

Fiscal Federalism, the NHS and Regional Redistribution and Risk-Sharing in Italy

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Abstract

The redistributive and risk sharing properties of the public budget are well acknowledged and have been analysed in a number of works. Less attention has been paid to the effects of specific public programmes. In this paper we focus on the National Health Service (NHS) in Italy, accounting for approximately 14% of total public expenditure. The NHS is also central to the current process of administrative and fiscal decentralisation in Italy. The aims of this paper are threefold. First, using regionalised public budget data for the years 1999-2006, we provide estimates of the redistribution and risk sharing across regional jurisdictions produced by the NHS in Italy. We find that the NHS redistributes about 7% of GDP across Italian regions, and therefore significantly reduces differences in regional per-capita GDP. This effect is largely driven by NHS expenditures, redistributing 5.3% of GDP. As regards the smoothing of asymmetric income shocks, the NHS is pro-cyclical by 6.3% of GDP, while benefits are only slightly counter-cyclical. Secondly, we compare the redistributive and shock-smoothing performance of public intervention in the health-care sector with that of total public budget over the same time span, finding that redistribution by the NHS amounts to approximately 16% of redistribution by the total public budget and that the NHS is more pro-cyclical than the total public budget. Finally, we discuss the implications of our results and the perspectives for inter-regional equalisation in the public health-care sector with reference to the current Italian debate on fiscal federalism reform.

Keywords: Health, Redistribution, Intergovernmental Relations, Regions
JEL classification: E62, H23, H50, H70, R10

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1. Introduction

The redistributive and risk sharing properties of the public budget are well acknowledged and have been analysed in a number of works (Italianer and Pisany-Ferry, 1992; Sala-i-Martin and Sachs, 1992; Von Hagen, 1992; Bayoumi and Masson, 1995; Obstfeld and Peri, 1998; Decressin, 2002; Méritz and Zumer, 2002; Padovano, 2007; Arachi et al., 2009). As noted elsewhere with reference to regional income redistribution only (Ferrario and Zanardi, 2009), these effects may result from policies and programmes purposely designed for that aim or from policies and programmes pursuing interpersonal redistribution. The latter may produce regional redistributive outcomes as a consequence of the heterogeneous distribution across regions of the personal features relevant for accessing a programme's net benefits.

The redistributive and risk sharing properties of public programmes are not a minor issue in the context of processes of revenue and expenditure decentralisation from central to regional or local governments. The latter are topical in Italy, where the institutional setting since the early 1990s has undergone radical reforms towards a more decentralized setting of intergovernmental fiscal relations, which are not yet completed. In particular the National Health Service (NHS), financially one of the major public programmes in Italy, accounting for approximately 14% of total public expenditure, is now a regional competency, both for revenues and expenditures. In principle this programme addresses individuals rather than territories. Its redistributive and risk sharing effects are only an (unintended) by-product. Although a regional competency, the central government still plays a significant role in the structure, operation and financing of the NHS. The central government influences expenditure levels, as it is responsible for the definition of minimum service standards for the whole country. It is also involved in the financing of NHS programmes, to overcome the relevant differences of fiscal capacities across Italian regions and to ensure that sufficient resources for basic service standards are available all over the country. This in turn may affect the redistributive and risk sharing properties of the programme.

In the following we focus on the Italian NHS, providing estimates of its redistributive and risk-sharing effects across regional jurisdictions. In doing so we also compare the redistributive and shock-smoothing performance of public intervention in health care and of total public budget. We focus on the years 1999-2006, as 1999 marks a radical change in the financing of the NHS.

The paper is organised as follows, after an introduction to the Italian institutional setting and fiscal federalism reforms and to the National Health Service (NHS) in Italy, together with a discussion of the perspectives of inter-regional equalization in the public health care sector in the light of the current debate on fiscal federalism reform, section 3 to 5 address the main methodological issues for the estimation of regional redistribution and risk sharing by the NHS: the specification of the econometric model and the construction of the data set. Section 6 presents the results on redistribution and risk sharing, also with reference to total redistribution and risk sharing by the public budget in Italy. Section 7 investigates the progressivity of NHS programmes. Section 8 concludes.

