2010), a summary measure of interregional redistribution can be derived by an OLS regression of regional per-capita GDP after net transfers from the public sector on regional per-capita GDP before net transfers.
A common measure of net transfers from the public sector is provided by fiscal residua defined as the difference between public expenditure G within a given territory, and public revenues E collected in that same territory. Fiscal residua may be computed for the total public budget, or for a single public programme. For a given programme *j*, in year *t* and region *r*, fiscal residua are defined as follows:

(9) $FR_{jt}^r = G_{jt}^r - E_{jt}^r$

Having defined fiscal residua, a summary measure of territorial redistribution by programme j may therefore be derived by running an OLS estimation of the following model:

(10) $\tilde{y}_{jt}^r = \alpha_j + \beta_j \tilde{x}_t^r + \eta_{jt}^r$

where:
- r, j and t respectively denote the region, the programme and the year;
- η is the error term;
- (11) $y_{jt}^r = \dfrac{Y_{jt}^r}{\sum_{k=1}^R Y_{jt}^k}$ and $x_t^r = \dfrac{X_t^r}{\sum_{k=1}^R X_t^k}$,

  X_t^r is per-capita GDP in region r and year t, while Y_{jt}^r, is given by X_t^r plus the corresponding fiscal residuum for programme j; all variables are divided by nationwide values to control for shocks that are common to all regions and may be absorbed via the national budget;
- tildes denote the regional trend component of y_{jt}^r and x_t^r over time, isolated by applying the Hodrick and Prescott (1997) filter.

The amount of redistribution is given by $1 - \beta$. For example, if $\beta = 0.9$, then a region with per-capita GDP 1 euro higher than the average, after net public transfers ends up with disposable resources 90 cents higher than the average, implying a redistribution of 10% of GDP.

This approach is applied to measure interregional redistribution by observed expenditure and by the simulated "personal distribution" of expenditure for five selected expenditure functions in Italy. First, we define two sets of fiscal residua (equation 9) for each of the five selected government spending functions and for all of them together. The first set makes use of observed expenditure, while the second uses the simulated "personal distribution" of expenditure. Then, we measure redistribution by each of the two sets of fiscal residua and we obtain a synthetic measure of redistribution $(1 - \beta)$ for the two distributions of expenditure - observed and "personal".

4. An application to public expenditure in Italy

The methodological approach presented in section 3 is here applied to the case of Italy during the period 1999-2010. Italy is a country characterised by significant economic differences across its 20 regions, as well as by considerable interregional differences in

its socio-demographic structure (table 2 below exemplifies these disparities, with reference to a selection of quantitative indicators). In Italy territorial equalisation is a significant policy issue, and therefore the interregional redistributive properties of "personal" programmes may significantly complement the explicit redistribution achieved by territorial equalization schemes. This is of even greater importance within the context of the ongoing fiscal decentralisation process. Therefore, the analysis focuses on Italian regions as the terminus of public policies: the region is taken as the basic unit benefitting from expenditures and contributing revenues. We limit our analysis to the 15 ordinary statute Italian regions (out of a total of 20), due to the specific revenue and expenditure powers of the 5 special-statute regions.

4.1. Data

Regional redistribution by public functions is the result of net transfers of resources among regions accomplished by public revenue and expenditure. Net transfers can be expressed in terms of regional fiscal residua. Ideally, the implementation of the methodological approach described above and the measurement of territorial redistribution by personal public expenditure programmes would require data on all benefits and revenues pertaining to each region for each public expenditure programme. Such detailed data could be provided by two different sources. First, they may be derived from surveys that, on the expenditure side, record microdata on the amount of public expenditure allocated to each final beneficiary (individuals, households, firms,…), for each public programme and whichever the public body that gives the benefit. Similarly, on the revenue side, these surveys should record revenues collected from each contributor for each programme. If such data were available for a sample of representative individuals on a regional basis, then they could be used to compute representative individual fiscal residua for each region. Secondly, a dataset recording regional revenues and expenditures for each public expenditure programme may be used to measure territorial redistribution by personal programmes. However, neither of the two kind of detailed database is available. Therefore, this paper makes use of a more aggregate dataset and a procedure to isolate "personal" public expenditures is devised.

In this paper, the empirical analysis uses Italian public budget figures for the years 1999-2010. These figures are taken from the *Conti Pubblici Territoriali* (Territorial Public Accounts, TPA) drawn up by the Italian Agency for Territorial Cohesion[2]. Based on the general government's budget, the TPA attribute public revenue and expenditure, on a cash basis, to Italy's 20 regions. Expenditure is recorded by region and disaggregated by economic classification and by function. Revenue is recorded by region and

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[2] Agenzia per la coesione territoriale, https://www.contipubbliciterritoriali.it/CPTDE/CPTDE_Home.html, last accessed April 2021.

disaggregated by economic classification. For each level of government (central, regional, local, social security institutions), revenue is allocated to the region that generated the fiscal flows, while expenditure is allocated to the region where the means of production of public services or investments are located ("expenditure principle").

The TPA are consistent with the purpose of this paper in that they provide data on the regional distribution of revenues and expenditure, however they record expenditure by functions of government and not for each single public programme. Therefore, the empirical analysis is conducted at this level of aggregation and focuses on public functions. In addition, for the purpose of measuring fiscal flows and of reconstructing the "personal distribution" of expenditure, four adjustments to the TPA database were made, primarily to obtain a regional distribution of expenditure that reflects the actual benefits accruing to each Italian region. Details of this operation are set out in Annex 1. Out of the thirty public functions recorded in the TPA dataset, for the purpose of this paper the five major areas of spending in financial terms were selected, namely: general services, social assistance and charity, education, health, social security, and income support. These expenditure functions account for about 83% of total public expenditure in Italy.[3]

The distribution of per-capita public expenditure for the five selected functions across Italian regions, based on the adjusted TPA, is shown in table 1. Table 1 shows that total per capita expenditure, as well as per capita expenditure for single functions, vary significantly across Italian regions. The overall coefficient of variation is 12%, but it varies from a minimum of 8% for health to a maximum of 22% for social security and income support.

In particular, Table 1 shows a generally higher level of per capita expenditure on education, and social assistance and charity, in Italy's southern regions, while the opposite holds for social security and income support, and health expenditure. Overall

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[3] The TPA classify public expenditure into 30 functions, which are defined on the basis of the COFOG (Volpe et al., 2007). Each TPA function includes one or more COFOG groups. A particular relationship concerns the COFOG groups within the division "social protection". These groups include, among others: administration and operation of social protection policies addressing conditions of insufficient economic means or deprivation (sickness and disability, old age and survivors, family and children, unemployment, housing, social exclusion); provision of in-kind services or transfers; expenditure for retirement homes. In the TPA these groups are divided between two different functions, on the basis of the means of financing. If financed through social contributions, activities are included in the function "social security and income support". Conversely, if financed through general taxation, they are included in "social assistance and charity". As regards the other three functions, the main items included in "general services" are the general operation of administrative bodies; the administration and operation of services provided by central offices (e.g., personnel services, budget office); the administration, operation or support of executive and legislative bodies. For this function, central government expenditure was netted out (see Annex 1). "Education" includes, among others, the administration, operation and management of pre-primary, primary, secondary, and tertiary education institutions (public schools and universities); expenditure for school and university buildings; scholarships, grants, loans, and allowances to students. Finally, "health" includes hospital in-patient services; outpatient services, delivered by medical, dental, and paramedical practitioners; medical products, appliances and equipment, obtained by individuals or households, for use outside a health facility or institution.

