WILL WE TREAT FUTURE GENERATIONS FAIRLY? ITALIAN FISCAL POLICY THROUGH THE PRISM OF GENERATIONAL ACCOUNTING

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We compute the value of the net taxes that current policies impose to present and future generations of Italians. We use such figures to show that current fiscal policies are neither financially sustainable nor fair to future generations. This is due to the generous treatment awarded to past and currently-living cohorts. We discuss some policy options which could potentially restore sustainability while at the same time improving intergenerational justice. Our analysis is also meant to contribute to an assessment of Italian fiscal policy in the last decade. When confronting our findings with those of previous studies, it appears that in the last ten years neither sustainability nor fairness have improved.

1 Introduction

Italians are often reminded that Italy's public debt, which exceeds gross domestic product, is the world's third largest. However, in a broad sense, debt-holders are not the only creditors of the Italian Treasury. Current and prospective pensioners, students, users of the Public Health service, all expect something from the Government in one form or another.

The costs of the entitlements granted by the Italian pension-centred welfare state are set to rise significantly, mainly due to the pronounced ageing of the population. Tax-payers will be then asked to finance increasingly expensive welfare programs and to service a huge public debt. Assessing how heavy is this burden, and which generation is most likely to bear it, appears important both from a positive and from a normative point of view.

To assess long-run fiscal sustainability several forward-looking methodologies have been developed, some of which are also endorsed by national and supra-national institutions (see, e.g., European Commission, 2006; Congressional Budget Office, 2007).[1] They go well beyond the standard debt-deficit accounting, as they take into account both implicit and explicit liabilities, and cover a long time period. However, as they are computed independently of whom is paying a tax or receiving a benefit, they cannot capture the conflict of interests between different generations and do not allow for an assessment of intergenerational equity.

Generational accounting (GA)[2] is a forward-looking method of long-term fiscal analysis which takes into account all government's liabilities, be they explicitly labelled as such or implicit

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The views expressed in the paper are those of the authors and do not necessarily reflect those of the Banca of Italia.

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[1] While the concept of fiscal sustainability is intuitive (quite simply: can current policies go on forever?), it has proved to be quite difficult to define theoretically (Spaventa, 1987) and to measure in practice (Balassone and Franco, 2000). The definition of sustainability that we adopt is spelled out below.

[2] The methodology of generational accounting was developed by Auerbach, Gokhale and Kotlikoff (1991) and Kotlikoff (1992).

in current budgetary policies.[3] On top of this, compared to other methodologies developed to assess long-run fiscal sustainability, GA is unique as it is also focuses on the intergenerational distribution of resources.

Suppose for example that current policies can be shown to be sustainable: are they also generationally fair? If, on the contrary, they are *not* sustainable (implying that they will have to be changed at some point in time) what generations should bear the burden of the unavoidable adjustments? While one cannot hope to settle these thorny issues once and for all, generational accounting provides indicators of intergenerational fairness which are useful to make our value-judgements more precise and economically grounded, improving the quality of public discussion.[4]

The use of GA in Italy dates back to the early nineties. In particular, the paper by Franco *et al.* (1994) is actually the first exercise based on such methodology outside the US. Almost ten years later, Cardarelli and Sartor (2000) produced a new fully-fledged GA assessment of the Italian intergenerational balance based on 1998 data.[5] We believe this tradition provides a unique value added: by comparing the three different waves of GA, we can use the Italian generational accounts to evaluate the reform process which characterised Italy over the last fifteen years[6] from a new perspective.[7]

We also aim to improve on previous studies from a methodological point of view. While their data-sources are partly coincident with ours, albeit of course of a different vintage,[8] they could not use two important sources that are instead available to us. First, the functional classification of General government expenditures provided by ISTAT according to the COFOG methodology, which enabled us to better allocate budgetary items to different welfare programs. Second, the aggregate projections of age-related expenditures provided by Ragioneria Generale dello Stato (RGS), the State General Accounting Department of the Ministry of the Economy.[9]

The rest of the paper is organized as follows: in Section 2 we sketch the basics of the GA methodology; Section 3 describes the data we used and how we constructed relative age profiles to

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[3] The assessment of public finances cannot rely only on deficit and debt figures, which are subject to changes due to accounting conventions with no real economic substance. A recent measure of the Italian government provides a good example. With the Finance Bill for 2007 the government disposed the transfer to the social security administration (INPS) of part of the severance pay provisions not allocated to pension funds by employees of firms with more than 50 workers. In respect of these receipts the public finances will bear the burden of the redemption (at retirement) of the severance pay provisions, currently re-valued at an annual rate near 3 per cent. As a result, the deficit of 2007 was lower by about 6 billion euros. Alternatively, the government could have forced workers to lend 6 billions at 3 per cent rate of return, setting the reimbursement date at the day of retirement. While the economic substance of the transaction would not change in the two cases, in the second one the operation would have been recorded as debt with no impact on the 2007 deficit. The issue of "label-free" fiscal indicators has been recently addressed in a general setting by Green and Kotlikoff (2008).

[4] The goal of this paper – and of GA in general – is to assess the amount of intergenerational redistribution which takes place trough the government budget. Computing the amount of redistribution which takes place though private tranfers, both monetary and in-kind, is well beyond the scope of this paper. Such transfers could either reinforce or partially offset the generational redistribution of resources attributable to public policies.

[5] Franco *et al.* (1994) used 1990 data. Between Franco *et al.* (1994) and Cardarelli and Sartor (2000), two other GA exercises have been performed (Sartor, 1999 and Franco and Sartor, 1999), both based on 1995 budget data.

[6] Major changes have been introduced in Italy since 1990. Among the most relevant there are the interventions to introduce a federalist structure of the State and several pension reforms (1992, 1995, 1997 and 2007).

[7] We discuss below the main differences between our study and the previous ones. While we are aware of the fact that these differences do not allow for full comparability, we believe that the changes in generational imbalances as measured in the three studies still provides interesting insights.

[8] Cardarelli e Sartor (2000) use 1998 aggregate budgetary data, while we use the latest available (2007). They use the 1995 wave of the Bank of Italy Survey on Household Income and Wealth (SHIW), while we use the 2006 vintage.

[9] Both shortcomings are also present in two further GA studies for Italy, performed taking the 1995 national accounts as a basis: Sartor (1999) and Franco and Sartor (1999). The use of official projections for the purposes of generational accounting is becoming common practice. See, among others, Cardarelli *et al.* (2000), Agulnik *et al.* (2000), and Gokhale and Smetters (2003 and 2005).

allocate taxes and transfers to each cohort; in Section 4 we build the generational accounts for Italy and present the main results; Section 5 compares our results to those of previous studies and makes a GA-based assessment of Italian fiscal policy in recent years; in Section 6 we use the accounts to evaluate several reform scenarios; Section 7 concludes.

2 Basics of generational accounting[10]

The cornerstone of the GA approach is provided by the intertemporal budget constraint of the government (IBC):

$$PV[\text{Govt expenditures}] + \text{Net Govt debt} = PV[\text{Govt revenues}] \quad (1)$$

which simply says that, as for any other agent in the economy, government's actions are constrained by the requirement that the sum of net debt and of the present value of current and future expenditures equals the present value of revenues. The IBC can in turn be equivalently rewritten as:

$$PV(G) + \text{Net Govt debt} = PV[taxes - transfers]_{current\ generations} + PV[taxes - transfers]_{future\ generations} \quad (2)$$

where $PV[taxes - transfers]_{generation\ t}$ represents the present value of net taxes – viz. the generational account – of the generation born in t and $PV(G)$ collects those government expenditures not included in the accounts. Indeed, with the exception of government outlays on health care and education, which are treated as transfer payments, in general we do not impute to any particular generation the value of the government's purchases of goods and services because in most cases it is not clear how to attribute the benefits of such purchases (defence and infrastructure are obvious examples). Alternatively, as it is done in some studies, one could allocate in the generational accounts also these items, distributing them equally on a per capita basis. Typically, while the nominal value of the accounts obviously changes, the main messages of the paper do not. For completeness, we report in the paper the results obtained in both cases.

The left hand side (*LHS*) of equation 2 constitutes the *fiscal bill* of the government, that is the total amount of payments (in present value) which will have to be made either to repay the debt or to purchase public goods. The right hand side (*RHS*) represents the financing of such expenditures, distributed between currently-living and future generations. Computing each component of equation (2) allows to assess not only whether current fiscal policies are sustainable in the long run (*i.e.*, *LHS* and *RHS* coincide), but, more importantly, how much of the fiscal burden is apportioned to each generations under the current fiscal policies (in the paper, we include in the definition of current policies also future changes in the rules which have already been legislated).[11]

Starting from the generational accounts we first construct summary indicators of fiscal sustainability. In particular, we compute the *intertemporal budget gap* (*ITG*), which is defined as

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[10] This section is not technical and simply provides an overview of the indicators we use and of their theoretical underpinnings. The theory and the methodology of GA has been described and discussed in several papers. Early references are Auerbach *et al.* (1991) and Kotlikoff (1992). Diamond (1996) discusses some limitations of the theory. Auerbach and Kotlikoff (1999) provide a detailed and complete description of both the theory and the procedures to implement to construct the accounts. A more technical description of GA – based on Auerbach and Kotlikoff (1999) – is also contained in the Appendix.