2. The National Health Service (NHS) in Italy

TO BE COMPLETED

Table 1: regional indicators

3. Data issues

Essentially all studies estimate regional redistribution and risk sharing by regressing a regional “activity” variable (output or income) after net transfers from the public sector on the same regional variable before net transfers across regions (Italianer and Pisany-Ferry, 1992; Sala-i-Martin and Sachs, 1992; Von Hagen, 1992; Bayoumi and Masson, 1995; Decressin, 2002; Mélitz and Zumer, 2002; Arachi et al., 2009). Those variables are broken up into a trend component (redistribution) and a short-term component (risk sharing). Estimates of regional redistribution and risk sharing may be computed with reference to the action of the general government or of single levels of government (central government, regional governments, local governments). Net transfers may be measured through *fiscal residua*, that is the difference between total expenditure by a given level of government in a given region (net of transfers to other levels of government), and total revenues by that level in the same region (net of transfers from other levels). Revenues and expenditures should be allocated to regional territories according to the benefit principle, that is to the territory whose residents pay the contributions and receive the benefits (which may differ from the jurisdiction of the government actually collecting revenues or paying expenditures).

Differently from most previous works (but similarly to Ferrario and Zanardi, 2009), in this work we focus on a single area of public sector action, that is health care services. We therefore need either regionalised data on each level of government’s total revenues and total expenditure (net of, respectively, inward and outward transfers) for health care programmes only or total revenues and total expenditure by *all* levels of government (i.e. general government) on each region for health care programmes (obviously revenue and expenditure by the general government may be obtained by adding up data on individual levels of government and netting out intergovernmental transfers). Unfortunately neither of the above data are available. Instead, the General Report on the country economy (*Relazione generale sulla situazione economica del paese*), published each year by the Italian Ministry of Economy, details revenue and expenditure by regional governments for health care programmes. Given that the NHS is a regional function, we may assume that on the whole national territory these items correspond to general government revenues and expenditures for health care programmes (thus we implicitly assume that other levels of government do not spend for health programmes and that outward transfers from regional governments are directed to local governments in their jurisdiction only). However we cannot take each regional government separately and assume that its revenue and expenditure reflect the revenue collected from residents of its jurisdiction and expenditure paid to residents of its jurisdiction. Rather it is true the opposite: each regional government budget reflects revenues accruing to that body or expenditure paid by that body, but not the regional distribution of revenues and expenditure according to the benefit principle. In fact, part of a given regional government revenue may be collected from residents of other jurisdictions and part of its expenditure may be paid to residents of other jurisdictions. This is particularly so in Italy, due to the relevant role still played by the central government in the financing of the Italian NHS: regional revenues include *vertical transfers* from the central government, financed by central government tax revenues. In order to derive each region revenues and expenditure according to the benefit principle we need to take into account the different components of a regional government budget, that is revenues and expenditures directly effected by that body on its territory and revenues financed by central government vertical transfers. Then we apply an adjustment procedure for the latter in order to distribute them across regional territories according to the jurisdiction where revenues were collected rather than to the jurisdiction to which revenues are transferred by the central government. This procedure implicitly corresponds to the isolation of central government vertical transfers in regional government budgets, to the reconstruction of the regional distribution across regions of the general government revenues that finance these transfers and then to the consolidation of the central and regional government revenues for health care services. In doing so we implicitly net out central government *vertical transfers* from regional governments budgets and transform them in *horizontal transfers* among

regions. Therefore we implicitly transform the actual *vertical equalisation scheme* into an implicit *horizontal equalisation scheme*. The adjustment procedure is described in detail below (section 5).

4. Specification of the econometric model

In order to estimate regional redistribution and risk sharing by the NHS we adopt GDP as a measure of regional “activity” before net transfers from the public sector. We then construct GDP plus fiscal residua, respectively for health care and for overall public programs, as a measure of regional “activity” after net transfers by the public sector.

Following the approach proposed by Bayoumi and Masson (1995), as later developed by Mélitz and Zumer (1998, 2002), applied by Decressin (2002) and partially modified by Arachi *et al.* (2009) a synthetic measure of regional redistribution is given by an OLS estimate of the following equation:

$$\tilde{y}_{it} = \alpha_2 + \beta \tilde{x}_{it} + \eta_{it} \quad (1)$$

where:

- the index i ($=1, \dots, 15$) refers to the region;
- η is the error term;
- tildes denote the trend component over time ($t=1996-2005$), isolated by applying the Hodrick and Prescott (1997) filter;

- for each year the variables are defined as follows: $y_{it} = \frac{Y_{it}}{\sum_{j=1}^{15} Y_{jt}}$ and $x_{it} = \frac{X_{it}}{\sum_{j=1}^{15} X_{jt}}$ (2)

and X_{it} is per capita GDP in region i and year t , while Y_{it} , is given by X_{it} plus the fiscal residuum; that is, all variables have been divided by nationwide values to control for shocks that are common to all regions and may be absorbed via the national budget.