(last two columns) the average per capita expenditure on all five functions is higher in the northern regions than it is in the southern ones: the minimum level of such spending is to be found in Campania, and the maximum in Liguria. This result is strongly affected by the distribution of social security and income support per capita spending in these regions. It is highest in Liguria and lowest in Campania, respectively, the region with the highest percentage of elderly (as revealed by the variable "old" in Table 2) and the region with the highest percentage of young people in Italy (variable "young", Table 2). Finally, the high spending levels in Lazio are partly due to the concentration of public sector activities in the capital city (Rome) which is part of that region.

Table 1. Public expenditure per spending function (Italy, 1999-2010, per capita average values in euro, at constant prices base year 2011)

	General services	Social assistance and charity	Education	Health	Social security and income support	Total	All functions
Piemonte	460	466	876	1,671	5,849	9,323	11,193
Lombardia	387	478	845	1,749	5,327	8,785	10,220
Veneto	420	463	856	1,607	4,625	7,971	9,441
Liguria	647	619	821	1,630	6,767	10,484	12,840
Emilia Romagna	451	566	919	1,723	5,847	9,505	11,110
Toscana	477	565	1,019	1,670	5,628	9,360	11,124
Umbria	605	730	1,055	1,785	5,644	9,820	12,124
Marche	514	607	985	1,605	5,014	8,724	10,340
Lazio	384	724	1,046	1,600	6,306	10,060	12,603
Abruzzo	422	662	1,027	1,561	4,437	8,109	9,948
Molise	543	559	1,040	1,296	4,305	7,743	10,406
Campania	431	587	1,101	1,432	3,157	6,708	8,496
Puglia	314	526	980	1,496	3,690	7,006	8,446
Basilicata	499	556	1,131	1,578	3,714	7,478	10,070
Calabria	427	646	1,160	1,709	3,581	7,523	9,865
All regions (euro)	428	558	960	1,628	5,010	8,584	10,378
All regions (%)	4.1	5.4	9.2	15.7	48.3	83	100
Coefficient of variation	0.19	0.14	0.11	0.08	0.22	0.14	0.12

Source: authors' calculations based on TPA (Agency for territorial cohesion).

4.2. Implementation of the methodological approach

The adjusted TPA do not allow a straightforward identification of *personal* functions for two reasons: first, a public programme may be driven both by personal and territorial criteria; and secondly, and most importantly, due to the aggregate nature of the TPA, each function is given by the sum of many different programmes, which in principle could be both "personal" and "territorial".

Therefore, following the methodological approach described in section 3, interregional redistribution by public spending programmes is measured by proceeding in two

successive stages, the first aimed at overcoming the above-described limitation of available data:

1) during the first stage - the "variable construction phase" - the observed territorial distribution of expenditure (equations (2) and (3)) is contrasted with the distribution that would be observed if only socio-demographic criteria ("personal" drivers) were used to allocate expenditure across regions ((equations (7) and (8)).

2) during the second stage - the "redistribution estimation phase" - the econometric model portrayed by equation (10) is used to evaluate the territorial redistributive effects of public functions, in the two spending scenarios: the observed scenario and the simulated "personal" scenario, that is, the one where expenditure is only driven by "personal" criteria.

As regards the "variables reconstruction phase", it departs from public budget figures for expenditure aggregated by government functions and assigned to regions according to the territorial distribution of benefits. A two-stage empirical method to "neutralise" the territorial drivers of public expenditure and reallocate total expenditure across regions *as if* expenditure were only driven by personal characteristics is developed (simulated "personal" distribution of expenditure). Starting from observed expenditure, this process ends up with a distribution of expenditure across territories which only reflects the interregional distribution of the personal characteristics of regions' residents.

The first stage of the aforementioned method consists in assessing, for each function, the respective roles of territorial and personal drivers in determining total spending in each territory. This is done by devising an econometric model where for each function of government, the dependent variable is public expenditure in each territory, and the regressors are several territorial and socio-economic variables, including also territorial and time dummies, to take into account, respectively, time-invariant and territorial-invariant regional characteristics that could affect public expenditure.

During the second stage it is assumed that there are only differences in the socio-demographic structure, while the territorial structure is the same for the entire country. This process is referred to as the 'neutralisation' of the effect of territorial drivers on the distribution of expenditure across territories., and is achieved by setting territorial covariates equal to their overall mean, and territorial dummies equal to zero (i.e. there are no differences across territories). Following this process of 'neutralisation', this model is used to predict the 'personal distribution' of total expenditure, that is, the distribution of expenditure exclusively reflecting the interregional distribution of socio-demographic features.

Secondly, in the 'redistribution estimation phase', using the econometric model described in equation (10), the interregional redistributive effects of public functions is measured. Fiscal residua for each function are computed both using the observed distribution of public revenue and expenditure, and using the simulated personal distribution of expenditure, i.e. the distribution driven by socio-demographic criteria

only. The first set of fiscal residua is used to estimate actual interregional redistribution. The second set, on the other hand, provides a measure of the degree of redistribution that would be produced if spending were allocated on the basis of personal criteria only ('personal distribution').

The comparison of the degree of redistribution generated by the two different sets of fiscal residua allows an evaluation to be made of the relative role of territorial and personal features in driving the territorial distribution of expenditure, and consequently of the degree of territorial redistribution. Such a comparison enables us to isolate the interregional redistributive effect of personal drivers of public expenditure. For a better understanding of the phenomenon, redistribution by public expenditure only is also measured, and the degree of redistribution achieved by observed expenditure is compared with that by the 'personal distribution' of expenditure.

4.3. Estimating the "personal" distribution of public spending programmes

According to the definition given in section 3, public functions may be classified as "territorial", "personal" or "mixed" depending on the type of drivers that guide the allocation of expenditure across regions (respectively: only topo-geographical, only socio-demographic, or a mix of the two).