[11] For example, we include under current policies the effects on pension expenditure of future changes in the rules for benefit calculations and for eligibility, which have been approved in the nineties, but are subject to a lengthy phase-in.

the gap between the right- and the left-hand side of equation (2) under current policies. Current policies can be said to be sustainable if and only if the *ITG* is less or equal than zero.[12]

To move from sustainability to considerations of intergenerational fairness, we first compute what we call the *GS* indicator (with reference to Gokhale and Smetters, 2003 and 2005). It differs from the ITG because: (i) all government expenditures are allocated in the generational accounts; (ii) the generational accounts of future generations are set to zero, instead of being calculated on the basis of current policies:

$$GS = Net\ Govt\ debt - PV[taxes - transfers]_{current\ generations} \quad (3)$$

GS represents the amount of the fiscal imbalance (both in terms of explicit and implicit debt) that past and current generations can be held responsible for.[13] If the *GS* indicator is bigger than the *ITG*, then under current policies future generations can be said to be net contributors to the budget. The *GS* measures the total amount of debt left for future generations to pay. However, since it does not consider separately the fiscal bill of each currently-living generation, it does not allow to make homogenous intergenerational comparisons.

Therefore, we compute also the traditional Auerbach-Gokhale-Kotlikoff (AGK) indicator. To this aim, it is first necessary to calculate the sum in present-value terms of all the generational accounts of all future newborns under the assumption that all the costs of the adjustment are borne by them. In particular, the burden is allocated across future generations in such a way that the lifetime net-tax to income ratio is equal across all future individuals.[14] The AGK indicator is then defined as the per capita generational account of tomorrow's newborns divided by the per capita generational account of today's newborns. The AGK is also equal to the ratio between the lifetime net tax rate of future citizens and that of the youngest living generation, times productivity growth.

The construction of generational accounts requires the age- and sex-distribution of present and future taxes and transfers, together with projections for population and government purchases. An initial value of government net debt and assumptions on productivity growth and discount rate are also needed.

To calculate government debt we do not net out the value of the government's existing physical capital, such as highways, state-owned enterprises, Palazzo Pitti in Firenze or the Colosseo in Roma. Including such assets should have no impact on sustainability, as one should also subtract from future government revenues the flow of rents granted by the assets.

Our general rule regarding tax incidence is to assume that taxes are borne by those paying the taxes, when the taxes are paid: income taxes on income, consumption taxes on consumers, and property taxes on property owners. There is one exception, which involves corporate income taxes. In line with the previous GA literature, marginal corporate income taxes are assumed to be borne by (and are therefore allocated to) labour (which is quite realistic in the case of a small open economy, like Italy). Therefore we impute the corporate income tax (IRES), the regional tax on productive activities (IRAP) and all other production taxes on the basis of the age and sex distribution of labour income.

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[12] We also compute the generational balance gap (GBG), which is the same of the IBG, except that we assume that future generations pay the same amount as a current newborn would pay under current policy. If future changes in the rules are already embedded in current laws, the GBG will be different than the ITG. In the case of Italy, even if past pension reforms envisaged a lengthy phase-in, the legislated changes will be fully in place when the current and future newborn will be retiring. Therefore the ITG and IGG do not differ.

[13] The ITG can also be written as ITG = GS – PV[Taxes – Transfers]$_{future\ generations}$

[14] Specifically, the generational account of a person born in $t+s$ is set equal to that of a person born in $t+s-1 \bullet (1+g)$, where g is the growth rate of labour productivity.

3 Data, assumptions and relative age profiles

As we remarked in the previous section, to compute generational accounts one needs four main ingredients: relative age profiles, budgetary data, budgetary and demographic projections.

Assumptions concerning macroeconomic parameters are also needed: we adopt in the baseline scenario a 1.5 per cent productivity growth and a 3.0 per cent real interest rate on government debt (this is also the discount rate used to calculate the generational accounts). Such figures are in line with the RGS projection exercise as well as with the sustainability exercise performed by the European commission (European Commission, 2006).

3.1 Relative age profiles

The distribution, by age and sex, of as many of taxes and transfers as possible allows us to apportion the total amount of each government expenditure and revenue reported in official documents to the proper cohort. For each age-cohort alive in the reference year, an age profile basically provides the average amount of a given transfer (tax) received (paid) by an individual belonging to that cohort. We refer to Appendix 2 for a more detailed description of the age profiles and of their use.

As information on the age and sex distribution of taxes and transfers is not immediately available, an important stage of our research concerned the construction of these profiles starting from microdata. In particular, our main data source is the 2006 release of the Banca d'Italia household survey of income and wealth (SHIW).[15]

The SHIW does not contain information on the amount of taxes effectively paid by the interviewees. To cope with this issue, the allocation of taxes to different age groups has been mainly based on the age and sex distribution of the relevant tax bases. In particular, we allocated VAT using consumption levels;[16] similarly, taxes on financial income have been allocated based on the age and sex distribution of the income generated by each financial instrument and reported in the survey, and the allocation of taxes on real estate income has been based on the value of the properties owned (Figure 1-3).

As long as the tax structure is proportional to the tax base, the age distribution of the former will coincide with that of the latter. However, this is not true in the case of a progressive tax, such as the Italian income tax (Irpef). Therefore, the allocation of the income tax needs to be addressed in a different way.[17] In the SHIW, households only report net income. So we construct data on gross labour income of employees in the survey by using a model embedding all features of the Italian income tax system.[18] Since this model currently provides gross income only for employees,

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[15] The 2006 survey concerns a representative sample of the Italian population, consisting of 19,551 individuals (7,768 households). Among them, 13,009 earn some form of income. Details about the interviews and data collection procedures are reported in Banca d'Italia (2008).

[16] In the SHIW consumption is reported at the household level. In order to compute the age profile for the VAT, we allocated consumption to each member on the basis of personal income. The only exception concerns partners/spouses. In this case (and only to allocate consumption) we first cumulated their income and then split it equally among them. The idea behind this strategy is that husbands and wives (or partners) take the consumption decisions together and represent the main consumption-decision centre of the household.

[17] The same problem arises also in the allocation of social security contributions. Households report net labour income, whereas contributions are calculated on gross labour income.

[18] The model has been built by our colleague M.R. Marino. It takes into account all household and individual characteristics contained in the 2006 SHIW, to derive the gross labour income and the gross income tax, using SHIW net income as input. The model applied to the 2004 SHIW data was first presented in Marino and Staderini (2006). A paper based on 2006 SHIW data is forthcoming.

we complete the dataset with gross incomes from pension and other social transfers, which we take from Istat (2007a) where social security benefits are broken down by sex and age group.[19] The difference between gross and net income represents our estimate of the income tax paid by each age cohort (Figure 4). It turns out that the relative Irpef profile for women shifts upward around the age of seventy. This is the age when married women start becoming widow and get survivors' pensions on top of their own pension. Together with the very low labour market participation rate among women, this explains why at very old ages the profile bends upward.

The reconstructed series for gross labour income is also used to allocate social security contributions (Figure 6), as well as production and corporate income taxes (see the discussion about this issue in Section 2).

On the expenditure side, we focus on the three main categories of age-related expenditures, namely education, health care and pension transfers. These account

Figure 1

VAT
(relative to the amount paid by a 50-year old man)

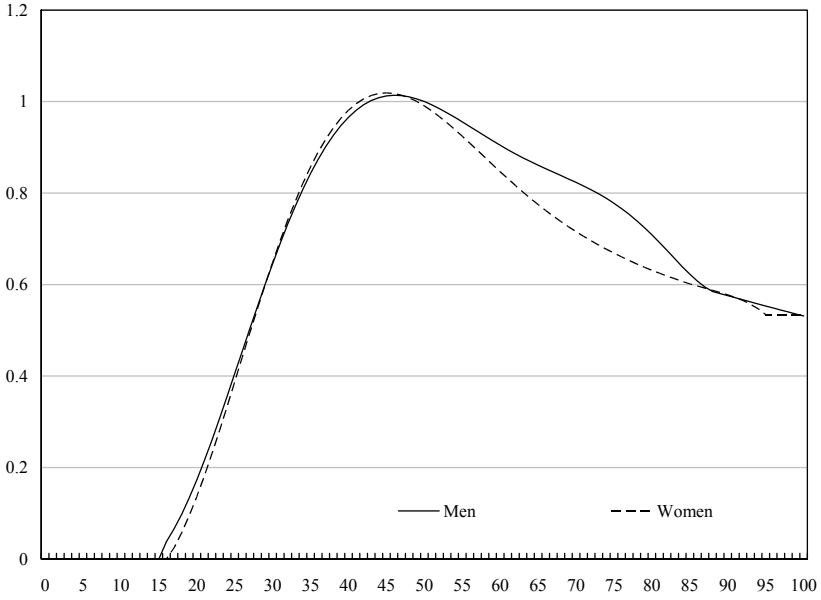
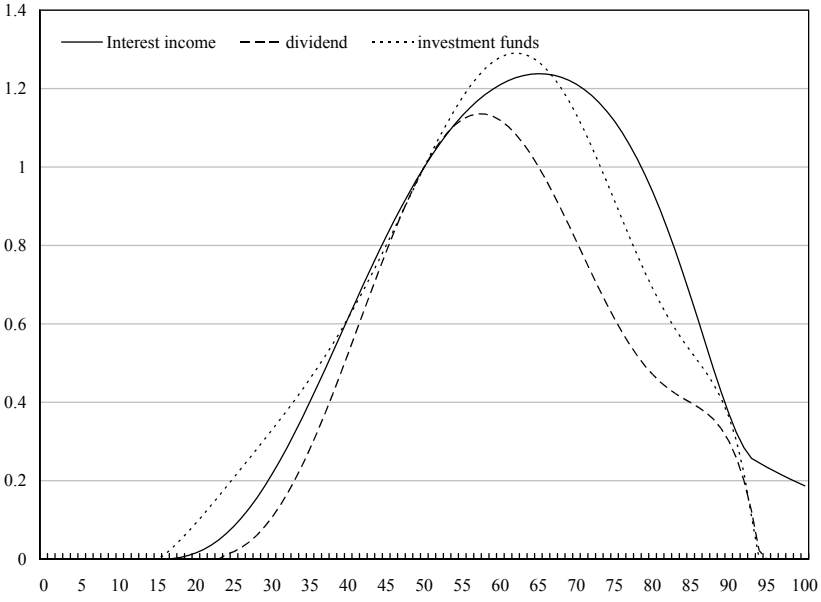


