Generational Policy and the Measurement of Tax Incidence[1]

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September 2008

Abstract

In this paper we show that the generational accounting framework used to measure tax incidence can give inaccurate measurement of tax burden imbalances across cohorts. We find that it is possible to construct tax policy reforms consistent with the same pattern of consumption, work effort, and utility across generations, but with different tax burden measurements when using the standard generational accounting procedure. This result is very important for policy evaluation, since it shows that the selection of tax policies based on generational accounts could potentially be misleading. In addition, we provide an alternative procedure robust to the choice of tax instruments.

[1] We want to thank the useful comments of Tim Kehoe, Chris Phelan and seminar participants at ITAM, Alacant, EUI, Bern and 2008 Meetings of the SED. Conesa acknowledges financial support from SEJ2006-02879 of Ministerio de Educación, SGR01-00029 from Generalitat de Catalunya, Barcelona Economics and Consolider. Carlos Garriga acknowledges support from the National Science Foundation for Grant SES-0649374. The views expressed herein do not necessarily reflect those of the Federal Reserve Bank of St. Louis nor those of the Federal Reserve System. The authors can be reached via e-mail at JuanCarlos.Conesa@uab.es, and Carlos.Garriga@stls.frb.org.

1. Introduction

The reduction in fertility and the increase in life expectancy combined with the post-war baby boom phenomenon will create economic challenges in the coming years. The demographic transition will not only have an important impact in the labor markets, and the social insurance programs such as Social Security and Medicare, but it will also affect tax revenue collection. One can discuss the magnitude of the fiscal adjustments based on projected demographics, but the ultimate and relevant question is how should we distribute the tax burden of our aging population across different cohorts. The answer is determined by issues of intergenerational equity and economic efficiency. However, prior to determine the tax incidence for present and future generations, it is important to understand how to measure the tax burden. Our paper contributes to clarify the measurement of tax incidence across different cohorts over time.

The most popular approach[2] to the measurement of generational tax incidence is the generational accounting framework developed by Auerback, Gokhale, and Kotlikoff (1991). The accounting procedure requires to rewrite the government intertemporal budget constraint in terms of the fiscal incidence and the transfer programs received by each generation. Assuming that taxes and transfers remain unchanged, they calculate the net tax burden that future generations have to bear to achieve long-term balance in the government budget constraint. Any structural change in the tax policy has to be captured by a change in the fiscal incidence and transfers received by each generation, and that implies a different measurement for present and future generations.

The advantage of the technique is that the measurement of the tax burden is relatively easy to compute since it does not require specific assumptions about functional forms for individual preferences or technology.[3] It is sufficient to determine an intertemporal

[2] A similar approach has been used by the economists in the Board of Governors. They have developed a stylized model to measure the impact of population aging in living standards measured using consumption growth. For example Bernanke (2006) summarizes the findings of Elmendorf and Sheiner (2000) and Sheiner, Sichel, and Slifman (2006), and proposes different alternatives to deal with the demographic transition.

[3] An alternative method to measure tax incidence is welfare analysis. This approach requires specific assumptions about preferences and technology, and is fully based on individual optimizing behavior together with market clearing conditions. Conesa and Garriga (2008b) uses optimal fiscal policy to design the best possible response to demographic shocks.

discount rate so the tax burden paid by future generations can be directly compared with the current ones. That explains the widespread use for policy analysis in practice (Board of Governors, Department of Treasure, World Bank,…) to assess the burden of future demographics or the impact of policy reforms. Two of the limitations of the generational accounting framework are that it ignores the impact of taxation on economic activity, and it omits the welfare gains and losses resulting from fiscal reforms. To address this critique Fehr and Kotlikoff (1996) measured the fiscal incidence implied by the generational accounts in a dynamic general equilibrium life-cycle model. They find that generational accounts match the evolution of welfare changes for each cohort, but they miss the magnitude of the utility changes. They argue that the bias is quantitatively small when the capital to output ratio that pins down relative prices does not change much.

In this paper we show that the measurement of the tax burden across cohorts implied by the generational accounts does not give an accurate description of generational imbalances since it is not robust to the choice of tax instruments. We argue that it is possible to construct neutral policy reforms (i.e. same consumption, hours worked, and utility distributions) using different policy instruments, and that as a result they would generate different measurements of the tax burden using the generational accounting approach. The implications of this result are rather important for policy evaluation. It is possible to evaluate different tax reforms to solve future fiscal imbalances that provide different costs when measured using generational accounts, but that are in fact equivalent in welfare terms. We show that it is possible to construct a robust alternative measurement approach, equally simple in its implementation, based on the consumer intertemporal budget constraint. To quantify the size of the bias we use a standard life-cycle model and compare the generational accounts implied by the baseline model with the ones associated to a Pareto neutral social security reform (as in Conesa and Garriga (2008a)). We find that the quantitative bias is as large as 15 percent across reforms, and much larger when compared to our alternative measurement procedure.