Therefore, for each one of the five functions, the observed distribution of expenditure is replicated by an econometric model that includes both "territorial" and "personal" explanatory variables, as described in equation 2:

(12) $G = \alpha + \sum_{i=1}^{9} \beta P_i + \sum_{j=1}^{4} \gamma T_j + \delta YD + \lambda TD + \varepsilon$

where, for each function:
− G is the matrix of expenditure for each region (15 rows) and year (12 columns)
− P_i are the matrices for each of the nine personal explanatory variables (age structure, state of health, unemployment levels,…) for each region (rows) and year (columns)
− T_j are the matrices of territorial explanatory variables (per capita GDP, sector composition of the economy) for each region (rows) and year (columns)
− YD is the matrix of time dummies (years: D1999 − … − D2010)
− TD is the matrix of territorial dummies (one for each region: Dpiemonte, Dlombardia,…, Dbasilicata, Dcalabria)

For each one of the five selected Italian public functions (general services, social assistance and charity, education, health, social security and income support) the model described by equation 12 is estimated using a set of personal and territorial explanatory

variables, summarised in Table 2. We estimate a LSDV regression model and adopt a stepwise regression approach to identify the significant time and territorial dummies. Territorial dummies, in particular, were used to take into account time-invariant regional characteristics that could affect public expenditure. Obviously, both personal and territorial explanatory variables are measured at the regional level, as this is the territorial level at which all other relevant data are recorded (GDP, revenue and expenditure), and this is the territorial level at which redistribution is measured. Therefore, the distinction between "territorial" and "personal" explanatory variables is not based on the level at which these variables are measured (the region, e.g. regional GDP; persons/individuals, e.g. age), rather it depends on whether the selected variable "pertains" to the territory or to the individuals that live in the region. This mirrors the very definition of personal and territorial drivers that was given in paragraph 2 above. Accordingly, "territorial" explanatory variables are measured at the regional level and include all variables describing features of the regional territory (such as morphological structure, climate, economic structure, per capita GDP – which reflects local endowments with productive factors,…). Similarly, "personal" explanatory variables are also measured at the regional level, but they can be conceived as the aggregation at the regional level of individual features of persons living in the region (age, state of health, employment status,…). So, for instance, the percentage of elderly (above 65) in a region is a "personal" explanatory variable, as it describes a feature of the population of the region, not of the regional territory itself. Furthermore, even if this variable is measured at the regional level, it indeed derives from aggregating up individual observations at the regional level (e.g. number of elderly people/total population).

Personal explanatory variables include the demographic structure (regional population, density, share under 16 years, share over 65 years) and indexes of population needs (relative poverty, unemployment, youth unemployment, share of population with at least one chronic disease, and with at least two chronic diseases). Territorial explanatory variables include per capita regional GDP, the sectorial structure of regional economy (share of regional value-added ascribing respectively to primary, secondary and tertiary sector), morphology, climate and other fixed regional effects are included in the model using regional dummy variables. Table 2 reports average values for all these variables, and also illustrates the marked structural and economic differences between Italian regions, to be found in a wide spectrum of regional features. This geographical dualism explains, among other factors, the particular concern for interregional redistribution in the Italian political and academic debate.

The results of the aforesaid estimation for each of the five spending functions are reported in Annex 2 (Table A2-A6). For each function, the estimation procedure has seen the iterated deletion of non-significant regressors (90% significance level), so that five different models have been identified, one for each function. These models' explanatory variables include both a subset of personal drivers, and a subset of territorial drivers,

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and some time and territorial dummies. Therefore, we can conclude that these functions are of a mixed nature, according to the definition provided in section 2.

Intuitively, the territorial explanatory variables used in our model (gdp per capita, sectoral composition of the economy, time-invariant regional characteristics such as morphology, climate, cultural attitudes, …) may affect public expenditures in the five analysed functions in many ways. To provide just a couple of examples, with regards to social assistance, observed expenditure for public nurseries and preschools is a function of female employment (related to local gdp), degree of urbanization and prevailing local cultural attitudes (family organization, propensity to entrust child-care to enlarged family members). Another example may be provided by social security expenditure: the pension benefits paid in a given area depend primarily on personal factors: the composition by age of the population, the pension entitlements and the life expectancy of elderly people, which in turn are correlated to the work activities carried out, but these latter (and therefore pension expenditure) are influenced by territorial variables, such as the level of economic development and the sectoral composition of the regional economy.

The reconstruction of the "personal" distribution of public expenditure programmes is based on the model described by equation (12). The coefficients estimated from equation (12), $\hat{\alpha}, \hat{\beta}, \hat{\gamma}, \hat{\delta}, \hat{\lambda}$, are used to predict the level of expenditure that would be accomplished if there were no "territorial" differences across territories, that is, if territorial factors were neutral to the regional distribution of expenditure. In order to do so, the two matrices containing territorial regressors (T and TD) are modified in order to "neutralise" territorial differences. This is done by assuming that all regions are equal as far as territorial factors are concerned, and that these factors in all regions assume the same value, equal to the average across all regions. Therefore, continuous "territorial" explanatory variables take the same value across regions year by year (and this value is given by their yearly mean across regions), so that each T_j matrix is transformed into $T_j{}^*$ (where each column contains just one repeated value). Furthermore, territorial dummies are set as equal to zero for all regions and years (TD becomes TD^*, a null matrix). Equation 13 describes the new model:

(13) $\widehat{\overline{G}} = \hat{\alpha} + \sum_{i=1}^{9} \hat{\beta} P_i + \sum_{j=1}^{4} \hat{\gamma} T_j^* + \hat{\delta} YD + \hat{\lambda} TD^* + \hat{\varepsilon}$

Table 3 reports per capita average general government spending by function for each Italian region, calculated using equation 13. Therefore, it shows the amount of expenditure there would be if only personal drivers existed, in other words, the simulated "personal" distribution of expenditure. For each function, Table 3 shows also the percentage difference between the simulated "personal" distribution of expenditure and the observed distribution.

As Table 3 shows, the "personal" distribution of expenditure for all five selected functions generally assigns higher per capita values to the northern regions than to the

southern ones. This is the result of the composition of the different behaviour displayed by the five selected functions, although it is mainly driven by the pattern of the "personal distribution" of education, health, and social security expenditure, which is generally higher in northern regions than in southern ones.

Table 3 also allows a comparison between the observed distribution and the "personal distribution" of expenditure. The two distributions display certain differences. Firstly, overall expenditure increases in northern regions under the simulated personal distribution compared to the observed one, while overall expenditure decreases in southern regions. Turning to the five functions, this pattern is also very clear in the case of education, and to a lesser extent also in the case social assistance and charity. Health expenditure is generally lower in southern regions under the "personal distribution" than it is under the observed distribution. The reverse is true of general services: expenditure increases in southern regions under the "personal distribution" compared to the observed distribution. This same pattern is also displayed to a certain extent by social security and income support.