The amount of redistribution is given by $1 - \beta$. If $\beta = 0.9$, then a region with per capita GDP 1 euro higher than the average ends up with disposable resources 90 cents higher than the average, implying a redistribution of 10 per cent of GDP.

As for the evaluation of risk sharing, we again resort to a widely used specification, proposed by Bayoumi and Masson (1995) and later developed by Mélitz and Zumer (1998, 2002), according to the adjustments proposed and applied by Arachi *et al.* (2009). We measure risk sharing by estimating the following equation:

$$y_{it} - \tilde{y}_{it} = \gamma(x_{it} - \tilde{x}_{it}) + \nu_{it} \quad (3)$$

where the amount of risk sharing is given by $1-\gamma$, the variables are defined as in equation (2), trend components are denoted by tildes and ν is the error term.

5. The dataset

In order to estimate the redistributive and risk sharing effects of public intervention in the health care sector (NHS) and in all sectors (General government), data on regional revenues and expenditures by the public sector respectively for health care and for total programmes are needed. We therefore constructed two datasets for Italy, both covering the years 1999-2006. The starting year was set at 1999, as in that year a radical change in the financing of the NHS was implemented and 1999 marks a significant discontinuity in the structure of health care revenues. We also focused on the 15 ordinary statute regions (OSRs) excluding from our analysis the 5 special statute regions of Italy (SSRs), due to their peculiar financing structure and spending autonomy.

With regards to the NHS, as mentioned above, the dataset was based on data reported in the General Report on the country economy. For the general government budget, the source were the Territorial Public Accounts – TPA (*Conti pubblici territoriali*) by the Ministry of Economy, which provide the allocation of revenues and expenditure flows collected/paid by each different level of government

(central government, regional government, local government, social security institutions) across the 20 Italian regional territories.

After a thorough analysis of available data, we concluded that both data from General Report and from the Territorial Public Accounts needed to be adjusted (as partially described above, section 3) in order to:

1. turn in the territorial allocation of public revenues and expenditures from a cash-flow approach (the jurisdiction to which revenues are assigned and where disbursements are paid) to a benefit approach (the jurisdiction where the individuals who receive the benefits of governments services and make contributions to their financing live)
2. remove the equalising component of National Health Service financing mechanism
3. offset excess revenues (surpluses) or excess expenditures (deficits)

In detail, NHS expenditures are recorded by the General report for each regional government and each year on a cash basis. As benefits are mostly delivered by regional governments (through the local health authorities) to individuals living in their jurisdiction, the distribution of expenditures across regional governments generally corresponds to the distribution across jurisdiction of disbursements and benefits. Consequently, they generally conform to the benefit principle, except for the case of patients accessing health care services in a region different from the one they live in. This is not a negligible issue 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 healthcare to residents in each jurisdiction, the raw data on regional expenditures were adjusted for net expenditures for inter-regional patient mobility as reported in the General report. These are measured, for each region, as expenditures for services to non-residents less expenditures by other regions for services to the region's own residents. In addition, data were also adjusted to include adjustments agreed with regions.

As for NHS revenues, they are reported for each region and each year on a cash basis, and are also disaggregated by sources of financing. The sources of financing may be classified into three main groups: *regional taxes*, amounting to 42% of total regional revenues in 1999-2006, and including the regional tax on productive activities (IRAP) and the regional surtax on personal income tax; *central government transfers*, including the National equalizing fund (mainly financed by a tax sharing of VAT, and amounting to 49% of total revenues in 1999-2006) and the National Health Fund (financed by Central government taxes, 4% of total revenues in 1999-2006); *copayments for services*, amounting to 4% of total revenues in 1999-2006. As described above (section 3), in order to turn in the territorial allocation of NHS expenditures from a cash-flow approach (the jurisdiction to which revenues are assigned) to a benefit approach (the jurisdiction where revenues are collected) data on NHS revenues were adjusted according to different procedures for each of the three groups. For regional taxes, no adjustments were made, as we assumed that each regional governments collects revenues in its jurisdiction. Conversely, as discussed above, the reported distribution of central government transfers reflects the benefitting jurisdictions, but not the jurisdictions that actually bear the burden of taxation. Therefore central government transfers needed to be adjusted to remove the equalising component of the National Health Service financing mechanism. The National equalizing fund was re-regionalised according to the regional distribution of VAT receipts, and the National Health Fund was re-regionalized according to the regional distribution of Central government taxes. Copayments for services needed no adjustment.