The remaining of the paper is organized as follows. In section 2, we briefly summarize the methodology of generational accounting and its applications. In section 3, we prove the main result of the paper in the context of a dynamic general equilibrium model. In section 4, we build a quantitative policy reform to illustrate the discrepancies in generational accounts. In section 5, we summarize the paper findings and conclude.

2. Generational Accounting

The generational accounting framework was developed by Auerbach, Gokhale, and Kotlikoff (1991) with the objective of measuring the generational incidence of tax policy independent of fiscal taxonomy labels (see Kotlikoff (1992, 2001) for a full description of the methodology). The approach compares the lifetime (net of transfers) tax bills between present and future cohorts, and it is regularly used in order to measure the generational impact of changes in fiscal policy. All these different tax burden measures can be compared independently of how fiscal deficits are calculated. An important aspect of generational accounting is the impact of the evolution of population demographics in the government budget constraint and the measurement of generational imbalances. The ultimate goal is to prescribe tax policies that could correct any imbalance, so all generations bear a similar tax burden.[4]

Methodology

For the description of the methodology of generational accounting we closely follow Kotlikoff (2001).

The tax burden in period t of a cohort born in period k is measured as:

$$ga_{t,k} = \sum_{s=\max\{t,k\}}^{k+d} R^{-(t-s)} \frac{p_{s,k}}{p_{t,k}} TAX_{s,k}$$

where $TAX_{s,k}$ is taxes net of transfers paid at time t by cohort born in period k, R is a discount factor and $p_{s,k}/p_{t,k}$ denotes the fraction of individuals surviving at time s. Therefore, it represents the present value of the average amount of taxes paid by the survivors of cohort members born at time k. The tax term includes total taxes paid minus transfer payments of different forms. If we are calculating the generational account

[4] A similar concept called equal burden-sharing is used by Bernanke (2006). This concept is interpreted to mean that the current generation and all future generations experience the same percentage reduction in per capita consumption.

implied by a model all these elements are clearly specified. However, if we are using data as input the process is a bit more involved (Auerbach, Kotlikoff, and Gokhale (2001) provide a detailed description of how to map the data into the generational accounts), since it includes expenditures in health care, education, and other form of transfer programs. However, it does not impute to any specific cohort the value of government expenditure in goods and services. The main reason is the difficulty to assign the benefit of government purchases to different generations.[5]

The government intertemporal budget constraint can then be reinterpreted in terms of generational accounts:

$$\sum_{s=0}^{d} m_{t,t-s} b_{t,t-s} + \sum_{s=1}^{\infty} \frac{m_{t,t+s} b_{t,t+s}}{R^s} = B_t + \sum_{s=1}^{\infty} \frac{G_{t+s}}{R^s}$$

where $m_{t,k}$ denotes the measure of individuals in period t of cohorts born at time k. The term $b_{t,s}$ represents the per capita generational account in period t for a generation born in period k. The first term on the left-hand side captures the existing cohorts, while the second term adds together the generational accounts of unborn cohorts discounted at rate R. The term on the right hand side represent the amount of outstanding government debt B_t (financial liabilities minus the sum of its financial assets and market value of public enterprises) and the value of present and future government expenditures.

The choice of the discount rate R deserves special attention, since it influences the generational accounts for present and future generations. The choice becomes even more problematic in the presence of varying rates or uncertainty because it would in principle require the use of the term structure or the use of some specific stochastic discount factor to adjust for risk. Moreover, in the presence of incomplete markets risk adjustment should be cohort specific. However, in practice it is standard to use a benchmark constant discount rate, and present the results under alternative constant discount rates. Keeping the discounting constant can be restrictive because the capital-output ratio that ultimately determines interest rates may be varying in the presence of demographic shocks.

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[5] By contrast, welfare analysis can measure the benefits of government purchases when they enter in the production function or in the utility function in the form of public goods.

Generational Accounts Imbalances

Given the tax burden for the current generations and the sequence of future expenditures, it is possible to calculate as a residual the tax payments of future generations. In the presence of imbalances $b_{t,t+s} \neq b_{t,t-s}$ it is possible to compute what policy changes (and paid by what generation) are necessary to restore sustainability.