Figure 2

Taxes on Financial Income – Men
(relative to the amount paid by a 50-year old man)



[19] Istat provides average benefits at various ages, conditional on receiving them. As we need pension averages conditional on being alive, we compute them using the number of receivers and the size of each age cohort (provided by Istat as well).

for two thirds of current primary expenditure and are by far the most significant age-related expenditures in the Italian budget. Since we allocate to the generational accounts only these spending programs, all the remaining primary public expenditure represents the term G of equation (2) and it is not assigned to any age group.[20]

As we mentioned above, the age-pension profiles for 2006 have been estimated starting from data taken from Istat (2007a); we allocate separately old-age pensions (Figure 7), survivors pensions, disability allowances, non-contributory pension transfers.

We disaggregated health expenditure into four categories: pharmaceuticals, hospitals, diagnostics and general services. To estimate their relative age profiles we start from the 2005 Istat survey on the health conditions and access to health services (Istat, 2007b). Unsurprisingly, it turns out that the use of health services is mainly concentrated at the start and at the end of one's life (Figure 8).

Figure 3

Taxes on Wealth – Men

(relative to the amount paid by a 50-year old man)

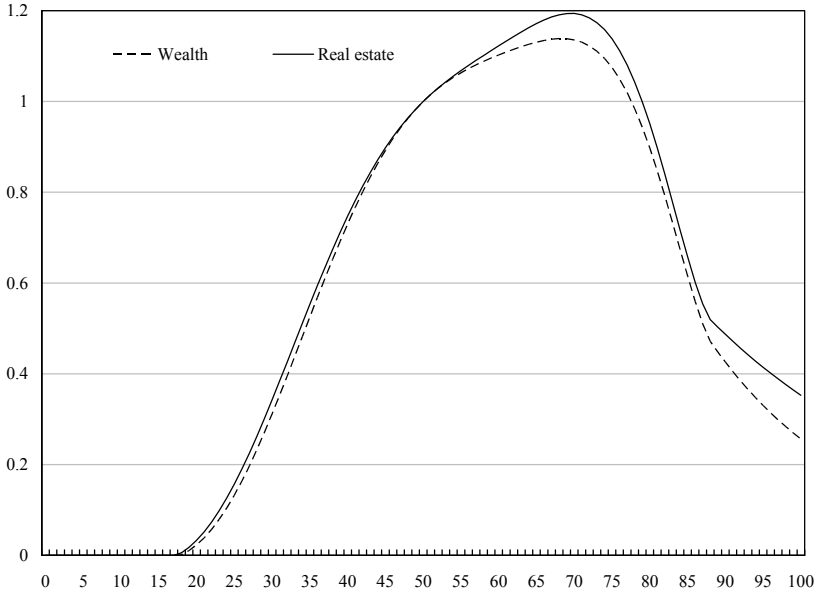
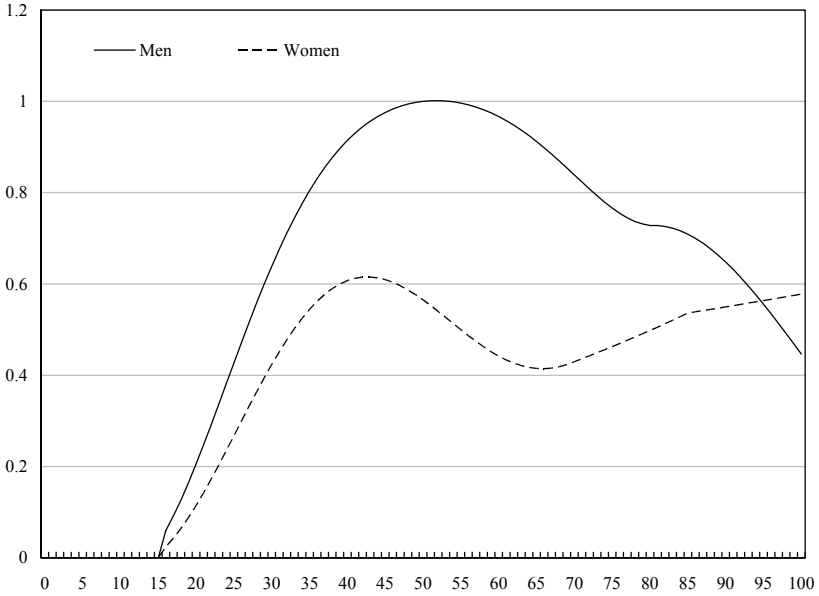


Figure 4

Income Tax

(relative to the amount paid by a 50-year old man)



[20] When we need to make comparisons with other studies in which these expenditures have been fully allocated to the generational accounts (so that G=0), we use a flat age profile.

Figure 5

Self-employed Income Tax
(relative to the amount paid by a 50-year old man)

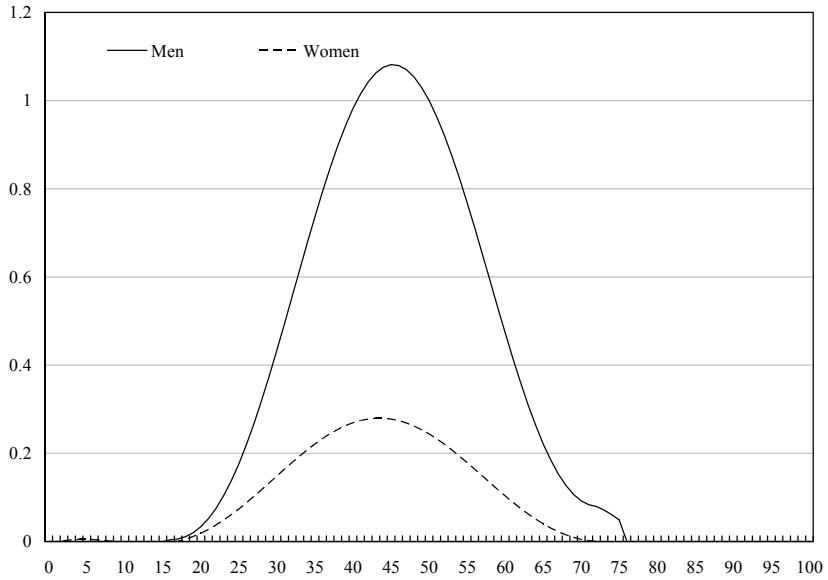
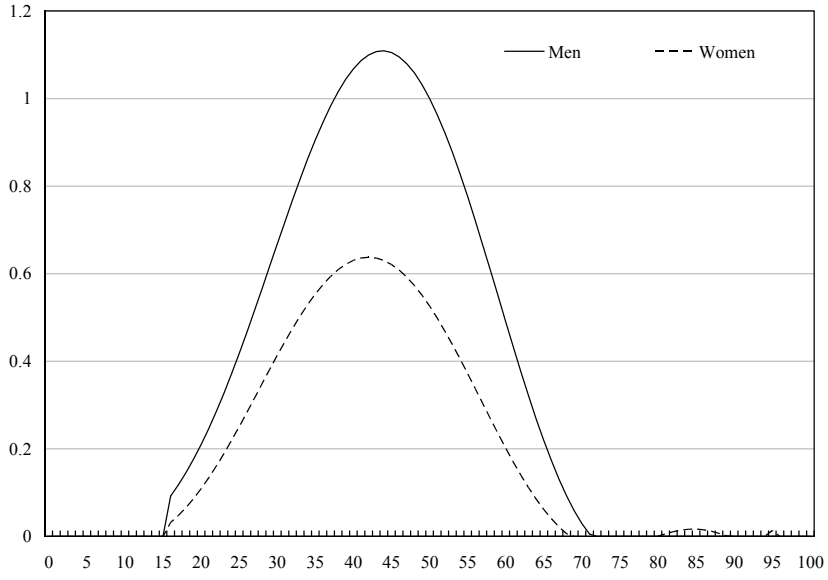


Figure 6

Social Security Contributions
(relative to the amount paid by a 50-year old man)



Finally, education expenditure has been broken down into five categories, namely pre-primary, primary, secondary, high school, university. The profiles are built under the assumption that every student completes his/her coursework in the standard number of years.[21]

3.2 The evolution of the old-age pension and social contribution profiles

Since the early nineties three major pension reforms have been implemented in Italy which drastically altered the age and sex distribution of the benefits.