As for general government budget data, taken from the TPA, these were as well adjusted to turn in the territorial allocation of public revenues and expenditures from a cash-flow approach to a benefit approach

In the TPA, expenditure flows are regionalized according to what may be called the *expenditure principle*: they are imputed to the territory where the means of production for the relevant public services and investments are located. However, this allocation of expenditures may differ

significantly from the territorial location of the benefits from the expenditure (*benefit principle*). For this reason, the original data set was been adjusted by two different procedures. First, for central government expenditures, 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 regionalization of financial flows according to the expenditure principle does not coincide with that according to the benefit principle. For publicly provided private goods, however, it can be presumed that the expenditure principle largely matches the benefit principle. Accordingly, central government expenditures were revised as follows:

- in the case of pure national public goods, total expenditures were regionalized according to the population distribution (population criterion);
- in the case of publicly provided pure private goods, the regionalization of the Territorial Public Accounts was retained (expenditure principle);
- in the case of publicly provided mixed goods, featuring both public and private characteristics, the rule of thumb was to apply the population criterion and the expenditure principle in equal proportions.

The Territorial Public Accounts were also corrected with reference to regional governments' health services expenditure (which accounts for nearly 80% of total regional budgets). In the TPA, these flows are regionalized according to the expenditure principle and are attributed entirely to the regional jurisdiction responsible for the expenditure (where the services are provided), regardless of where the patients actually reside. As explained above, this distinction proves to be significant in Italy, due to the considerable inter-regional mobility of National Health Service patients. Therefore, to measure the real benefits of healthcare to residents in each jurisdiction, the raw data on regional expenditures were adjusted for net expenditures for inter-regional patient mobility.

Once data on revenue and expenditure for the NHS and for overall public action are derived, these may be used to construct regional fiscal residua and then estimate regional redistribution and risk sharing. When constructing fiscal residua, a relevant issue, partially overlooked by most of the literature, but clearly acknowledged by Ruggeri (2008), is the recognition that they have two components. The first is the balanced budget component, that is the part of fiscal residua that, for the overall country, registers the same amounts of revenue and expenditure. The second component is overall excess revenues or expenditures (surplus/deficit). While the first component measures the net transfers of resources by a given level of government/by a given public programme among regions in a given year, the latter may be interpreted and treated according to two alternative perspectives. Under the first perspective, proposed by Ruggeri (2008, p. 20) and based on a notion of interregional redistribution as the measure of fiscal resources that are transferred from some regions to others, through the intermediation of government, "for a correct measure of interregional redistribution one needs the amount of allocated (...) revenues to be equal to the amount of allocated expenditures". Therefore surpluses or deficits need to be netted out or neutralized. We prefer an alternative approach, which departs from the basic definition of interregional redistribution as the effect produced by the net fiscal system on the distribution of regional levels of economic activity in a country, and recognizes that both the balanced budget component of fiscal residua and the deficit/surplus component share the same nature: they are fiscal measures with the potential to impact on the distribution of regional economic activity levels. The essential difference among the two components does not rest in their redistributive/risk-sharing power, but in their intertemporal nature. Both components impact on the regional distribution of economic activity in the year when they are registered, but in an intertemporal perspective one can expect the deficit/surplus component to be netted out, as deficits/surpluses cannot be maintained indefinitely. We therefore separated the balanced budget component of fiscal residua from the deficit/surplus component and separately estimated their redistributive and risk-sharing effects.

With reference to NHS revenues and expenditures, as shown in figure 1, after these adjustments, benefits from health care expenditures in per-capita terms are distributed almost homogeneously across regions, although slightly lower in southern regions and greater in little regions. Figure 2 depicts contributions for health care financing, which are strongly correlated to regional GDP: they are higher in Northern regions and lower in Southern ones. As a consequence, we expect a strong equalizing effect, which is also announced by the structure of regional fiscal residua (table 2).