Another important element is the impact of demographic changes in the imbalance of generational accounts. Consequently, population growth of future generations can reduce imbalances, whereas population aging can exacerbate a larger tax burden on currently young or future cohorts.

There exists an extensive literature that uses generational accounts to measure fiscal imbalances associated to tax reforms of different nature. For example Gokhale, Page, Potter and Sturrock (2000) analyze the case of the U.S. using the long-term projections of The Congressional Budget Office. They use a 4 percent discount rate and 2.2 percent of productivity growth, and they find that future generations will face a lifetime burden that is 41.6 percent higher than the existing generations. They propose five alternative policies. The first is a 31 percent permanent increase in federal and personal corporate income taxes. The second is a 12 percent raise of all federal, state, and local taxes. The third one requires to cut all transfers programs (Social Security, Medicare, Medicaid, food stamps, unemployment insurance benefits, housing support, etc...) by 21.9 percent. The final two options require the reduction of all government expenditures by 21 percent, or federal expenditure by 66.3 percent. Other applications include a swift from income to consumption taxation as in Altig, Kotlikoff, Smetters, and Walliser (2001), or social security privatization such as Kotlikoff, Smetters, and Walliser (2001). The methodology has also been applied to other countries such as the U.K. in Cardarelli, Kotlikoff, and Sefton (2000). For an international study we refer to Kotlikoff and Raffelheuschen (1991).

3. Measuring Tax Incidence

In this section we use a general equilibrium model with two purposes. First, we illustrate that the generational accounts can be biased since they are not robust to the choice of tax instruments. Second, we propose a robust alternative based on the consumer intertemporal budget constraint. This new measure is equally simple in its implementation and is robust to the choice of tax instruments. To construct this new measure, we use a fairly general overlapping generations model with production. We describe these steps in detail.

A Standard Life-Cycle Model

Generations live for I periods. Preferences of an individual born in period t are represented by a time separable utility function of the form

$$U(c^t, l^t) = \sum_{i=1}^{I} b^{i-1} u(c_{i,t+i-1}, 1 - l_{i,t+i-1})$$

where $c_{j,t}$ and $l_{j,t}$ denote consumption and hours worked of individuals of age j at time t. Individuals' subjective discount rate is denoted by b. The utility function is assumed to be twice continuously differentiable, strictly concave, monotonically increasing in consumption and leisure, and satisfies the Inada conditions. At each point in time households are endowed with one divisible unit of time that can be used for work and leisure. One unit of time of a household of age i transforms into e_i units of labor input. The time-invariant endowment profile of efficiency units of labor over the life-cycle is $e = \{e_1, ..., e_I\}$.

Individuals supply their labor services and assets in competitive markets. Then, individuals receive a competitive wage, w_t, per efficiency unit of labor supplied in period t. They also hold assets $a_{i,t}$ in the form of physical capital or government bonds in exchange for a market rental rate, r_t. Clearly the return of both investments has to be the same if households are to hold both types of assets. We denote the transfer payments received by cohort j as $m_{j,t}$. Notice that allows for transfers to change over the life-cycle.[6]

[6] We are not restricting the sign of government transfer programs for workers and retirees. This is not relevant since the focus of the paper is the measurement of tax incidence over different cohorts, not the distortionary effect of different tax instruments on these individuals.

We assume that markets are complete. Therefore households are allowed to trade assets to smooth consumption over the life-cycle. There are two potential extensions from the standard model. One would be to introduce intragenerational heterogeneity, and the second would be to introduce mortality risk with or without annuity markets. The findings in the paper do not depend on neither of these two model features.

The production possibility frontier is represented by a constant returns to scale technology $Y_t = F(K_t, L_t)$, that transforms units of capital K_t and efficiency units of labor $L_t = \sum_{i=1}^{I} m_{i,t} e_i l_{i,t}$ into value added. The production function is assumed to satisfy the standard Inada conditions. There is no technological progress and capital depreciates at a constant rate d. We consider a single representative firm that operates the aggregate technology taking factor prices w_t, r_t as given.