Table 2. Explanatory variables for spending functions (Italy, average values 1999-2010)*

		Demographic structure								Territorial structure			
	POP	POPDENS	YOUNG	OLD	POVR	UN	YUN	ONED	TWOD	PRIM	SEC	TERT	GDPPC
Piemonte	4,307,247	170	13.2	21.9	6.2	6.0	17.1	37.2	19.5	1.9	30.4	67.6	25.425
Lombardia	9,331,528	391	14.4	19.0	4.3	4.1	13.3	37.4	18.1	1.4	33.8	64.8	31.102
Veneto	4,673,578	254	14.6	18.9	4.6	4.4	11.6	37.8	18.0	2.4	34.3	63.3	27.582
Liguria	1,593,463	294	11.6	26.2	6.7	6.7	18.8	40.7	21.8	1.8	19.0	79.2	24.053
Emilia R.	4,127,856	187	12.9	22.6	4.1	3.6	11.9	40.9	20.8	3.0	32.3	64.8	29.735
Toscana	3,585,888	156	12.8	22.9	5.4	5.1	15.2	39.6	20.4	2.2	27.2	70.6	25.672
Umbria	854,597	101	13.4	23.1	8.2	6.2	16.1	41.7	22.9	2.9	27.7	69.4	22.185
Marche	1,509,149	156	14.0	22.1	6.2	5.1	14.4	38.3	20.1	2.5	31.8	65.7	23.913
Lazio	5,313,289	308	14.9	18.7	8.2	8.8	28.2	37.6	20.1	1.3	15.5	83.2	27.659
Abruzzo	1,293,114	120	14.7	20.8	15.1	8.4	25.6	39.7	22.1	3.3	31.9	64.8	19.934
Molise	321,212	72	14.8	21.5	21.6	9.8	27.2	37.8	21.2	4.6	25.1	70.4	17.396
Campania	5,761,930	424	19.2	14.8	23.6	15.6	40.3	32.8	18.8	3.0	18.2	78.7	14.604
Puglia	4,052,103	209	17.3	16.8	21.6	14.0	34.2	34.2	18.8	4.9	23.8	71.3	15.372
Basilicata	595,425	60	16.1	19.2	26.2	12.6	38.6	38.9	22.5	6.0	27.1	66.9	15.767
Calabria	2,011,489	133	17.1	17.7	26.4	15.1	39.2	39.7	23.9	5.4	16.1	78.5	14.614
All regions**	*49,331,868*	*218*	*15.0*	*19.3*	*12.0*	*8.7*	*23.8*	*37.2*	*19.6*	*3.1*	*26.3*	*70.6*	*24.319*

* For a key to abbreviations and units of measurement used in this table, see annex 2 (table A1).
** Averages for all regions for POVR, UN, YUN, ONED, TWOD are reconstructed based on ISTAT data.
Source: Istat.

Table 3. General government expenditure by function (Italy, per capita average values 1999-2010, euro 2011)

	General services		Social assistance and charity		Education		Health		Social security and income support		Total	
	"Personal" distribution	*% observed distribution*	*"Personal" distribution*	*% observed distribution*	*"Personal" distribution*	*% observed distribution*	*"Personal" distribution*	*% observed distribution*	*"Personal" distribution*	*% observed distribution*	*"Personal" distribution*	*% observed distribution*
Piemonte	376	*82*	355	*76*	1219	*139*	1554	*93*	5785	*99*	9288	100
Lombardia	378	*98*	546	*114*	1202	*142*	1670	*95*	5322	*100*	9117	104
Veneto	431	*103*	567	*123*	947	*111*	1584	*99*	5192	*112*	8721	109
Liguria	571	*88*	1177	*190*	237	*29*	2282	*140*	6662	*98*	10930	104
Emilia Romagna	398	*88*	452	*80*	1118	*122*	1670	*97*	5919	*101*	9557	101
Toscana	395	*83*	404	*71*	1147	*112*	1616	*97*	5997	*107*	9558	102
Umbria	443	*73*	493	*67*	896	*85*	1635	*92*	6072	*108*	9539	97
Marche	458	*89*	601	*99*	792	*80*	1668	*104*	5782	*115*	9300	107
Lazio	450	*117*	691	*95*	840	*80*	1669	*104*	5065	*80*	8716	87
Abruzzo	439	*104*	472	*71*	901	*88*	1530	*98*	4681	*105*	8022	99
Molise	439	*81*	396	*71*	925	*89*	1494	*115*	4655	*108*	7910	102
Campania	518	*120*	880	*150*	469	*43*	1739	*121*	3317	*105*	6922	103
Puglia	426	*136*	357	*68*	1031	*105*	1373	*92*	3692	*100*	6879	98
Basilicata	420	*84*	279	*50*	1030	*91*	1316	*83*	3735	*101*	6781	91
Calabria	429	*100*	326	*51*	982	*85*	1342	*79*	3546	*99*	6625	88
All regions	*428*	*100*	*558*	*100*	*960*	*100*	*1628*	*100*	*5010*	*100*	*8584*	*100*

Source: authors' calculations based on TPA (Agency for territorial cohesion).

4.4. *Measuring the interregional redistributive effects*

Two sets of fiscal residua are generated (equation (9)) for each of the selected government spending functions and for all of them together. The first set makes use of observed expenditure, while the second uses the simulated personal distribution of expenditure. Table 4 displays the two sets of fiscal residua and reports the percentage differences between them for each selected function and for all of them together.

The distribution of observed fiscal residua across regions gives a preliminary picture of the main patterns characterising inter-regional fiscal flows in Italy for each function. First, there is a substantial degree of redistribution from the wealthier to the poorer regions (i.e. respectively, those with per capita GDP above the national average, and those with per capita GDP below the national average), the former generally being situated in the North of the country, the latter in the South. In fact, with very few exceptions, both observed and "personal distribution" fiscal residua are positive in the South and negative in the North. Moreover, the size of the residua is to some extent negatively correlated with regions' surface area: they are generally higher in the smaller regions (Liguria, Umbria, Marche, Molise, Basilicata). Moving from the observed to the simulated personal distribution, overall fiscal residua generally display limited change in southern regions (small increases or reductions). Changes are conversely significant in central Italian regions, while under the "personal distribution", in northern regions fiscal residua are generally less negative than observed ones. A function-by-function analysis of the differences between the two distributions reveals that for general services, health, and social assistance and charity, fiscal residua are generally more negative in the north than under the observed distribution. Conversely, fiscal residua for education in northern regions are less negative under the personal distribution than under the observed distribution.

Regional fiscal residua provide a qualitative insight into the distribution of net benefits from public functions across Italian regions. However, to reach a conclusion regarding the redistributive properties of the selected public functions, and the differences between redistribution by observed expenditures and redistribution by the "personal" distribution of expenditure, a summary measure of interregional redistribution is proposed. Per-capita regional GDP is taken as a measure of economic "activity" before net benefits from the public sector. Following the approach presented in section 3.2, a summary measure of interregional redistribution is given by the complement to 1 of the coefficient β estimated by OLS from equation (10).

Table 5 presents the results on redistribution under the two different distributions of expenditure - observed and "personal" - by displaying the summary measures of redistribution obtained under the two scenarios.