Figure 1. NHS benefits and contributions (average per-capita values 1999-2006, Euro 2006)

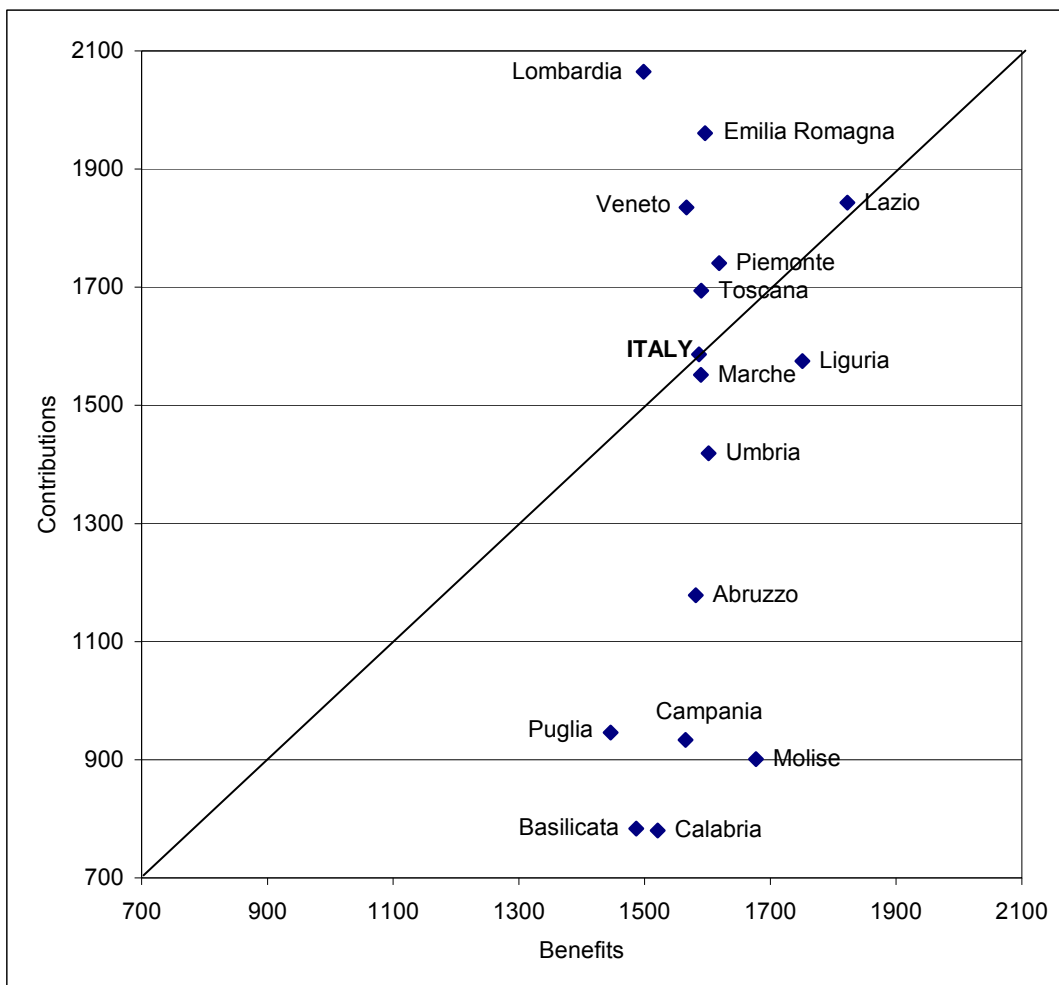


Figure 2. Expenditures and revenues of NHS

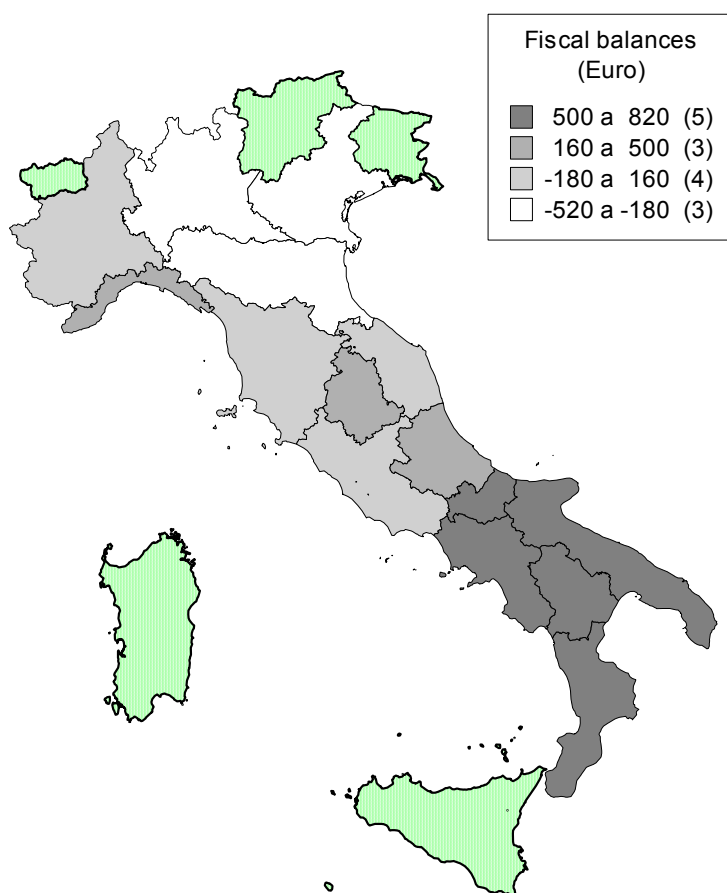


Table 2. NHS and General Government total budget (per-capita average values 1999-2006, euro 2006)

Regions	GDP	National Health Service					Fiscal residua	General government total budget
		Benefits	Contributions			Total		Fiscal residua
			Regional gov taxes	Central gov taxes	Fees			
Piemonte	27,279	1,618	660	985	96	1,741	-123	-212
Lombardia	32,314	1,498	899	1,094	73	2,065	-566	-3,425
Veneto	28,921	1,567	733	997	106	1,835	-269	-1,382
Liguria	25,539	1,751	531	979	65	1,575	176	1,894
Emilia-Romagna	30,818	1,596	766	1,086	109	1,961	-365	-1,806
Toscana	27,050	1,590	622	978	94	1,694	-104	71
Umbria	23,632	1,602	479	857	83	1,419	183	2,549
Marche	24,716	1,590	581	890	80	1,551	38	732
Lazio	29,448	1,823	749	1,027	68	1,843	-21	-1,206
Abruzzo	20,745	1,582	395	723	61	1,178	403	1,914
Molise	18,027	1,677	200	652	49	901	776	3,558
Campania	16,073	1,565	277	609	48	933	632	3,124
Puglia	16,376	1,446	274	623	49	946	500	2,975
Basilicata	17,225	1,487	177	569	38	784	703	4,020
Calabria	15,818	1,521	148	596	36	780	741	4,579
Italy (OSR)	25,631	1,586	601	906	79	1,586	0	0

6. Estimates of redistribution and risk sharing by the NHS and total public budget in Italy, 1999-2006

The estimated values of regional redistribution and risk sharing by the NHS and total public budget when only the balanced budget component is taken into account are reported in table 3. Column two reports the results for redistribution, column three for risk sharing. We also separated the total effect of fiscal residua from the effect of