Each period production can be used for private consumption, investment, and non-productive government expenditure[7]. We will take the sequence of government consumption to be exogenously specified. The period resource constraint is then

$$\sum_{i=1}^{I} m_{i,t} c_{i,t} + K_{t+1} - (1-d)K_t + G_t = F(K_t, L_t)$$

The government at each period collects consumption taxes, labor income taxes, capital income taxes, and one period bonds, to finance government expenditure and transfer programs. Thus the period government budget constraint is given by

$$t_t^c \sum_{i=1}^{I} m_{i,t} c_{i,t} + t_t^l w_t L_t + t_t^k r_t \sum_{i=1}^{I} m_{i,t} a_{i,t} + B_{t+1} = \left(1 + r_t\right) B_t + G_t + \sum_{i=1}^{I} m_{i,t} m_{i,t}$$

Definition 1: Given a government policy a market equilibrium in the economy is a sequence of allocations and prices such that: i) consumers maximize utility subject to their budget constraints, ii) firms maximize profits, iii) the government budget constraint is balanced, and, iv) markets clear and feasibility.

[7] We choose to have a non-productive government expenditure to have a comparable benchmark with the generational accounting methodology.

Model Generational Accounts

To construct the generational accounts for each cohort, we have to determine the net tax outlets (taxes minus transfers properly discounted) for each generation.

In our model environment the GA of every newborn generation is given by

$$ga_t = \sum_{i=1}^{I} \frac{q_{t+i-1}}{q_t}\left[t^c_{t+i-1}c_{i,t+i-1} + t^l_{t+i-1}w_{t+i-1}e_i l_{i,t+i-1} + t^k_{t+i-1}r_{t+i-1}a_{i,t+i-1} - m_{i,t+i-1}\right]$$

where $q_1 = 1$ and $q_t = q_{t-1}\dfrac{1}{1+(1-t^k_t)r_t}, t = 2,3,...$

We should do the equivalent calculation for the initial old.

The theoretical model offers a natural discount rate since it is possible to use the market clearing interest rate[8].

It is important to remark that individual generational accounts are just a metric to measure tax incidence and would not necessarily be related to the equilibrium in the model. In equilibrium, the government intertemporal budget constraint is always satisfied. However, the implied individual generational accounts and imbalances do not have to be consistent with the government budget constraint unless we use the market discount rate. We simply use the model to generate data that then is used to measure tax incidence by constructing generational accounts.

The Tax Incidence Measurement Bias of Generational Accounts

To illustrate the measurement bias of the tax incidence implied by the generational accounts, it is useful to state and prove a well-known equivalence result. Then, we use this equivalence to show that the generational accounting measurements are not identical across equivalent tax policies.

[8]Consequently, the long-run effects of demographic shocks or policy changes will impact future discount rates through changes in the capital-output ratio. This efficiency effect is usually not captured when the generation accounts are computed directly from the data, and the discount rate is fixed.

Proposition 1: Let $(\hat{t}, \hat{m}, \hat{B})$ be a feasible fiscal policy, and let $\left\{(\hat{c}_{i,t}, \hat{l}_{i,t})_{i=1}^{I}, \hat{K}_t\right\}$ be the resulting allocation. Then, there exists a fiscal policy $(\tilde{t}, \tilde{m}, \tilde{B})$ and a distribution of assets $(\tilde{a}_{i,t})_{i=1}^{I}$ such that $\left\{(\hat{c}_{i,t}, \hat{l}_{i,t})_{i=1}^{I}, \hat{K}_t\right\}$ is the equilibrium allocation corresponding to $(\tilde{t}, \tilde{m}, \tilde{B})$.

Moreover, the associated generational accounts would in general differ between policy $(\hat{t}, \hat{m}, \hat{B})$ and policy $(\tilde{t}, \tilde{m}, \tilde{B})$.

Proof: Any equilibrium allocation must satisfy the following first order conditions:

$$\frac{u^c_{i,t+i-1}}{u^c_{i+1,t+i}} = \frac{1+t^c_{t+i-1}}{1+t^c_{t+i}}\left[1+\left(1-t^k_{t+i}\right)r_{t+i}\right], \quad i = 1,\dots,I-1$$

$$-\frac{u^l_{i,t+i-1}}{u^c_{i,t+i-1}} = \frac{1-t^l_{t+i-1}}{1+t^c_{t+i-1}} w_{t+i-1}e_i, \quad i = 1,\dots,i_r$$

$$\sum_{i=1}^{I} q_{t+i-1}\left(1+t^c_{t+i-1}\right)c_{i,t+i-1} = \sum_{i=1}^{I} q_{t+i-1}\left(1-t^l_{t+i-1}\right)w_{t+i-1}e_i l_{i,t+i-1} + \sum_{i=1}^{I} q_{t+i-1}m_{i,t+i-1}$$

Clearly there is more than one policy that can implement the same allocation, since there are $2*J$ equations and there are $4*J$ fiscal variables to determine given an allocation. Given an alternative fiscal policy, assets can then be constructed directly from the sequential budget constraints. Notice then that aggregate wealth would change, and as a consequence government debt changes since the aggregate capital stock is unchanged. Finally, the new level of government debt must necessarily balance the government budget constraint by Walras' Law.