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Table 4. Fiscal residua for expenditure functions (Italy, per capita average values 1999-2010, euro 2011)

	General services			Social assistance and charity			Education			Health			Social security and income support			Total		
	Observed distr. [1]	"Personal" distr. [2]	(2-1)/1	Observed distr. [1]	"Personal" distr. [2]	(2-1)/1	Observed distr. [1]	"Personal" distr. [2]	(2-1)/1	Observed distr. [1]	"Personal" distr. [2]	(2-1)/1	Observed distr. [1]	"Personal" distr. [2]	(2-1)/1	Observed distr. [1]	"Personal" distr. [2]	(2-1)/1
	Euro	Euro	%	Euro	Euro	%	euro	euro	%	euro	euro	%	euro	euro	%	euro	euro	%
Piemonte	-30.2	-114.0	-277	-172.1	-283.1	-65	-222.6	120.1	154	-189.5	-307.3	-62	461.0	396.7	-14	-153.3	-187.7	-22
Lombardia	-202.3	-211.9	-5	-290.8	-222.4	24	-476.8	-119.4	75	-493.0	-572.5	-16	-1196.1	-1201.4	0	-2659.1	-2327.6	12
Veneto	-45.8	-34.8	24	-144.5	-40.3	72	-188.0	-97.1	48	-163.3	-186.5	-14	-877.2	-310.4	65	-1418.9	-669.0	53
Liguria	141.3	64.9	-54	-39.8	518.2	1401	-312.7	-896.3	-187	-292.6	360.2	223	1840.2	1734.8	-6	1336.4	1781.8	33
Emilia R.	-104.3	-157.3	-51	-157.3	-270.7	-72	-325.5	-126.9	61	-384.1	-437.8	-14	-255.6	-182.9	28	-1226.9	-1175.5	4
Toscana	-10.6	-92.7	-779	-68.7	-230.0	-235	-73.5	53.9	173	-179.6	-234.0	-30	458.7	827.2	80	126.2	324.4	157
Umbria	162.6	1.2	-99	155.3	-82.4	-153	65.0	-94.4	-245	107.9	-42.5	-139	1069.7	1497.2	40	1560.5	1279.2	-18
Marche	95.9	39.9	-58	64.3	58.4	-9	48.8	-144.0	-395	23.6	86.6	268	259.0	1026.2	296	491.5	1067.1	117
Lazio	-192.4	-126.2	34	-24.7	-57.5	-133	-244.5	-451.0	-84	-584.7	-515.2	12	200.6	-1040.1	-619	-845.7	-2190.0	-159
Abruzzo	62.9	80.2	28	193.7	3.5	-98	223.0	97.3	-56	195.6	163.9	-16	422.0	665.9	58	1097.2	1010.8	-8
Molise	222.2	118.7	-47	141.3	-21.3	-115	322.5	207.8	-36	77.4	274.6	255	860.7	1211.2	41	1624.0	1791.1	10
Campania	149.5	236.8	58	219.4	512.9	134	471.3	-161.5	-134	360.5	667.4	85	106.7	266.0	149	1307.4	1521.6	16
Puglia	33.3	145.3	336	159.6	-9.8	-106	350.5	401.5	15	425.8	302.9	-29	574.4	576.4	0	1543.6	1416.3	-8
Basilicata	213.2	134.9	-37	183.3	-93.6	-151	491.0	390.7	-20	490.9	228.8	-53	461.8	482.9	5	1840.2	1143.7	-38
Calabria	161.7	163.6	1	299.4	-20.2	-107	565.3	387.8	-31	697.4	330.1	-53	813.2	777.4	-4	2536.9	1638.8	-35
All regions	-32.4	-32.4	0.0	-42.1	-42.1	0.0	-72.7	-72.7	0.0	-123.1	-123.1	0.0	-34.8	-34.8	0.0	-305.1	-305.1	0.0

Source: authors' calculations based on TPA (Agency for territorial cohesion).

Table 5. Redistribution through fiscal residuals (Italy, 1999-2010, percentages)

		General services	Social assistance and charity	Education	Health	Social security and income support	Total selected functions
No.observations		180	180	180	180	180	180
1) Observed distribution	R^2	0.9987	0.9983	0.9968	0.9991	0.9776	-
	Redistribution	1.83	2.63	5.49	5.62	6.11	21.68
2) "Personal" distribution	R^2	0.9999	0.9988	0.9979	0.9992	0.9735	-
	Redistribution	2.11	1.59	2.95	5.17	7.14	18.96
3) % difference	Redistribution	15%	-40%	-46%	-8%	17%	-13%
4) Observed distribution-expenditure only	R^2	0.9992	0.9988	0.9982	0.9995	0.9854	-
	Redistribution	1.53	2.13	4.28	5.00	1.81	14.74
5) "Personal" distribution-expenditure only	R^2	0.9980	0.9933	0.9982	0.9986	0.9857	-
	Redistribution	1.79	1.20	2.12	4.58	3.05	12.75
6) % difference	Redistribution	17%	-44%	-50%	-8%	69%	-14%
7) "Personal distribution-expenditure only / "Personal" distribution-fiscal residua	Redistribution	85%	76%	72%	89%	43%	67%

Source: authors' calculations based on TPA (Agency for territorial cohesion).

The first section of Table 5 (rows 1-3) reports the degree of regional redistribution accomplished by observed fiscal residua and by fiscal residua obtained using the "personal" distribution of expenditure. The second section (rows 4-6) compares the degree of regional redistribution accomplished by observed expenditure and by expenditure according to the "personal" distribution approach. The last section (row 7)

compares redistribution by expenditure only and by fiscal residua under the "personal" distribution of expenditure.

The first section shows that for each of the selected functions of government, and for all of them considered together, both the observed fiscal residua and the fiscal residua obtained using the "personal" distribution of expenditure, have a redistributive impact; in other words, they generate a positive flow of resources from the richer (northern) regions to the poorer (southern) ones. This was anticipated by the data reported in Table 4, where positive residua in the South suggested that these territories are net beneficiaries of public programmes.

The second section shows that while expenditure always has a redistributive effect, when shifting from the observed data to the "personal" distribution of expenditure, total redistribution decreases for the five functions taken together, and for three of them individually (social assistance and charity, education, and health), whereas it increases for two of the functions considered individually (general services and social security and income support).

The third section shows that under the "personal" distribution of expenditure, redistribution by fiscal residua is always greater than that by expenditure alone. Therefore, revenue is seen to have a redistributive power too.

Turning to the results reported in the first section of Table 5, although both the observed fiscal residua, and the fiscal residua obtained using the "personal" distribution of expenditure, produce a redistributive impact, there are however differences between the degree of redistribution generated by the two sets of fiscal residua. To account for these differences, revenue is "neutral" (they are unaltered in both scenarios: revenue remains unchanged whether calculating "observed" fiscal residua or "personal" distribution fiscal residua). Therefore, the observed differences in the degree of redistribution resulting from both observed and "personal" distribution fiscal residua, are exclusively due to the changes in the distribution of expenditure across regions.