benefits only (the effects of expenditure only may be derived as a difference between the two), by considering first, as an endogenous variable, per capita GDP plus expenditure and then per capita GDP plus expenditure less revenue (i.e. per capita GDP plus the fiscal residuum).

6.1. Redistribution by the NHS and by total public budget

As shown in table 3, fiscal balances of the NHS significantly reduce differences in per-capita GDP across regional jurisdictions (by 7% of GDP): a region with 1 euro higher (lower)-than-average per-capita GDP ends up, after public intervention in health care, about 93 cents higher (lower)-than-average. The bulk of the redistribution in health care can be ascribed to benefits from public expenditures (5.2% of GDP on a total of almost 7% of GDP). This results could be foreseen from an analysis of figure 1: expenditure levels are almost equal across Italian regions, which conversely differ significantly in terms of per capita GDP - suggesting redistributive flows from higher to lower income regions.

Conversely, fiscal contributions play only a minor redistributive role. We may therefore conclude that the mix of taxes used to finance health care are only limitedly progressive with reference to GDP.

Compared to the NHS only, the General government total budget has much larger inter-regional redistributive effects (39.8% of GDP). Again this effect is mainly driven by the regional distribution of benefits and less by contributions. Total contributions, however, redistribute relatively more than NHS contributions: general government total contributions produce almost 40% of total redistribution, while NHS contributions produce only 20% of redistribution by the NHS.