In general, the associated generational accounts measurement would change, even though allocations and hence welfare are the same. In order to see that the generational accounts must change for at least one generation it suffices to recall Equation ():

$$\sum_{s=0}^{d} m_{t,t-s}b_{t,t-s} + \sum_{s=1}^{\infty}\frac{m_{t,t+s}b_{t,t+s}}{R^s} = B_t + \sum_{s=1}^{\infty}\frac{G_{t+s}}{R^s}$$

Notice that since aggregate debt in general changes across equivalent policies the right hand side must change. Therefore the left hand side must change as well. ■

This result has two important implications.[9] From the positive point of view, the measurement of tax incidence implied by generational accounts does not provide an accurate description (or invariant metric) of generational imbalances of the effective tax burden faced by different cohorts. From a normative point of view, the evaluation of tax policies based on the distribution of tax burden for different cohorts could mislead the true cost for each cohort. Our results show that we could be evaluating the implied tax incidence of different policies on different cohorts and using the generational accounts to conclude that one policy does a better job than other. Nevertheless, these policies could be equivalent from the household perspective, but the generational accounts would lead to a different conclusion.

Generational Accounting Based on the Households' Intertemporal Budget Constraint

One of the main problems in using the generational accounts to measure generational imbalances is the tax treatment of savings. The main result from Proposition 1 states that any equivalent tax policy that requires a different distribution of asset holdings, that includes claims on capital and government debt, is going to lead to different generational accounts.

One way to avoid the problem is to measure tax incidence using the intertemporal budget constraint and effective rather than nominal tax distortions. The idea is very simple, if the tax policies are equivalent the intertemporal budget constraints have to be the same, otherwise consumption-leisure plans would differ. Then, we should measure the magnitude of all the effective taxes paid using the consolidated budget constraint and not what is recorded in the government books.

This alternative procedure can be described as follows. Consider the sequential budget constraint:

[9] There are a few remarks to the proposition. First, notice that the different tax reforms consistent with the proposition might imply a change in statutory tax rates (with the same effective tax wedges), a change in the magnitudes of intergenerational transfers, or both. Second, the result still holds in the presence of borrowing constraint of some form. The proof is very general and holds in a larger class of economies that include uncertainty and certain forms of market frictions. It is sufficient to have a non-empty set of equivalent policies.

$$q_{t+i-1}\left(1+t^{c}_{t+i-1}\right)c_{i,\,t+i-1}+q_{t+i-1}a_{i+1,t+i}=$$
$$q_{t+i-1}\left(1-t^{l}_{t+i-1}\right)w_{t+i-1}e_i l_{i,\,t+i-1}+q_{t+i-1}\left[1+\left(1-t^{k}_{t+i-1}\right)r_{t+i-1}\right]a_{i,t+i-1}+q_{t+i-1}m_{i,\,t+i-1}$$

Define $\tilde{q}_{t+i-1}=q_{t+i-1}\left(1+t^{c}_{t+i-1}\right)$ and $1-f_{t+i-1}=\dfrac{1-t^{l}_{t+i-1}}{1+t^{c}_{t+i-1}}$.

The newborn households' intertemporal budget constraint can be written as:

$$\sum_{i=1}^{I}\tilde{q}_{t+i-1}c_{i,t+i-1}=\sum_{i=1}^{I}\tilde{q}_{t+i-1}\left[\left(1-f_{t+i-1}\right)w_{t+i-1}e_i l_{i,\,t+i-1}+\frac{m_{i,\,t+i-1}}{1+t^{c}_{t+i-1}}\right]$$

Notice that the difference between the market value of the endowment and consumption, valued at the effective price of consumption goods is:

$$\sum_{i=1}^{I}\tilde{q}_{t+i-1}\left(w_{t+i-1}e_i l_{i,\,t+i-1}-c_{i,t+i-1}\right)=\sum_{i=1}^{I}\tilde{q}_{t+i-1}\left[f_{t+i-1}w_{t+i-1}e_i l_{i,\,t+i-1}-\frac{m_{i,\,t+i-1}}{1+t^{c}_{t+i-1}}\right],$$

Undoing the transformation of variables in the right hand side of the previous equation, we arrive at our proposal for measuring tax incidence across cohorts:

$$GA_t^{IBC}=\sum_{i=1}^{I}\frac{q_{t+i-1}}{q_t}\left[\left(t^{c}_{t+i-1}+t^{l}_{t+i-1}\right)w_{t+i-1}e_i l_{i,\,t+i-1}-m_{i,\,t+i-1}\right]$$