Furthermore, when the behaviour of each of the five functions is analysed separately, two different patterns emerge when changing from the observed scenario to the "personal" distribution scenario. For three of the functions in question, namely health, social assistance, and education, and for all functions considered together, results show that the "personal" distribution of expenditure generates a lower degree of interregional redistribution than observed expenditure does. Therefore, in a country characterised by a polarised distribution of socio-demographic features, these features alone generate a significant degree of redistribution, albeit not as great as is achieved when the territorial distribution of the programmes' spending is also driven by territorial features.

This pattern is more clearly illustrated by the data reported in section 2 of Table 5. Row 6 shows that redistribution by public expenditure only decreases when shifting from observed expenditure to expenditure according to the "personal" distribution. The three

functions in question are: social assistance, education and health. The results obtained for the remaining two functions of government - general services and social security – is nevertheless rather significant. For these two functions, the "personal" distribution of expenditure generates a greater degree of interregional redistribution than the observed one.

The analysis developed in this paper therefore shows that when moving from observed to "personal" distribution fiscal residua, two patterns emerge. In pattern 1, the latter are less redistributive than the former, and this is the case for health, social assistance, and education, as well as for all the functions taken together. The opposite holds for pattern 2, which characterizes general services and social security. Going back to Table 3, for "pattern 1 functions", in southern regions expenditure according to "personal" distribution is lower than observed expenditure. Conversely, in southern regions the "personal" distribution of expenditure is higher than the observed distribution for "pattern 2 functions".

This result would appear to suggest that for some functions (pattern 1), the omitted territorial drivers for the allocation of public expenditure have a significant redistributive role, as they increase the concentration of expenditure in the southern (poorer) regions. On the contrary, for pattern 2 functions the omitted territorial drivers play no significant redistributive role.

The causes underlying these different patterns may only be inferred. First, for two functions in the pattern 1 group, namely health and education, citizenships rights should play a significant role in the distribution of expenditure across regions. Therefore, if the omitted territorial factors generate higher levels of expenditure in southern regions, this may be due to greater inefficiency in southern regions, where guaranteeing the same citizenship rights as are guaranteed in the north becomes "more expensive". Furthermore, for some functions in the pattern 1 group, the higher observed redistribution (due to the inclusion of territorial drivers) may also be explained by assuming that these programmes embed certain implicit retributive mechanisms (for instance, income support for southern regions, such as the one produced by a higher concentration of assistant teachers in southern regions than in northern ones) which result in a greater concentration of expenditure in Italy's poorer regions.

If these intuitions are sound, then evidence seems to indicate that these mechanisms operate to a lesser degree in the case of the pattern 2 functions.

Overall, the above results suggest that policy makers should carefully consider the interregional redistributive potential of personal public expenditure programmes, such as for instance, education or health care. These programmes may redistribute across territories as well as across individuals. Therefore, personal programmes may become a strategic and additional tool for policy makers to address regional inequalities. Through this tool personal and territorial redistributive purposes may be jointly pursued, in a country characterised by a stark and enduring interregional economic divide, which

seems far from reducing (Mangiameli et al. 2020). At the same time, it is worth recognizing that interregional redistribution by personal programmes is a consequence of the distribution across regions of individual recipients and that territorial redistribution can be effectively pursued by implementing territorial programmes.

5. Final remarks

This paper aims to develop a better understanding of the interregional redistributive power of personal expenditure programmes, that is of public expenditure programmes that allocate benefits across recipients on the basis of socio-demographic factors only. This issue is tackled by estimating a distribution of public expenditure across regions as if the allocation of the regions' benefits were driven purely by personal factors, and as if territorial factors were neutralised.

This approach is then applied to the analysis of public expenditure in Italy over the period 1999-2010. Results show that overall interregional redistribution slightly declines when we shift from the observed distribution of public expenditure across regions to the distribution where the role of personal criteria is considered in isolation, and this result holds for most public spending programmes. However, even if resources were distributed according to personal criteria only, public programmes would still produce a significant level of territorial redistribution (regardless of personal redistribution) in a country like Italy with its stark interregional economic divide. Moreover, in some programmes the redistributive power of personal allocation criteria is reinforced by the influence of territorial factors expressing interregional redistributive potential. In some cases, however, the opposite holds, and territorial factors seem to stifle the redistributive impact of public programmes.

This paper is significant from three different points of view. Firstly, from a methodological point of view it proposes an approach to isolate the redistributive impact of personal drivers of public expenditure programmes. This is done by first estimating the relative role of personal and territorial factors in explaining the distribution of expenditure across territories, and then by neutralising the territorial component. Secondly, in terms of analysing the outcomes of public expenditure systems at national level, the results of this work highlight the roles of personal factors in accounting for the level of total territorial redistribution accomplished by public budget. Finally, from a public policy perspective, this paper suggests that whether explicitly pursued or not, territorial redistributive effects may be a significant (by-) product of any kind of public spending programme. Therefore, there is scope for carefully considering these effects when designing public spending programmes, especially with regard to those measures pursuing objectives other than a reduction in economic disparities across territories (education or health care measures, for example). In countries where

territorial equalisation is a serious policy issue, the contribution that public spending programmes make towards territorial redistribution should not be underestimated.

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Annex 1. Database construction

In order to measure fiscal flows and reconstruct the "personal distribution" of expenditure, four adjustments were introduced to the Conti Pubblici Territoriali (Territorial Public Accounts, TPA) database, produced by the Italian Agency for territorial cohesion.

First, interest spending and government deficit were netted out. The former is not consistent with the focus on territorial expenditure compared with personal expenditure, so total expenditure was taken net of interest. The latter is of an inter-temporal nature, which again is not in keeping with the aim of this paper, so it was netted out by imposing a balanced budget: overall expenditure was reduced and, proportionally, its regional distribution.

Secondly, as the focus is on the "territorial" distribution of expenditure compared with the "personal" distribution thereof, a specific approach is also devised in the case of central government spending on public goods. Indeed, central government's public goods benefit all citizens equally, regardless of where the money is spent, and therefore the territorial distribution of the benefits from national public goods only reflects the population of each region, not the "socio-demographic" features of territories, and certainly not their "territorial structure". Therefore, central government spending on pure public goods is of a unique nature, and the previously described criteria for comparing the territorial versus the personal distribution of benefits cannot be applied. For this reason, this expenditure was netted out from the database. This procedure was applied to central government expenditure for the following functions: general services, health and social protection. As an exemplification, general services expenditure by the central government includes the operation of Ministries which are located in Rome, but whose activities benefit equally all citizens regardless of their residence. Therefore, this expenditure was netted out. Conversely, decentralised governments' spending on local public goods was included because, net of externalities, this spending (equally) benefits all citizens within that specific area, and the amount spent may reflect either the area's "territorial" or "personal" structure. Therefore, regional and local government expenditure for general services, such as those for the operation of the executive bodies, are retained, on the contrary to general services expenditure by central government. As for central government's mixed public goods, a specific procedure was followed as described below.