The last two lines of table 3 also report the degree of redistribution and risk sharing under the hypothesis that the NHS is totally financed by Central Government transfers and therefore the distribution of revenues is that of Central Government tax revenues. Under this hypothesis, total redistribution is lower (6.5% of GDP) than that estimated for the actual financing structure of the NHS (6.9% of GDP).

This result confirms that the decentralisation of functions has an impact on the redistribution produced by the public budget, when the decentralisation process modifies the spending and revenue responsibilities of decentralised governments. In principle, if the decentralisation of functions is accompanied by a total devolution of decision powers over spending, when expenditure produce no externalities, and by the attribution to decentralised governments of local taxes whose incidence is limited to the decentralised government jurisdiction, we may expect redistribution to drop to zero. This is not the case for the Italian NHS: despite the devolution of powers to regional governments, the central government retains a significant influence on regions' spending decision, as it mandates basic service levels. Similarly, on the revenue side, it engages in equalising transfers to guarantee all regions sufficient resources to provide at least the mandatory basic service levels. These arrangements partly replicate the spending and revenue structure of a centrally administered NHS and therefore we would expect the decentralised system to reproduce at least partially the redistributive features of a centralised system. In Italy, however, this redistribution is enhanced, rather than contained, by the decentralisation process. This is due to the specific tax source devolved to regional governments, i.e. the regional tax on productive activities (IRAP), which does not conform to the theoretical prescriptions for a "perfect" local tax: actually, its base is highly

unequally distributed across regions and therefore implies a need for a higher level of redistribution by central government equalising transfers.

Table 3 NHS and General government total budget: degree of redistribution and risk sharing through fiscal balances (% GDP, 1999–2006)

	<i>Redistribution (% GDP)</i>		<i>Risk-sharing (% GDP)</i>	
	$1 - \beta_2$		$1 - \gamma_3$	
Number of observations	120		120	
	National Health Service	General government total budget	National Health Service	General government total budget
Benefits	5.2% (0.0015131)	22.5% (0.0092267)	0.3% (0.0312333)	29.1% (0.0626384)
Fiscal balances	6.9% (0.0021095)	38.1% (0.0117604)	-6.5% (-0.00000000035)	15.5% (0.1805484)
Fiscal balances (NHS totally financed by CG transfers)	6.5% (0.0019149)		-6.0% (0.0339569)	

6.2. Risk sharing by the NHS and by total public budget

As regards risk sharing, the NHS shows a pro-cyclical effect and slightly emphasizes the variability of annual GDP of regions by about 6%. This pro-cyclical effect is mainly driven by the contributions to NHS and is only partially offset by the income-smoothing pattern of benefits from health care expenditures, which is only limitedly counter cyclical (+0.3% of GDP).

Conversely, the General government total budget is significantly counter cyclical (15.1% of GDP), and this effect is mainly driven by the income-smoothing properties of public expenditures (29.1% of GDP), which are contrasted but not neutralised by the pro-cyclical effect of revenues.

Two considerations may be drawn from these results. First, for both the NHS and total public budget expenditures are counter-cyclical and revenues are pro-cyclical. Second, the pro-cyclical effect of total revenues confirms the results presented in other works (Arachi et al. 2009, Decressin, 2002) and, as regards NHS revenues, may be due to their composition. NHS revenues are mainly composed by regional taxes (IRAP and the regional surtax on personal income tax) and a tax sharing of VAT. The latter is not directly correlated with income. As regards the former, the use of budget data on a cash basis and the specific payment methods applied in Italy may weaken the correlation between revenues from IRAP and income. In fact, each year firms make payments on account of their tax liability for that year, but payments are based on the previous year tax returns and any balance due between their actual tax liability and account payments is paid the following year. Therefore, account payments are based on the previous year's income, so tax revenue is lagged by one year with respect to income. This may partially explain why revenue does not decrease after a negative shock to regional income or increase after a positive one.

Finally, it is interesting to note that, differently from other works, in our estimates the counter-cyclical effect of total benefits is not completely offset by the pro-cyclical effect of revenues. This may be due to the inclusion of interest payments in our data (while these were excluded in other works) and to the use of balanced budget data, which has implied a reduction of revenues across all years.