Notice that two equivalent policies must satisfy the following first order conditions (and the intertemporal budget constraint):

$$\frac{u^{c}_{i,\,t+i-1}}{u^{c}_{i+1,t+i}}=\frac{\tilde{q}_{t+i-1}}{\tilde{q}_{t+i}}$$

$$-\frac{u^{l}_{i,\,t+i-1}}{u^{c}_{i,\,t+i-1}}=\left(1-f_{t+i-1}\right)w_{t+i-1}e_i$$

It is then clear that equivalent policies should therefore generate the same fiscal burden as measured by Equation (), since the relative price of consumption across periods, the effective taxation of the consumption-leisure margin, and the effective present value of transfers must be the same across equivalent policies.

Therefore, we have provided an alternative measurement of tax incidence that is robust to the choice of tax instruments to decentralize a given allocation. Moreover, it is even simpler in practice, as shown in this direct comparison between our proposal and the standard procedure:

$$GA_t^{IBC} = \sum_{i=1}^{I} \frac{q_{t+i-1}}{q_t} \left[\left(t_{t+i-1}^{c} + t_{t+i-1}^{l} \right) w_{t+i-1} e_i l_{i,\, t+i-1} - m_{i,\, t+i-1} \right]$$

vs

$$ga_t = \sum_{i=1}^{I} \frac{q_{t+i-1}}{q_t} \left[t_{t+i-1}^{c} c_{i,\, t+i-1} + t_{t+i-1}^{l} w_{t+i-1} e_i l_{i,\, t+i-1} + t_{t+i-1}^{k} r_{t+i-1} a_{i,\, t+i-1} - m_{i,\, t+i-1} \right]$$

4. Quantitative Assessment of the Tax Incidence Bias

In this section we want to measure the potential size of the tax incidence bias and compare it to our proposed robust measure. In general it is difficult to characterize the equilibrium path and the optimal decision rules for a given tax policy. In the absence of a closed form solution, we use numerical methods to simulate the policy reforms and compute the implied generational accounts.

As an illustration we perform a Pareto neutral social security privatization that transforms the unfunded system into a funded one with private accounts following Conesa and Garriga (2008a). The tax incidence bias can be measured as the difference between the implied generational accounts across social security regimes, and also comparing the magnitudes with the robust measure.

Parameterization

Next we determine the choice of functional forms and parameters for the model simulation.

Functional forms: We pose a standard log utility function between consumption and leisure:

$$u(c,l) = g \ln c + (1-g)\ln(1-l)$$

where g represents the consumption share on the utility function.

The aggregate technology is a standard constant returns to scale Cobb-Douglas:

$$F(K,L) = K^{a} L^{1-a}$$

where a represents the capital income share in output. We assume that capital depreciates at a constant rate d and there is no exogenous technological growth.

Population structure and income: A model period is equivalent to one year. Given our period choice we assume households live for 65 periods, so that the economically active life of a household starts at age 20 and we assume that households die with certainty at age 85. In the benchmark economy households retire in period 45 (equivalent to age 65 in years). Finally, we normalize the mass of households to be one. We assume that households are endowed with one unit of time. The lifetime profile of efficiency units is constructed using the Current Population Survey data (CPS).

Government policy: The level of government expenditure is exogenously specified as a fraction of output. Revenues come from capital and labor income taxes, and from consumption taxes. In addition the government runs a pay-as-you-go social security system in the benchmark policy scenario. We assume that the tax on capital income is 33 percent, social security contributions are 10.5 percent, and consumption taxes are 5 percent. The labor income tax is chosen to balance the government budget given the target level of outstanding government debt.

Given the assumptions on the functional forms, endowments and tax rates, we jointly solve for the equilibrium and the parameterization using and minimum distance method. The next table, defines the parameter values and the targets.

Table 1: Parameterization of the economy

Statistic	Target	Result
Wealth to GDP	3.00	3.00
Investment to GDP	0.16	0.16
Average Hours Worked	0.33	0.33
Debt to GDP	0.50	0.50
Government Expenditure to GDP	0.20	0.20

Variable	Parameter	Value
Discount factor	b	0.984
Consumption share	g	0.465
Labor income tax	t^{l}	0.220
Depreciation rate	d	0.053

We define aggregate capital to be the level of Fixed Assets in the BEA statistics. The implied capital to output ratio is 3. Government debt is defined as federal, state and local, with an implied ratio to GDP of 0.5. Firms' depreciation rate is chosen to match an investment to output ratio of 16 percent. Another target is the average number of hours worked over the life-cycle, the target is an average of 1/3 of the time of households allocated to market activities. The ratio of government expenditure to GDP is determined to be 20 percent.