The third adjustment to the regional allocation of expenditure was introduced in order to determine the territorial allocation of benefits from public expenditure (according to the "benefit principle") on the basis of the available data, distributed according to the "expenditure principle". This is relevant for central government expenditure, while for decentralised government expenditure the allocation calculated on the basis of the benefit principle generally coincides with the allocation determined using the expenditure principle (net of externalities). In theory, in the case of central government

spending consistency between the two principles depends on the nature of the publicly provided goods. For pure national public goods, public intervention benefits all citizens equally, so the regionalisation of financial flows determined using the expenditure principle does not coincide with that determined on the basis of the benefit principle, however, spending on pure national public goods had already been expunged from the dataset (see above). For publicly provided private goods, on the other hand, it may be presumed that the expenditure principle largely matches the benefit principle. Accordingly, in the case of publicly provided pure private goods, the regionalisation of the TPA was retained. Finally, in the case of central government mixed goods with both public and private characteristics, the rule-of-thumb was to expunge 50% of expenditure (the public good "quota", for the reasons described above) and keep the reminder 50% (the "private good" quota) without altering its regional distribution (as in the case of pure private goods).

Finally, the TPA also needed adjusting with regard to regional governments' health services spending (which accounts for nearly 80% of the total regional budget). These flows, regionalised according to the expenditure principle, were attributed entirely to the region responsible for the expenditure (that is, the region in which the services are provided), regardless of where the patients actually reside. This distinction proves to be significant in Italy, where there is considerable inter-regional mobility of National Health Service patients (especially from southern to northern regions). To measure the real benefits of health care to residents in each region, the raw figures for regional spending were adjusted for net expenditure for inter-regional patient mobility, which was determined, for each region, as the expenditure on services to non-residents less the spending by other regions for services to the region's own residents. The result of these adjustments is a distribution of general government expenditure by function across regions which should reflect the regional distribution of benefits. This is the first step towards measuring fiscal residua and interregional redistribution.

Annex 2. Modelling expenditure functions

The observed distribution of expenditure by each of the selected Italian public functions (general services, social assistance and charity, education, health, social security and income support) may be replicated by the econometric model described in equation 12 above, which includes both "territorial" and "personal" explanatory variables, that is:

$$G = \alpha + \sum_{i=1}^{9} \beta P_i + \sum_{j=1}^{4} \gamma T_j + \delta YD + \lambda TD + \varepsilon$$
(12)

The estimation results are reported in the following tables, from A2 to A6. Table A1 lists all explanatory variables, providing details of measurement units and abbreviations used.

Table A1. Explanatory variables: keys to measurement units and abbreviations

Personal variables		
Variable	*Abbreviation*	*Measurement unit*
Population	POP	units
Square population	POPQ	thousand billions
Population density	POPDENS	inhabitants/sq.km
Population under 16 years	YOUNG	share of total population
Population 65 years and over	OLD	share of total population
Relative poverty	POVR	share of families
Unemployment	UN	share of labour force
Youth unemployment	YUN	share of unemployed youth (15-24 years) over youth labour force
Population with at least one chronic disease	ONED	share over similar population
Population with at least two chronic diseases	TWOD	share over similar population

Territorial variables		
Variable	*Abbreviation*	*Measurement unit*
Primary sector	PRIM	share of total added value
Secondary sector	SEC	share of total added value
Tertiary sector	TERT	share of total added value
Per capita GDP	GDPPC	thousand euro

Source: Istat

Table A2 - General services expenditure: estimation results

Number of obs = 180
F(18, 161) = 40.92
Prob > F = 0.0000
R-squared = 0.7260
Root MSE = .0561

Dependent variable: per capita general services expenditure

	Coefficient	Robust std. error	t	P>|t|	[95% Conf.	interval]
pop	-0,0000000353	0.00000001	-5.020	0.000	0.000	0.000
popdens	0,001	0.000	4.210	0.000	0.000	0.001
pilpc	0,014	0.003	4.030	0.000	0.007	0.021
sec	1,935	1.052	1.840	0.068	-0.141	4.012
terz	1,937	1.103	1.760	0.081	-0.241	4.115
Dlombardia	-0,165	0.055	-3.010	0.003	-0.273	-0.057
Dveneto	-0,118	0.034	-3.490	0.001	-0.185	-0.051
Demiliarom	-0,073	0.033	-2.200	0.029	-0.139	-0.008
Dumbria	0,139	0.025	5.670	0.000	0.091	0.187
Dlazio	-0,197	0.035	-5.670	0.000	-0.266	-0.129
Dmolise	0,179	0.027	6.730	0.000	0.126	0.231
Dbasilicata	0,209	0.022	9.460	0.000	0.166	0.253
Dcalabria	0,134	0.032	4.200	0.000	0.071	0.198
D2000	-0,026	0.014	-1.880	0.062	-0.054	0.001
D2004	0,040	0.013	2.940	0.004	0.013	0.066
D2005	0,024	0.011	2.220	0.028	0.003	0.045
D2006	0,023	0.013	1.800	0.073	-0.002	0.048
trend	-0,012	0.002	-6.690	0.000	-0.016	-0.009
_cons	-1,676	0.958	-1.750	0.082	-3.568	0.217

Source: authors' calculations based on TPA (Agency for territorial cohesion) and on Istat data.

Table A3 - Social assistance and charity expenditure: estimation results

Number of obs = 180
F(26, 153) = 182.49
Prob > F = 0.0000
R-squared = 0.9332
Root MSE = .02728

Dependent variable: per capita social assistance and charity expenditure

	Coefficient	Robust std. error	t	P>|t|	[95% Conf.	interval]
pop	-0,0000000857	0,0000000126	-6,790	0,000	-0,0000001	-0,0000001
popdens	0,003	0,000	7,530	0,000	0,002	0,003
giov	-2,635	0,608	-4,330	0,000	-3,837	-1,434
dis	-0,007	0,004	-1,780	0,077	-0,014	0,001
disgiov	0,002	0,001	2,110	0,036	0,000	0,004
pilpc	0,008	0,003	2,630	0,009	0,002	0,014
Dpiemonte	0,177	0,030	5,980	0,000	0,118	0,235
Dliguria	-0,267	0,059	-4,510	0,000	-0,383	-0,150
Demiliarom	0,169	0,016	10,710	0,000	0,138	0,200
Dtoscana	0,238	0,026	9,040	0,000	0,186	0,290
Dumbria	0,367	0,025	14,870	0,000	0,318	0,416
Dmarche	0,149	0,016	9,210	0,000	0,117	0,181
Dlazio	0,167	0,018	9,250	0,000	0,131	0,202
Dabruzzo	0,332	0,034	9,780	0,000	0,265	0,400
Dmolise	0,306	0,043	7,160	0,000	0,221	0,390
Dpuglia	0,319	0,048	6,600	0,000	0,224	0,415
Dbasilicata	0,404	0,055	7,320	0,000	0,295	0,513
Dcalabria	0,467	0,053	8,770	0,000	0,362	0,573
D2001	-0,079	0,009	-8,900	0,000	-0,096	-0,061
D2002	-0,023	0,006	-3,720	0,000	-0,036	-0,011
D2003	-0,023	0,006	-3,870	0,000	-0,035	-0,011
D2004	-0,042	0,006	-6,880	0,000	-0,054	-0,030
D2005	-0,048	0,007	-7,170	0,000	-0,061	-0,035
D2006	-0,028	0,007	-4,090	0,000	-0,041	-0,014
D2008	-0,028	0,008	-3,580	0,000	-0,043	-0,012
D2009	0,050	0,010	4,920	0,000	0,030	0,070
_cons	0,354	0,103	3,450	0,001	0,151	0,556

Source: authors' calculations based on TPA (Agency for territorial cohesion) and on Istat data.