7. On the progressivity of the NHS

As observed, NHS has a smaller redistributive impact with respect to all public sector programmes (7% versus 38% of GDP). However this does not necessarily imply that health programmes have a

low redistributive power. It may rather result from the limited financial dimension of the NHS compared to all public programmes (14 per cent of total public expenditure). In order to investigate the interregional redistributive properties of the NHS, it is useful to resort to a different measure of redistribution, by adapting the Reynolds-Smolensky index for redistribution originally developed for taxes only. Equation 4 reports the Reynolds-Smolensky type index of redistribution for contributions and for benefits. In the former case it is defined as twice the area between the concentration curve for regional GDP less contributions and the Lorenz curve for regional GDP before public intervention, in the latter as twice the area between the concentration curve for regional GDP plus benefits and the Lorenz curve for regional GDP before public intervention:

$$RS_T = 2 \int_0^1 [L_{GDP-T}(x) - L_{GDP}(x)] dx \quad (4)$$

$$RS_G = 2 \int_0^1 [L_{GDP+G}(x) - L_{GDP}(x)] dx \quad (5)$$

Table 4 reports the values of the Reynolds-Smolensky index calculated both for the NHS and for all public programmes distinctively for benefits and for contributions. A comparison with Table 3 shows that the Reynolds-Smolensky index is consistent with the conclusions drawn from the analysis of the regression results. Interregional redistribution by NHS benefits measured through the Reynolds-Smolensky index accounts for about 20% per cent of total redistribution, consistently with the results from the estimation of equation 1.

A useful decomposition of the Reynolds-Smolensky index, proved by Kakwani (1977) for taxes and readily extendible to the benefits (see Lambert 2001), shows that the redistributive effect of policies results from the combination of a measure of their incidence (i.e. departure from a balanced budget) and their departure from proportionality. In particular, the following identities holds, respectively for contributions and for benefits:

$$RS_T = \frac{\bar{t}}{1 - \bar{t}} \cdot KAK_T \quad (6)$$

$$RS_G = \frac{\bar{g}}{1 + \bar{g}} \cdot KAK_G \quad (7)$$

where the Reynolds-Smolensky index is equal to the product of a measure of policies incidence (that is: average tax rate/(1- average tax rate) or average benefits rate/(1+ average benefits rate)) and an index of policies deviation from proportionality (KAK). The specification of this latter index is based on that introduced by Kakwani (1977) for taxes and is extendible to benefits as follows:

$$KAK_T = 2 \int_0^1 [L_{GDP}(x) - L_T(x)] dx \quad (8)$$

$$KAK_G = 2 \int_0^1 [L_G(x) - L_{GDP}(x)] dx \quad (9)$$

The Kakwani index measures policies progressivity as twice the area between the Lorenz curve for regional GDP before public intervention and the concentration curve for taxes and/or twice the area between the concentration curve for benefits and the Lorenz curve for regional GDP before public intervention. For taxes only, a positive (negative) Kakwani index implies progressivity (regressivity). The reverse holds in the case of benefits.

The results reported in table 4 confirm the regression results: both the benefits and the contributions component of the NHS have a redistributive impact on regional GDP, with the former playing a greater role than the latter. However the redistributive effects of NHS are more limited than that one of the General government total budget for both benefits and contributions.

The decomposition of the Reynolds-Smolensky index described in equations 5 and 6 allows a more thorough investigation of the interregional redistributive properties of NHS benefits and contributions. The different effects on redistribution can be ascribed to the different levels of public intervention in NHS compared to General government (in terms of benefits 6.4% vs 53.6% of GDP). On the contrary both contributions / benefits are more progressive / regressive in the case of the NHS compared to the General government total budget (0.125 vs 0.101 in the case of benefits;

0.037 versus 0.016 in the case of contributions). Finally, both in the case of the NHS and the total budget benefits are more regressive than contributions are progressive.

Table 4: Redistribution, incidence and progressivity of benefits and contributions (NHS and public budget)

		National Health Service	General government total budget
	Reynolds-Smolensky index RS	0.0077	0.0343
Benefits	Average tax rate g	0.0659	0.5176
	Kakwani index KAK	0.1250	0.1007
	Reynolds-Smolensky index RS	0.0024	0.0161
Contributions	Average tax rate g	0.0614	0.5049
	Kakwani index KAK	0.0372	0.0158

8. Conclusions

TO BE COMPLETED

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