In 1992, in the aftermath of an exchange rate crisis, the rules for pension eligibility and for the calculation of pension benefits were tightened. Post retirement indexation of benefits was linked to prices instead of wages. In 1995, a notional defined system was introduced, linking pensions to life expectancy at retirement. However, only workers

[21] This approach suffers from some drawback in the case of university students, because in Italy there is a high drop-out rate, and the length of the period spent in university is typically longer than the statutory one. Moreover, recent reforms might reduce over time the number of university dropouts and the time actually needed to get a degree. In an alternative specification, we tried to take these features into account, but the results do not differ significantly.

entering the labour market after 1995 are fully subject to the new rules, and workers with more than 18 years of contributions as of 1995 are fully exempted.[22] Finally, as legislated in 2007, the earliest eligibility age for seniority pensions will gradually increase, starting from 2008. The 2007 law also tightened the age eligibility requirements for those workers fully subject to the 1995 reform (bringing it to 65 years for men and to 60 years for women).

All these reforms involve a lengthy phase-in, which implies that the relative age-pensions profiles are expected to shift over time. Given the quantitative importance of the old-age pension scheme and the magnitude of the reforms, the simplifying assumption of a time-invariant age profile made for all other budgetary items is not acceptable.

In order to address the transition we build a stylized microsimulation model of retirement and pension income. In our model each individual enters the labour market at the age of 25, is never unemployed and retires as soon as the rules allow

Figure 7

Old-age Pensions, 2006

(relative to the amount given to a 60-year old man)

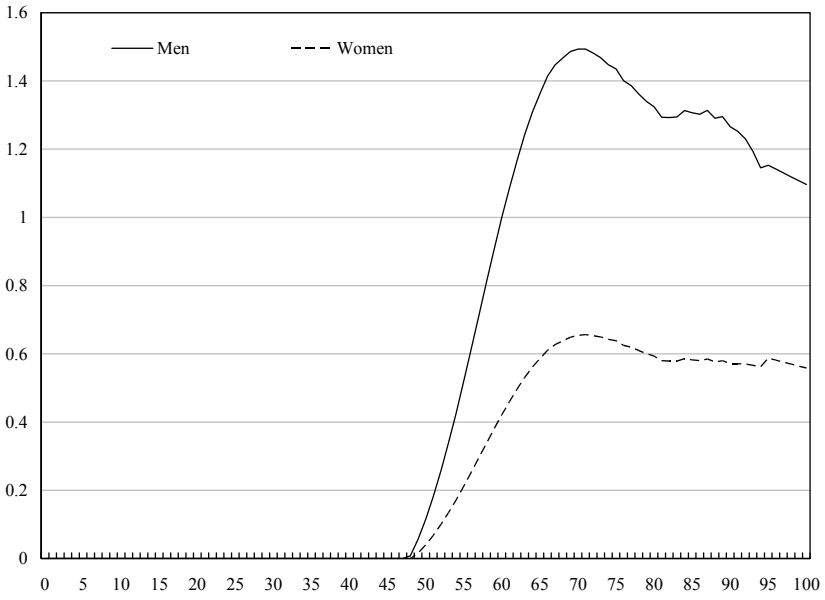
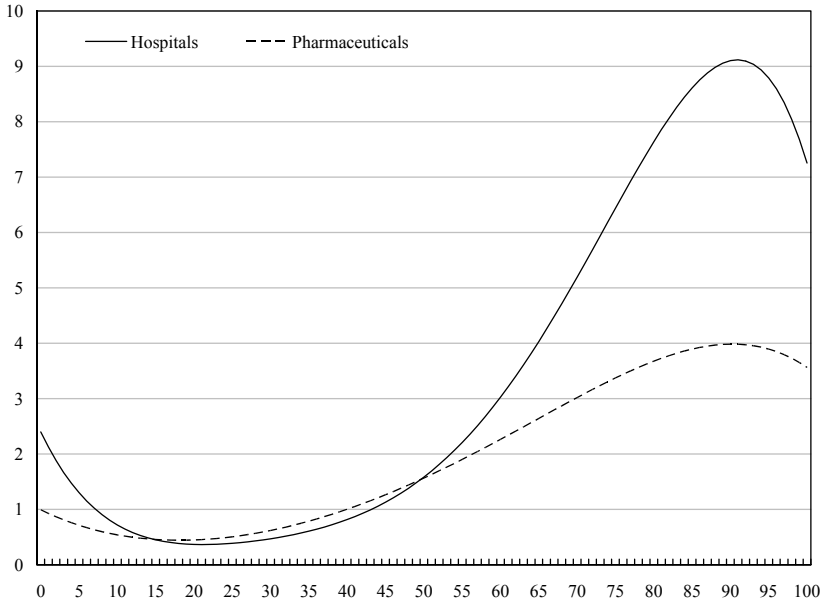


Figure 8

Access to Health Care Services – Men

(relative to the amount given to a 40-year old man: age 40 = 1)



[22] For a thorough analysis of the pension reforms of the nineties, see Franco (2002), and Franco and Sartor (2006).

Figure 9

Pension Profiles over Time (1)

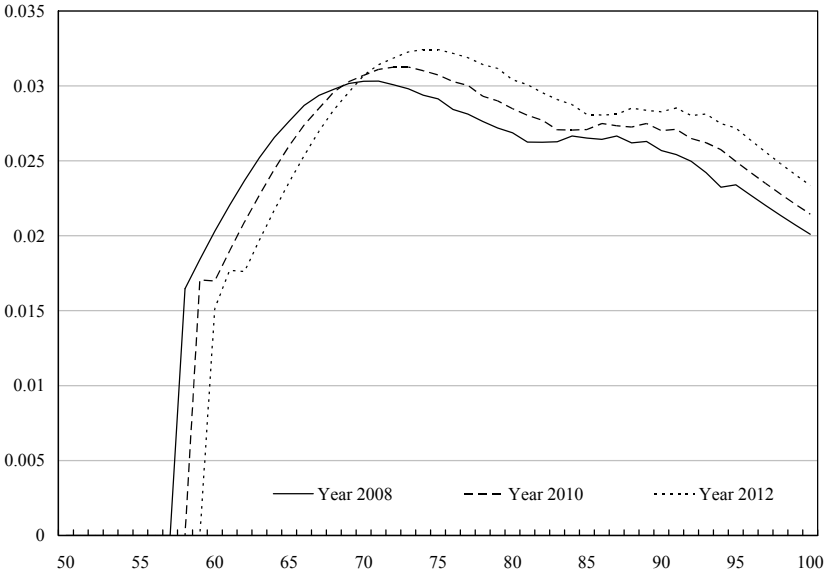
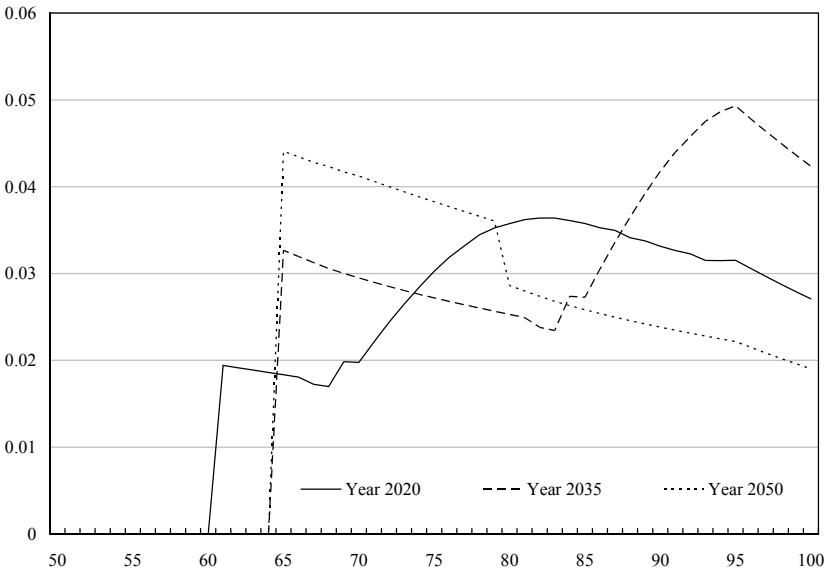


Figure 10

Pension Profiles over Time (2)



him/her to go (this last assumption seems to represent the actual behaviour quite accurately). Every year the wage for each age grows in line with the rate of growth of GDP. On top of this, the wage of each individual also reflects a tenure effect, calibrated to match the age-wage distribution observed in the 2006 SHIW.[23]

Our model calculates yearly pension benefits from retirement to death for all the cohorts alive in at least one year of the 2006-50 period;[24] correspondingly, it produces relative age-pension profiles for each year up to 2050, separately for men and women (the age profile is assumed constant after that date). Importantly, in the model the coefficients which translate the stream of life-time social security contributions into the pension benefit at retirement are updated according to the current law, that is each three years starting from 2010. The law imposes that coefficients are updated to take into account the increases in the residual lifetime at retirement.[25]

[23] In so doing we are assuming away cohort-specific effects in the return to seniority.