A Pareto Neutral Social Security Reform

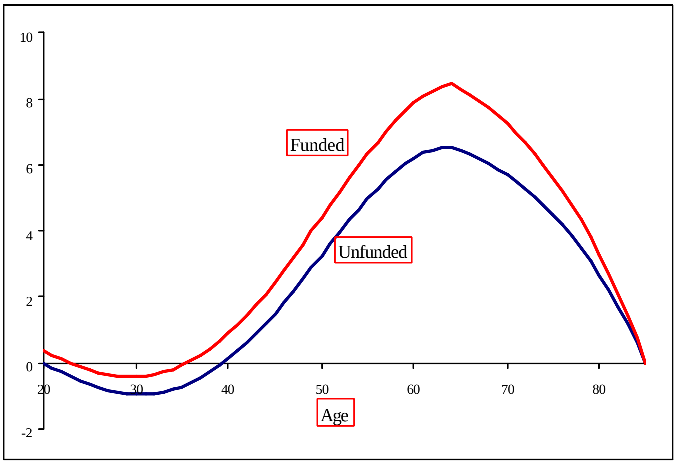
The fiscal reform we examine follows Conesa and Garriga (2008a), and it serves the purpose of illustrating the measurement discrepancies generated by the standard procedure of generational accounting. The idea is to implement a privatization of the social security system while maintaining the level of distortions from the baseline economy.[10] The timing of events works as follows. We assume that at time 1 the

[10] Clearly then it is possible to do better by eliminating distortions, and Conesa and Garriga (2008a) uses optimal fiscal policy to do precisely that.

economy is in steady state with an unfunded social security system. The contributions made by the young generate an entitlement to a future benefit upon retirement, which constitutes an implicit debt of the social security administration towards them. Upon retirement, these retirees receive their claims.

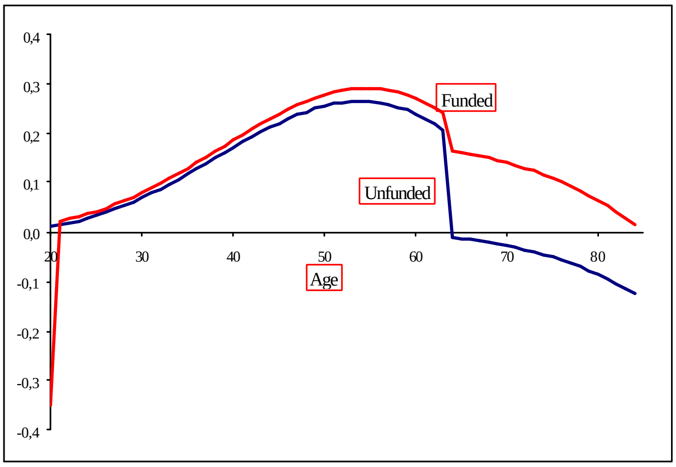
The reform is implemented at $t = 2$. The government eliminates pensions giving compensatory transfers to all households. These household specific transfers are financed with government debt. The privatization effectively transforms the implicit debt of the social security system into explicit debt, but real allocations and welfare remain unchanged. The resulting distribution of wealth is different, since now social security implicit claims are transformed into explicit assets in the hands of households. Figure 1 compares both distributions of wealth.

Figure 1: Asset Distributions over the Lifetime



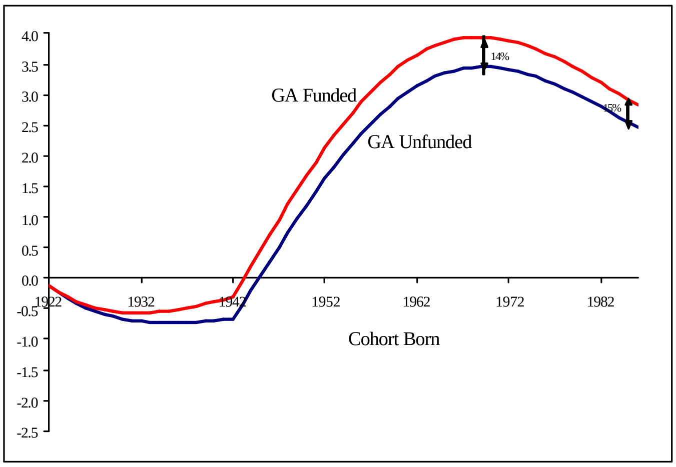
The asset distribution under the funded system is always above the unfunded one, since now workers use the proceedings from social security contributions to invest in private savings accounts. The youngest cohort receives as a transfer an initial level of assets that is equivalent to the net present value of social security transfers. This number ensures that the consumer intertemporal budget constraint is satisfied. The difference between the newly issued government bonds and the initial outstanding government debt determines the implicit debt of the social security system. Figure 2 represents the net taxes paid over the life cycle in these two equivalent policy regimes.