Table A4 - Education expenditure: estimation results

Dependent variable: per capita education expenditure

	Coefficient	Robust std. error	t	P>|t|	[95% Conf.	interval]
pop	0,00000071	0,00000012	5,770	0,000	0,00000046	0,00000095
popdens	-0,016	0,003	-6,170	0,000	-0,022	-0,011
giov	1,708	0,515	3,320	0,001	0,691	2,725
pilpc	-0,034	0,010	-3,580	0,000	-0,053	-0,015
sec	1,069	0,316	3,390	0,001	0,446	1,693
Dpiemonte	-4,000	0,671	-5,960	0,000	-5,326	-2,673
Dlombardia	-3,808	0,709	-5,370	0,000	-5,209	-2,407
Dveneto	-2,891	0,495	-5,840	0,000	-3,868	-1,914
Demiliarom	-3,425	0,594	-5,760	0,000	-4,600	-2,251
Dtoscana	-3,528	0,614	-5,740	0,000	-4,742	-2,314
Dumbria	-2,603	0,456	-5,710	0,000	-3,504	-1,702
Dmarche	-2,236	0,382	-5,850	0,000	-2,991	-1,481
Dlazio	-2,056	0,401	-5,130	0,000	-2,848	-1,264
Dabruzzo	-2,775	0,475	-5,840	0,000	-3,714	-1,836
Dmolise	-2,873	0,496	-5,790	0,000	-3,853	-1,893
Dcampania	-0,983	0,231	-4,260	0,000	-1,439	-0,527
Dpuglia	-3,424	0,577	-5,940	0,000	-4,564	-2,284
Dbasilicata	-3,286	0,575	-5,720	0,000	-4,422	-2,151
Dcalabria	-2,990	0,534	-5,600	0,000	-4,044	-1,935
D2000	0,032	0,010	3,140	0,002	0,012	0,051
D2001	0,162	0,020	8,120	0,000	0,123	0,202
D2002	0,060	0,012	5,170	0,000	0,037	0,083
D2003	0,149	0,011	13,090	0,000	0,126	0,171
D2004	0,097	0,009	10,370	0,000	0,079	0,116
D2005	0,057	0,009	6,100	0,000	0,039	0,076
D2006	0,089	0,008	11,600	0,000	0,074	0,105
D2008	0,044	0,007	6,220	0,000	0,030	0,057
D2009	0,072	0,007	10,690	0,000	0,059	0,085
trend	0,017	0,005	3,640	0,000	0,008	0,026
_cons	4,742	0,672	7,060	0,000	3,415	6,070

Source: authors' calculations based on TPA (Agency for territorial cohesion) and on Istat data.

Table A5 - Health expenditure: estimation results

Number of obs = 180
F(16, 163) = 25.17
Prob > F = 0.0000
R-squared = 0.6504
Root MSE = .12088

Dependent variable: per capita health expenditure

	Coefficient	Robust std. error	t	P>|t|	[95% Conf.	interval]
pop	-0,0000000524	0,0000000213	-2,460	0,015	-0,0000000946	-0,0000000103
popdens	0,002	0,001	4,390	0,000	0,001	0,004
vec	5,388	1,182	4,560	0,000	3,053	7,723
pilpc	0,019	0,005	4,030	0,000	0,010	0,028
terz	-0,458	0,251	-1,830	0,069	-0,953	0,037
Dpiemonte	0,153	0,042	3,620	0,000	0,069	0,237
Dliguria	-0,492	0,126	-3,900	0,000	-0,741	-0,243
Dtoscana	0,101	0,036	2,840	0,005	0,031	0,171
Dumbria	0,262	0,047	5,550	0,000	0,169	0,355
Dabruzzo	0,157	0,061	2,570	0,011	0,036	0,277
Dpuglia	0,355	0,070	5,090	0,000	0,217	0,492
Dbasilicata	0,462	0,068	6,780	0,000	0,328	0,597
Dcalabria	0,643	0,094	6,840	0,000	0,457	0,828
D2001	0,073	0,042	1,720	0,087	-0,011	0,156
D2009	0,067	0,032	2,050	0,042	0,002	0,131
trend	0,007	0,004	1,770	0,079	-0,001	0,015
_cons	-0,114	0,297	-0,380	0,702	-0,700	0,473

Source: authors' calculations based on TPA (Agency for territorial cohesion) and on Istat data.

Table A6 - Social security and income support expenditure: estimation results

<div align="right">

Number of obs = 180
F(19, 160) = 507.13
Prob > F = 0.0000
R-squared = 0.9773
Root MSE = .17238

</div>

Dependent variable: per capita social security and income support expenditure

	Coefficient	Robust std. error	t	P>|t|	[95% Conf.	interval]
vec	19,262	1,172	16,440	0,000	16,947	21,576
povr	-0,047	0,005	-9,690	0,000	-0,056	-0,037
pilpc	-0,037	0,009	-4,020	0,000	-0,055	-0,019
prim	-9,729	2,497	-3,900	0,000	-14,661	-4,798
Dpiemonte	0,597	0,053	11,180	0,000	0,492	0,702
Dlombardia	0,716	0,052	13,850	0,000	0,614	0,818
Dliguria	0,652	0,111	5,870	0,000	0,432	0,871
Demiliarom	0,628	0,063	10,000	0,000	0,504	0,752
Dtoscana	0,188	0,053	3,510	0,001	0,082	0,293
Dmarche	-0,296	0,058	-5,100	0,000	-0,411	-0,182
Dlazio	1,806	0,080	22,640	0,000	1,649	1,964
Dmolise	-0,202	0,075	-2,700	0,008	-0,349	-0,054
Dcampania	-0,214	0,088	-2,420	0,016	-0,388	-0,040
D2001	-0,193	0,049	-3,970	0,000	-0,289	-0,097
D2004	-0,179	0,043	-4,180	0,000	-0,264	-0,095
D2005	-0,309	0,043	-7,240	0,000	-0,393	-0,224
D2006	-0,378	0,051	-7,470	0,000	-0,478	-0,278
D2007	-0,357	0,038	-9,320	0,000	-0,433	-0,281
D2008	-0,278	0,054	-5,170	0,000	-0,384	-0,172
_cons	2,598	0,344	7,540	0,000	1,918	3,278

Source: authors' calculations based on TPA (Agency for territorial cohesion) and on Istat data.