[24] The pensions for those already retired at the start of the simulation period are computed using administrative data (ISTAT, 2007a).

[25] The exact formula can be found in Ministero dell'Economia e delle finanze – Ragioneria Generale dello Stato (2007). Our calculation follows the methodology developed in Forni and Giordano (2001).

It goes without saying that this model is far too simple to capture all the heterogeneity currently existing among both the active and the retired population. However, it seems able to summarize the main trends in the relative profiles stemming from the changing pension rules. The pension profile progressively shifts to the right due to the increase in the minimum eligibility age (Figure 8). The profile, which today looks single-peaked,[26] gradually becomes bi-modal. This is caused by the coexistence, for several years, of younger pensioners whose benefits are mainly calculated according to the post-1995 rules, and older pensioners, whose benefits are mainly calculated according to the pre-1995 rules. Once these earlier cohorts leave the stage, the profile becomes single peaked-again. The peak is now reached soon after retirement, as younger pensioners' wages benefit from higher productivity levels, that translate into higher contributions and higher benefits.

3.3 Budgetary data and projections

As we remarked above, relative age profiles are to be applied to aggregate budgetary figures, in order to apportion such figures among cohorts. Aggregate data for 2006 and 2007 are mainly taken from (and in general consistent with) the consolidated budget of the General government (Istat, 2007c and 2008a). Education expenditure is broken down into the different categories (pre-primary, primary, secondary, high school, university) using data from the Ministry of Education and the COFOG classification of expenditure.[27] Figures for health-care and different categories of pension expenditure come from Ministero dell'Economia e delle finanze (2007) and are consistent with the classification of public expenditure by function produced by Istat (2008b). On the revenue side, we keep track separately of each existing tax.[28] Last, in our analysis we properly account for one-off measures implemented in 2006 and 2007 as they will not affect the budget in the future.[29]

Turning to budgetary projections, in the case of age-related transfers (education, health care and social security) we refer to the official forecasts produced yearly by RGS (Ministero dell'Economia e delle finanze – Ragioneria Generale dello Stato, 2007).[30] The definitions of pension, health care and education expenditures in these projections are only slightly different from those adopted in the general government accounts. Therefore, we apply the projected implicit growth rate to the corresponding 2007 items in the general government accounts.

In the case of budgetary items for which no official forecast is available, we project revenues and expenditures by using the demographic projections and the age profiles. In particular, we keep the average tax/transfer by age and sex constant in per capita terms, after adjusting for productivity growth (see Appendix 2).

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[26] The peak is actually at around 70 years. The upward sloping part is due to the less favourable rules granted to people affected by the 1992 reform. After that age, the profile slopes downward because older pensioners typically suffer from more discontinuous careers and from the rules concerning the post-retirement indexation of benefits (which are linked to prices, not to wages).

[27] These data are only available for 2006. Therefore, education expenditure is the only item for which the 2007 figure represents a projection. The COFOG data are broken down into only three categories: pre-primary and primary, secondary (which includes high school) and higher education. In order to refine these categories we used as weights total teachers' wages and salaries in each school category. They represent almost 98 per cent of central government's total education expenditure.

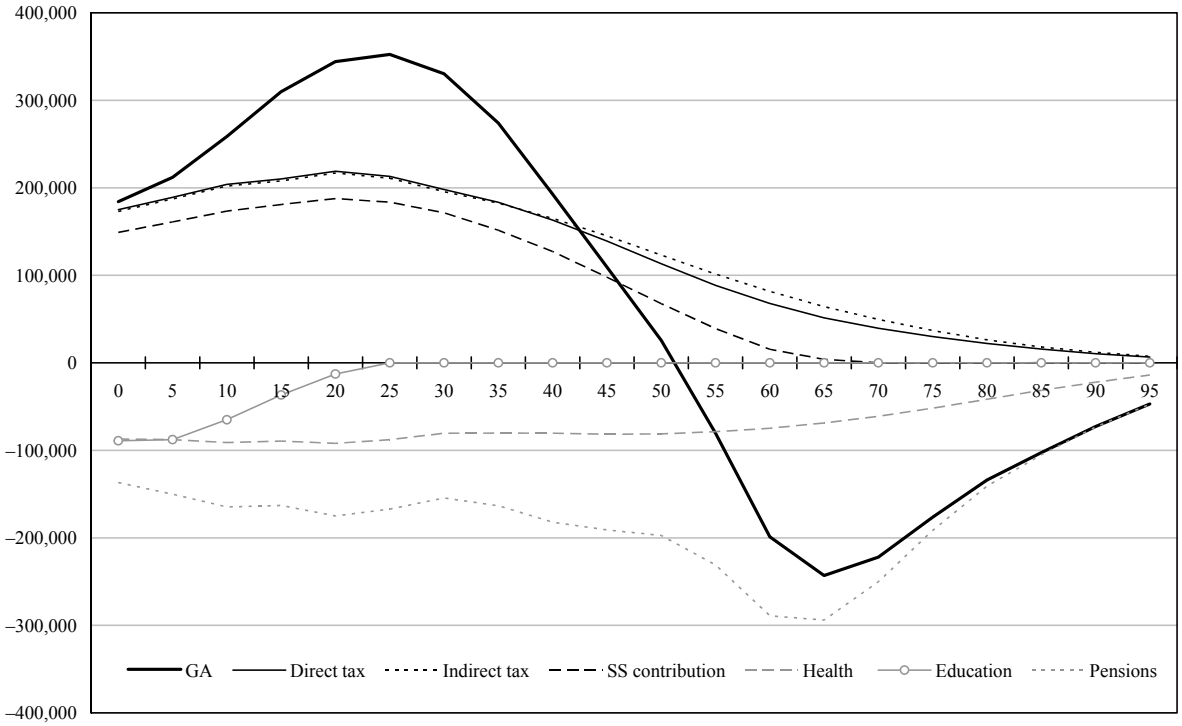
[28] In particular, we used Tables 17 and 18 of "Statistiche in breve" (2008) which include official data for both 2006 and 2007.

[29] One-off measures are taken from Momigliano and Rizza (2007).We do not consider as temporary the revenues due to the transfer to INPS of part of the severance pay provisions (such transaction is described in footnote 3), because the expenditure-increasing effects of such measures are included in the pension projections.

[30] The yearly projections cover only pension and health-care expenditure. Projections of education expenditures are taken from the European Commission report (European Commission, 2006) and are also produced by RGS for the European-level projection exercise coordinated by the "Ageing working group".

Figure 11

GA of Currently Living Generations



3.4 Demographic projections

Average net taxes paid by a member of a given cohort are multiplied by the size of the cohort to obtain the corresponding generational account. So GA requires accurate long term demographic projections on a year-by-year basis for each age group. We use the demographic projections provided by the National Statistical Office (Istat) up to the year 2050 and assume that the population structure remains constant afterwards. The Istat projections are consistent with the long-term forecast of age-related expenditures realized by RGS and used in our calculations.

4 Results

Using the relative age profiles and the projections of the demographic structure and of age-related expenditures, we are able to compute the generational accounts of currently living cohorts under the assumption that current policies remain unchanged. It turns out that individuals born in 2006 can be expected to pay to the government net-taxes for 184,191 euros (Figure 11). Those born between 1955 and 2006 are all net payers to the government, while generations born before 1955 are net receivers. In fact, as of 2006, the latter already paid a large share of their lifetime taxes and social security contributions, but they still are to receive the bulk of government transfers, both monetary (pensions) and in kind (health care services).

As already explained in the previous sections, the generational accounts of currently living cohorts are necessary to compute the size of the imbalance towards future generations, however

one should not refer to them to assess fairness between generations. In fact, the comparison would not be homogenous as it would not take into account what these generations have already paid or received since their birth: this is the reason why the AGK indicator measures intergenerational imbalance by only looking at the generational accounts of today's and tomorrow's newborns, which are instead comparable.

This said, Figure 11 still allows us to highlight the enormous difference of treatment between younger and older generations at least in terms of pension transfers, as a result of the pension reforms of the nineties and their lengthy phase-in. Indeed, the present value of lifetime pension transfers for a current newborn can be expected to be around 75 per cent of that of a 40-year old person, and half of that of a 60-year old person. The lifetime pension transfers of 30-year old persons are equal to those of the newborns, confirming that pension reforms had a negative impact especially on the current young and on the future generations. These comparisons are surely informative. In fact, people under 40 typically do not yet receive pension benefits, and the age of 60 represents the average retirement age in Italy.

4.1 Sustainability

Aggregating up the GAs of currently living generations and those of future generations calculated under the assumption of unchanged policies, it turns out that current fiscal policies are indeed not sustainable: the ITG is positive and equal to 190 per cent of 2006 GDP (or 2.8 per cent of the present value of all future GDPs).

While explicit government debt accounts for almost half of the intertemporal fiscal gap, the other half of the imbalance has nothing to do with officially-labelled government debt. This illustrates, once again, the point that the sole focus on debt can be highly misleading in assessing both fiscal sustainability and government's generational policy.