Figure 2: Net taxes paid over the Lifetime



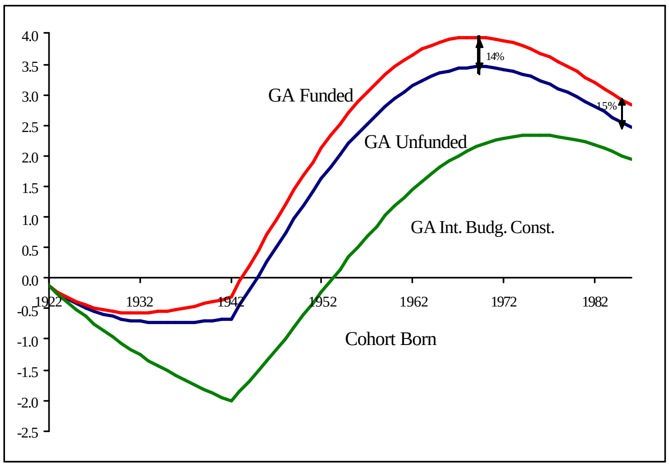
Under the unfunded social security system all the tax burden is placed on the individuals age 65 and below. Retired households pay consumption and capital income taxes, but in net terms they receive resources (their pensions). Under the new regime, retired households do not receive a transfer from the government, and they are fully taxed from the interest earned in the retirement accounts. Despite the differences in the amount of taxes paid, the welfare distribution is the same across tax regimes. Using the net taxes paid and the relative size of each cohort, we can compute the generational accounts of each cohort based on their chronological birth. Figure 3 summarizes the model implied generational accounts for these two equivalent social security regimes using the standard approach.

Figure 3 Generational Accounts



Notice that the standard generational accounting procedure is not invariant between these two equivalent policy regimes since the two curves on Figure 3 do not lie on top of each other. To the contrary, the implied values have a bias that can be as high as 15 percent for the young and middle age cohorts. The bias is purely driven by the fact that government bond holdings are larger in the funded regime, while they are not net wealth. Since capital income (coming from holding government debt or financial assets) is taxed, the imputed tax burden varies across the two policy regimes. However, the proceedings from selling the government bonds are by construction equal to the transfers received from the social security system. The distinction is that under the equivalent policy transfers are computed as a taxable asset and a liability for the government that remains forever, whereas in the other case is a net transfer from the government and funded by workers' contributions (but an implicit liability for the government). Next, we compare this standard measurement with our proposed robust measure for generational accounts.

Figure 4 Generational Accounts based IBC



The generational accounting procedure we propose is based on the intertemporal households' budget constraint, and therefore only accounts for the tax treatment of capital and consumption insofar as they affect the relative price of consumption across time. Also, the measure only considers the effective distortion in the labor supply net of the government transfers received in the corresponding period. As a consequence, the new measure predicts a lower tax burden for all households except for households in their last period.

Notice the large bias of the previous two measurements ("GA Funded" and "GA Unfunded") when compared with the proposed generational accounting metric based on the intertemporal budget constraint. We claim that the new metric is not only robust to the choice of tax instruments, but it is also easier to calculate since it requires less information.

5. Conclusions

In 25 years the U.S. economy will have twice as many retirees but only twenty percent more workers. This demographic transition surely will have an important effect in the government budget unless the benefits from Social Security and Medicare are reduced. The determination of which cohorts are going to bear the cost is very important, but first we need to agree on how to measure generational imbalances.

In the paper we show that the standard generational accounting procedure gives an inaccurate measurement of tax burden imbalances across cohorts. We find that it is possible to construct tax policy reforms consistent with the same pattern of consumption, work effort, and utility across generations, but yield different tax burden measurements when using generational accounting. This result is very important for policy evaluation, since it shows that the selection of tax policies based on generational accounts can be biased.

We quantify the potential bias introduced by the methodology, at the same time that we provide a robust alternative, equally simple in its implementation.

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