Another way to measure the fiscal gap is to compute what immediate and permanent change in taxes and social security contributions is necessary to close the intertemporal budget gap, under the assumption that policy remains otherwise the same (including the phase-in of reforms already legislated). Given 2006 and 2007 budgetary data, a permanent and immediate 7 per cent tax hike (around 3 per cent of 2007 GDP) would be required. This result is broadly in line with the official assessment of the European Commission, which adopts a similar indicator (European Commission, 2006).[31]

4.2 Intergenerational fairness

To measure the intergenerational imbalance we next compute the standard AGK indicator. It turns out that if all the burden of the adjustment was left to the future generations, the results could hardly be accepted as fair: the per capita generational account of tomorrow's newborns would be approximately 65 per cent higher then the one of the generation born in 2006 (Table 1). Tomorrow's newborns would have to pay approximately 120,000 euros more than 2006 newborns.

To better grasp the magnitude of the imbalance we construct a new indicator aimed at quantifying the lifetime net-tax rate implicit in our results. We take the ratio between the

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[31] The European Commission calls it S2. In the calculations made for Italy in 2006, it amounts to 3.0 per cent of GDP. The main difference with the EC methodology is that we also project revenues based on demographic trends, whereas the EC assume constancy over GDP.

Table 1

Main Findings

Scenario	Net Lifetime Taxes			Implicit Net-tax Rate on Lifetime Labor Income			Tax Increase to Restore Balance		Assumptions
	Current Newborns	Future Generations	AGK	Current newborns	Future generations	Change	*(percent)*	*(as a fraction of GDP)*	
Baseline	184,191	304,610	1.65	15.8	25.7	9.9	7.0	3.0	*g = 1.5%; r = 3.0%*
Sensitivity to discount rate	69,075	189,346	2.74	8.6	23.3	14.7	8.4	3.7	*g = 1.5%; r = 5.0%*
Sensitivity to growth	278,777	299,221	1.07	21.5	22.6	1.1	-	-	*g = 2.0%; r = 3.0%*
No debt	184,191	254,192	1.38	15.8	21.5	5.7	3.1	1.4	*g = 1.5%; r = 3.0%; public debt = 0*
No revision of coefficient	167,759	328,415	1.96	14.4	27.7	13.4	10.1	4.3	*g = 1.5%; r = 3.0%; no revision of the pension benefits coefficient*
No ageing	266,729	218,261	0.82	22.9	18.4	–4.4	–4.1	–1.8	*g = 1.5%; r = 3.0%; demographic structure constant at 2006 levels*

generational account of a person and her lifetime labour income.[32] If the burden of the fiscal adjustment is entirely left for future generations to pay, the lifetime implicit net-tax rate of each future citizen will have to be approximately 25 per cent, compared to 15 per cent of those born in 2006. In other words, future generations will have to transfer to the government 10 per cent more of their lifetime labour income than current ones.

The substance of the results does not change if we allocate to the generational accounts all government expenditures and not just those age-related. In the absence of any specific allocation criterion, we use a flat age profile and therefore let this expenditure grow with demographics. Under this assumption current newborns become net receivers (each of them will receive approximately 14,000 euros), while future generations would have to be net payers (84,000 euros) to restore sustainability. In terms of lifetime net-tax rate, our results imply an increase of approximately 8.5 percentage points (Table 2).

The GS indicator, which is also calculated after fully allocating all government revenues and expenditure to the generational accounts, is 360 per cent of 2006 GDP, signalling the huge amount of explicit and implicit debt passed to future generations. Under current policies future generations are going to be net payers to the State, their overall fiscal bill amounting approximately to 170 per cent of current GDP.

To our view, all these figures suggest that future generations should not be left alone in bearing the burden of the adjustment. Actually, we believe they provide a convincing case for currently living generations to pay for most of it.

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[32] The computation of the lifetime labor income is realized by imposing the same assumptions in terms of growth rate of labor productivity and discount rate used for the computation of the generational accounts.

4.3 Sensitivity analysis

Of course, results are sensitive to different assumptions concerning productivity growth and the interest rate. If we consider a "bad" scenario in which labour productivity still grows at the baseline 1.5 per cent but the discount rate is set at 5.0 instead of 3, the intertemporal budget gap increases from 2.8 to 3.4 per cent of the present value of future GDPs.[33] Symmetrically, in a "good" scenario in which productivity growth is permanently one percentage point higher than in the baseline, the gap almost disappears.

Results are less sensitive to the initial level of debt than one would expect: even with zero net debt, the ITG is positive and equal to around 85 per cent of 2006 GDP (or 1.2 per cent of the present value of future GDPs). To ensure sustainability without harming currently living generations, the GA of tomorrow's newborns would have to be 38 per cent heavier than the one of current newborns, compared to the 65 per cent found in the baseline scenario. In terms of lifetime net tax rate, a 5.7 percentage points increase would be needed. This confirms that the imbalance in Italian fiscal policy reflects in large part the pending demographic transition. Indeed, we calculate that Italy were to experience no demographic change in the future, current fiscal policies would be sustainable.[34]

Last, we simulated the impact of not updating the coefficients to transform social security contributions into pension transfers. According to the Italian law, these should be updated every three years in order to account for increasing life-expectancy. Our simulation show that not updating such coefficients would increase the size of the intergenerational imbalance.

This means that results in the baseline scenario depend crucially on the full and timely implementation of already legislated pension reform. In particular, the actuarial coefficients used in the calculation of pension benefits should be updated every three years, to account for the increases in life expectancy. The costs of not doing would imply a deterioration of the intergenerational imbalance.[35]

5 Crisis, adjustment, new imbalances: Italian generational policy through time

As already mentioned in the introduction, the use of GA in Italy dates back to the early nineties. Notwithstanding some methodological differences between our study and the previous ones, comparing the results allows to some extent an assessment of the Italian budgetary policies through the prism of GA.

Some issues need to be accounted for before making a comparisons of the results of these three studies. First, Franco *et al.* (1994) and Cardarelli and Sartor (2000) produced generational accounts which include all government expenditures, both age and non age-related (G=0). Therefore, for the sake of comparability, in this section we only refer to our results in the case of full allocation. Second, the set of summary indicators provided in each study is not always the

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[33] Expressing the ITG as share of present and future GDPs is advisable when considering changes in the interest rate and/or in the growth rate, as these parameters influence both the fiscal imbalance and the overall amount of resources in the economy. Using current GDP to deflate the ITG does not take this second effect into account.

[34] In this exercise we assumed that the population structure remains constant at the 2006 level. Consistently, we exclude the projections of the age-related expenditures, as those are strictly related to the demographic dynamics, and assume that they grow in line with labour productivity. We are ignoring the effect of the increase of the retirement age.

[35] To build the non-updating scenario we apply the profiles which would prevail without the updating (that is, they only take into account the increase in the retirement age) to aggregate expenditure projections provided by RGS for the non-updating case (since for this scenario RGS does not provide data for each future year, we constructed an interpolated series).

same. Last, the AGK indicator cannot be computed if a given cohort is a net receiver of resources. To tackle these issues we make comparisons only based on the difference between lifetime net-tax rates of current and future newborns. Table 2 summaries our findings. In the rest of the section we will focus only on our baseline case, even though Table 2 reports findings for the case in which the discount rate is set at 5 per cent.[36]

Table 2

A Comparison across Time

Scenario	Net lifetime taxes			Implicit net-tax rate on lifetime labor income			Tax increase to restore balance		Assumptions
	Current Newborns	Future Generations	AGK	Current newborns	Future generations	Change	*(percent)*	*(as a fraction of GDP)*	
Our estimates (2006)	–37,426	76,432	-	–4.7	9.4	14.1	8.4	3.7	*g = 1.5%; r = 5.0%*
	–14,344	83,902	-	–1.2	7.1	8.3	7.0	3.0	*g = 1.5%; r = 3.0%*
Franco *et al.* (1990)	40,278	160,557	4	8.8	34.6	25.8	-	-	*g = 1.5%; r = 5.0%*
	79,752	205,537	3	12.0	30.4	18.4	-	-	*g = 1.5%; r = 3.0%*
Cardarelli and Sartor (1998)	–11,726	39,862	-	–1.9	6.4	8.3	5.0	2.0	*g = 1.5%; r = 5.0%*
	-	-	-	-	-	3.7	3.1	1.2	*g = 1.5%; r = 3.0%*

Franco *et al.* (1994) provide the first application of GA to Italy. The reference year in their study is 1990, at about the peak of the fiscal imbalance which ultimately drove Italy out of the European monetary system (1992).

With the benefit of hindsight, the authors' demographic scenario was extremely optimistic. It was assumed that by the year 2000 the total fertility rate would stabilize at 2.1, whereas it has remained exceptionally low, at around 1.3. The percentage of the male and female population over-60 in 2050 was expected to be 20.5, and 26.7 per cent, respectively, while according to the most up-to-date projections, fertility should somewhat increase in the future, up to 1.6 in the year 2050. The share of 60+ individuals should reach 40 per cent. This notwithstanding, the authors found a quite high generational imbalance. In particular, under the usual AGK assumptions, 1991 newborns had to pay 125,000 euros more than 1990 newborns, corresponding to a lifetime net-tax rate 18.4 percentage points higher.[37]

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[36] This case represents the baseline scenario in the two previous studies.

[37] Current newborn had to pay 79,752 euros while future newborn had to pay 205,537 euros.

The wide imbalance stemmed from a huge and growing explicit public debt, due to 25 years of unsustainable fiscal policies, a very generous pension system, which was expected to grow by around 10 percentage points of GDP over the following decades,[38] and a double-digit deficit.[39]

Italian public finances had dramatically improved at the time of the second comprehensive GA study performed by Cardarelli and Sartor (2000; the authors used 1998 as the reference year). The adjustment was obtained through a painful consolidation process, starting in the aftermath of the 1992 exchange rate crisis, which ended with the admission of Italy to the monetary union. By the end of the nineties, the overall deficit declined from double-digit levels to well below the 3 per cent limit set by the Maastricht Treaty. Public debt, while still above GDP, was on a descending path driven by the reduction of the cost of debt servicing.[40] The adjustment package also included two major pension reforms which tightened the rules for pension eligibility and for the calculation of pension.

A comparison between Cardarelli and Sartor (2000) and Franco *et al.* (1994) shows a sizable improvement in the generational accounts. In the former, the difference between the fiscal bill of the current newborn and that of the future newborn is equal to 33,811 euros. This implies a lifetime net tax rate of future citizens 3.7 percentage points higher than the one faced by a 1998-born individual.[41]

The strong improvement of intergenerational fairness compared to 1990 must be mainly attributed to the 1992 which determined an immediate and permanent cut of pension benefits, affecting also generations currently living in 1992.

After Italy was admitted to join the European Monetary Union in 1998 (on the basis of an evaluation of 1997 budget), the goals of Italian budgetary policy gradually changed, partly reflecting the problematic legacy of the previous consolidation process (Balassone *et al.*, 2002). The reduction of the fiscal burden and the implementation of policies to support growth became priorities in the action of the governments.

Overall, the primary surplus, at 6.6 per cent of GDP in 1997, shrunk to 1.3 in 2006. In 2005 the ratio of debt to GDP began to increase again, rising to 106.2 per cent. The structural budget balance shrunk by 4 points, as well. The deterioration of the structural primary surplus was concentrated in the years 1998-2003, amounting to 6 per cent of GDP; between 2004 and 2006, the structural balance improved by 2 percentage points of GDP (Marino *et al.*, 2008).[42]

At a first glance, these data suggest that the 1999-2007 period was a lost decade in terms of public finances consolidation and motivate our new assessment of the Italian generational accounts.

Our results show that the intergenerational imbalance has grown over the last decade, in line with the deterioration of the primary balance. The 3.7 percentage points difference in lifetime net-tax rate between current and future newborns has increased to 8.3. A relevant part of this is

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38 Pension expenditure was expected to reach 25 per cent of GDP by 2050. At the time the paper was written, the pension system had not yet been reformed.

39 The net borrowing in 1990 was equal to 11.4 per cent of GDP; also the primary balance was negative (1.4 per cent of GDP).

40 The explicit debt in 1998 was around 115 percent of GDP, down from the peak of 121.8 in 1994. The expenditure for interest payment declined from 11.4 per cent of GDP in 1994 to 7.9 per cent in 1998 and continued to fall afterwards (Marino *et al.*, 2008; Franco and Rizza, 2008).

41 With a 1.5 per cent growth rate and a 5 per cent interest rate current newborns would receive from the government 11,725 euros, while future newborns would have to pay 39,861 euros. The implicit lifetime net-tax rates would respectively be –1.9 and +6.4 per cent.

42 In Marino *et al.* (2008) structural figures are net of the effects of the economic cycle and temporary measures, both computed using the methodology developed within the European System of Central Banks. Changes in structural figures are also decomposed in order to distinguish the effect of discretionary measures, fiscal drag and *decoupling* between tax bases and GDP growth.

attributable to the different demographic projections. Indeed, the latest population forecasts incorporate a stronger ageing of the population compared to what was expected in 1998. However, the tax cuts implemented over the last 10 years have certainly reduced the contribution of currently-living generations to fixing the fiscal imbalance, so leaving an higher burden for future generations to pay.

6 Some policy exercises

In Section 4 we looked at the generational accounts of currently living and future Italians to conclude that: (i) current policies are not sustainable in the long run; (ii) future generations should not be left alone in bearing the burden of consolidation. In this section we explore some policy experiments potentially able to restore long-term sustainability while at the same time increasing the degree of generational fairness.

Of course, to spread more evenly the burden of adjustment across generations one should intervene promptly, frontloading the savings needed to confront the rise in age-related expenditures and the contraction in several tax bases due to a shrinking workforce.

For example, intertemporal budget balance could be restored by a 7 per cent immediate and permanent across-the-board increase of taxes and contributions. By construction, the AGK indicator would also be 1 under this scenario, implying that current and future newborns are treated equally. The lifetime net-tax rates for current newborns would be the roughly the same of the tax rate of future citizens, and would amount to 19 per cent (approximately 230,000 euros).

The GS indicator would be lower than in the baseline scenario (2.2 times current GDP against 3.6), but still high, signalling the large contribution asked to future generations in order to restore sustainability (Table 3).

Tax increases in Italy can hardly be considered a wise (let alone politically viable) policy option. In fact, taxes and social security contributions were equal to 43.3 per cent in 2007, which is the second highest level ever achieved[43] and well above the euro-area average. The gap is wider in terms of the amounts effectively paid by the taxpayers who fulfil their obligations, owing to the large size of the Italian underground economy.

As repeatedly recognised by many analysts and by the Italian governments themselves, the crucial challenge of Italy's public finances consists in simultaneously consolidating public finances and reducing the fiscal burden on the economy. To achieve these objectives it is necessary to curb primary current expenditure, which over the last ten years has grown at an average real rate of between 2 and 2.5 per cent per year, much faster than GDP. Our analysis suggests that restraining the growth of current primary expenditure has also the potential to balance the gap between the net taxes paid by newborns and those paid by future citizens.

In particular, we show that a 5 per cent cut of all non-age related expenditures for three years would make fiscal policy sustainable (and consequently the AGK indicator equal to 1).[44] The GS indicator decreases from 3.8 to 2.2 times the current GDP.[45]

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[43] The highest level ever achieved was 43.7 per cent in 1997, the year relevant for the admission to EMU.

[44] In GDP terms, the cut is slightly below 3 percentage points. Non-age related primary expenditures account for about 40 per cent of total primary expenditures and is approximately equal to 17 per cent of GDP.

[45] Correspondingly, the accounts of all future generations increase from 1.74 to 2.3 times the current GDP.

Table 3

Policy Exercises

Policy Exercise	ITG		GS indicator	Description
	(percent of 2006 GDP)	*(percent of PV of future GDPs)*	*(percent of 2006 GDP)*	
Baseline	191	2.8	360	g = 1.5%; r = 3.0%
Tax hike	-	-	216	A 7 per cent increase of all taxes and S.S. contributions.
Expenditure cuts (1)	-	-	220	A 5 per cent reduction of non age-related expenditure for 3 years
Expenditure cuts (2)	-	-	200	Immediate 15 per cent cut of non age-related expenditure plus 10 per cent cut of old-age and survivors pensions
Switch from S.S. contributions to VAT	154	2.2	310	10 points reduction of SS contribution rates and 12 points increase of VAT rate

We also consider a reform made up of: (1) and immediate 15 per cent cut in non age-related primary expenditure,[46] while keeping their growth rate constant afterwards; (2) a 10 per cent reduction in old-age and survival pensions in all the future years. This two-pronged strategy would make fiscal policy sustainable and the GS indicator equal to 2 times current GDP.

Finally, we experimented the effects of a switch of revenues from social security contributions to VAT.[47] This reform clearly improves the generational accounts of currently living young and middle-age generations as compared to the old-age ones. Indeed, while social security contributions are only paid by middle-age working people, the VAT is paid by old-age retirees as well. In particular, we assumed a 10 per cent cut of the Social security contribution rates (from 33 to 23 per cent). At the same time, we also implement a 12 percentage points increase of the VAT rate, from 18 to 30,[48] keeping the overall primary balance unchanged. As a result, the ITG improves (form 191 to 154 per cent of GDP). Most importantly, fairness between generations clearly improves, with the GS indicator going from 3.6 to 3 times GDP.

7 Conclusions

We documented that Italian public sector redistribute resources from middle-age individuals to the old and the very young. This is a characteristic of every modern welfare state, which can be

[46] That is, we excluded social security health care and education expenditures. The remaining components amount to approximately 200 billions euros (14 per cent of GDP).

[47] Here we assume that the switch does not affect prices and agents' choices. A general equilibrium analysis of such reform would be beyond the scope of this paper.

[48] We are assuming that the VAT rate is always 18 per cent, even though for some goods it may vary. We focus only on VAT revenues from domestic transactions and leave unchanged the VAT rate on import, as an increase of the latter might induce substitution effects and a reduction of the exchanges.

understood as an insurance scheme which smoothes resources along the individuals' life cycle. However, these systems are vulnerable to adverse demographic developments. This is particularly true in Italy, where pensions absorb a large part of social transfers, and population ageing is particularly pronounced.

We show that current policies are not sustainable in the long run. The amount of net public liabilities implicit in current entitlements is about of the same size of "official" public debt; the two together amount to almost 200 per cent of GDP.[49]

As current policies are unsustainable, they will have to be changed, sooner or later. However, not all reform paths are equal. We show that: (1) the observed fiscal imbalance is due to the generous treatment awarded to past and currently living generations of Italians; (2) if currently living generations were exempted from the costs of the adjustment, the future ones should have to bear a very heavy fiscal burden.

We believe that both findings give weight to the opinion that current generations should share at least part, if not most, of the costs of the fiscal retrenchment. This in turn calls for prompt actions. In the last section of the paper we sketch some policy options which could potentially restore sustainability while at the same time improving intergenerational fairness.

Our exercise is also meant to contribute to an assessment of Italian fiscal policy over the last two decades. In the period between the first two studies (1990-98), long-term sustainability and intergenerational fairness had dramatically improved, as a result of the consolidation effort which first helped Italy to recover from the crisis of the early nineties and then allowed it to join the monetary union. When confronting our new figures with the calculations of Cardarelli and Sartor (2000), we find that Italy has improved neither its long term budgetary position, nor intergenerational fairness. While explicit public debt declined by some 10 percentage points of GDP in the 1998-2007 period, the burden of implicit public debt has increased, mainly due to a worse demographic scenario; on top of this, the primary balance is lower (3.1 percentage points of GDP instead of 5.1 percentage points in 1998).[50] Future generations will be asked to pay much more than current newborns to cover for an imbalance predominantly attributable to past and current generations.

Overall, it appears that precious time was lost. As population ageing is looming large, inaction will likely require a more abrupt adjustment, while its costs will have to be concentrated on fewer cohorts.

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[49] Our figures are based on official expenditure projections which might be somewhat underestimated. Some risk elements are common to other European countries. First, the increase in age-related expenditures is likely to be higher than expected. For example, in the past, longevity increases have been consistently underestimated. Second, official projections do not factor in the effects of technological improvements health care expenditure, nor the effects of changes in household composition and organization on the demand for formal long-term care. Moreover, some risk elements are specific of the Italian context: in particular, as the European commission remarks, "current pension arrangements might come under pressure at some points if the projected decrease in the benefit ratio were to fully materialize". For example, the first actuarial update of the rule for the calculation of pension benefits, due to be implemented in 2005, was repeatedly postponed (it is now scheduled in 2010).

[50] The decrease in the structural primary balance is about 1.5 percentage points of GDP.

APPENDIX 1
THE METHODOLOGY OF GENERATIONAL ACCOUNTING

The methodology of generational accounting is accurately described, among others, by Auerbach and Kotlikoff (1999). In this section we provide a short summary, while we encourage the interested reader to go through the original paper.

Let us start by defining the generational accounts as the present value of net taxes that, under current policy, individuals of different age cohorts are expected to pay over their remaining lifetimes. By net taxes we mean the difference between total taxes and contributions paid to the government and total transfers received from the government. Transfers include both explicit monetary transfers (pension benefits, unemployment benefits, etc.) and transfers in kind (health care service, public education, etc.). Formally, the generational account at time t of the cohort born at time k is given by:

$$N_{t,k} = \sum_{s=\kappa}^{k+D} T_{s,k} P_{s,k} (1+r)^{-(s-\kappa)} \tag{A1.1}$$

where:

$N_{t,k}$ = Generational account at time *t* of the generation born in year *k*

$T_{s,k}$ = Average net tax payment made in year *s* by a member of the cohort born in year *k* (conditional on he/she still being alive in k).

$P_{s,k}$ = Time *s* number of surviving members of the cohort born at time *k*.

D = maximum length of life

$\kappa = \max\{t,k\}$

Notice that the formula applies to both currently living generations ($t > k$) and future generations ($t < k$). Consider the Government Intertemporal Budget Constraint (IBC) rewritten in terms of generational accounts:

$$\sum_{k=t-D}^{t} N_{t,k} + \sum_{k=t+1}^{\infty} \frac{N_{t,k}}{(1+r)^{k-t}} = \sum_{s=t}^{\infty} \frac{G_s}{(1+r)^{s-t}} + D_t \tag{A1.2}$$

The first term on the left-hand side of the equation is the sum of the generational accounts of all living generations, that is the total amount of lifetime net-taxes that the government will collect from currently living cohorts. The second term is the sum of the generational accounts of all future generations (lifetime net-taxes that the government will collect from future generations). On the right hand side there is the present value of current and future government consumption (it is assumed to grow over time at the growth rate of productivity) and net financial wealth. The *intertemporal budget gap* and *intergenerational budget gap* are defined respectively as:

$$\begin{aligned} IBG &= \left[\sum_{s=t}^{\infty} \frac{G_s}{(1+r)^{s-t}} + D_t - \sum_{k=t-D}^{t} N_{t,k} - \sum_{k=t+1}^{\infty} \frac{N_{t,k}}{(1+r)^{k-t}} \right] / GDP \\ IGG &= \left[\sum_{s=t}^{\infty} \frac{G_s}{(1+r)^{s-t}} + D_t - \sum_{k=t-D}^{t} N_{t,k} - \sum_{k=t+1}^{\infty} \frac{N_{t,t}}{(1+r)^{k-t}} \right] / GDP \end{aligned} \tag{A1.3}$$

In equation (A1.3) all the variables are calculated under current policies. The only difference is that in defining the intergenerational budget gap we are assuming that, apart from productivity growth, each member of all future generations pay $N_{t,t}$ in net taxes; *i.e.*, except for the growth factor, they pay the same amount as a current newborn would pay under current policy.

Finally, the Auerbach-Gokhale-Kotlikoff (AGK) indicator is calculated under the assumption that the generational account of a member of a certain future generation ($N_{t,k}/P_{k,k}$) rises with respect to the one of a member of the previous generation at the economy's rate of productivity growth. Thus, the share of labour income paid to the government as net-taxes is equal for all future generations. The IBC implies:

$$\sum_{k=t-D}^{t} N_{t,k} + \sum_{k=t+1}^{\infty} \frac{\bar{n}(1+g)^{k-t} P_{k,k}}{(1+r)^{k-t}} = \sum_{s=t}^{\infty} \frac{G_s}{(1+r)^{s-t}} + D_t \qquad \text{(A1.4)}$$

where g is the growth rate of productivity and $\bar{n}$ is the generational account of newborns next period (+1). We, then, solve for $\bar{n}$.

The AGK indicator is defined as the ratio between $\bar{n}$ and the GA of current newborns. If current policies are sustainable, its value is less than 1. Moreover, it is a meaningful measure of intergenerational fairness, because the numerator and the denominator are fully comparable (indeed, contrary to the GAs of previous generations, they both involve net taxes over an entire lifetime).

APPENDIX 2
THE CONSTRUCTION OF THE RELATIVE AGE PROFILES

An age profile gives the average amount of a certain transfer (tax) received (paid) by an individual of a given age-cohort alive in a given year. In more formal terms, let us assume that:

$$\frac{T_{s,k}}{\sum_{j=s-D}^{s} T_{s,j}} = \frac{T^{SHIW}{}_{s,k}}{\sum_{j=s-D}^{s} T^{SHIW}{}_{s,j}} \qquad \text{for } k = s-D, ..., s \tag{A2.1}$$

In (A2.1), D is the maximum lifespan (that we take to be 100 years). The term $T_{s,j}$ is the average amount of (say) income tax paid in year s by those born in year j. The $T_{s,j}$ are what we are looking for, as they are used to build the generational accounts (see Appendix 1). As we do not observe them directly, we reconstruct them using average income taxes taken from a micro data source, for example the Bank of Italy's SHIW. In equation A2.1 we define $T^{SHIW}{}_{s,k}$ as the average amount of income tax paid in year s by those born in year j as recorded in *SHIW*. So, equation A2.1 states that we assume that the relative profile we observe in the survey are equal to the unobservable ones. We define the elements of such profile as:

$$\rho_{sk} = \frac{T^{SHIW}{}_{s,k}}{\sum_{j=s-D}^{s} T^{SHIW}{}_{s,j}}$$

We then exploit the fact that:

$$H_s = \sum_{j=s-D}^{s} T_{s,j} P_{s,j} \tag{A2.2}$$

where H_s is the aggregate amount of income taxes in s and $P_{s,j}$ is the number of members of the j-generation still alive in s. Indeed, substituting (A2.1) in (A2.2) one gets:

$$H_s = \sum_{j=s-D}^{s} T_{s,j} P_{s,j} = \left(\sum_{j=s-D}^{s} T_{s,j} \right) \left(\sum_{j=s-D}^{s} \rho_{s,j} P_{s,j} \right)$$

That is:

$$\sum_{j=s-D}^{s} T_{s,j} = \frac{H_s}{\sum_{j=s-D}^{s} \rho_{s,j} P_{s,j}}$$

Finally, using equation (A2.1) again, one has:

$$T_{s,k} = \rho_{s,k} \sum_{j=s-D}^{s} T_{s,j} = \frac{\rho_{s,k} H_s}{\sum_{j=s-D}^{s} \rho_{s,j} P_{s,j}}$$

For years in which we have budgetary outturns or official projections, the equation explains how one can use demographic information ($P_{s,j}$) aggregate data on tax and transfers (H_s) and the profiles ($\rho_{s,j}$) to recover the $T_{s,k}$. In the absence of official figures, we assume instead that the $T_{s,k}$ grow every year in line with productivity:

$$T_{s+1,k+1} = (1+g) T_{s,k}$$

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