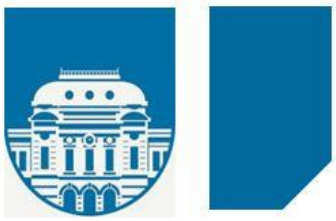

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Documentos de Trabajo

The Distribution and Redistribution of Income in the Presence of Pensions

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Documento No. 03/23
Agosto 2023

ISSN 0797-7484

The Distribution and Redistribution of Income in the Presence of Pensions

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August, 2023

Abstract

In this document, I present a conceptual framework for the analysis of the distribution and redistribution of income in the presence of pensions. The paper makes specific recommendations on the controversial issue of whether pensions should be treated as transfers or "deferred income". I show that most pension programs have both dimensions in different degrees and present a proposal to deal with them in a unified framework. The proposal has specific recommendations in terms of accounting and counterfactuals. Using some simple examples, I show that usual accounting and "nonbehavioral" assumptions —particularly regarding non-labor income— may be very misleading.

Keywords: Pensions, redistribution, fiscal incidence analysis.
JEL Codes: D31, H55, I38

Resumen

En este documento, presento un marco conceptual para el análisis de la distribución y la redistribución del ingreso en presencia de jubilaciones. El artículo hace recomendaciones específicas sobre el tema controversial de si las jubilaciones deberían ser tratadas como transferencias o "ingreso diferido". Muestro que la mayoría de los programas jubilatorios tienen ambas dimensiones en diferentes grados y presento una propuesta para tratarlas en un marco analítico unificado. La propuesta tiene recomendaciones específicas sobre

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[†]Nora Lustig, Andrea Vigorito and participants at the workshop "Methodological Advances in Fiscal Incidence Analysis: Commitment to Equity Institute (CEQ)" held in Universidad de San Andrés, Argentina, in November 2017, provided useful comments. The usual disclaimer applies. A previous version of the present paper was included in 2017 and 2018 in the working paper series of dECON-UDELAR and CEQ Institute, University of Tulane, under the title "Measuring the Redistributive Effect of Pensions"

contabilidad y contrafactuales. Con algunos ejemplos simples, muestro que la contabilidad usual y los supuestos “no comportamentales” —especialmente en relación al ingreso no laboral— pueden conducir a resultados engañosos.

Palabras clave: Jubilaciones, redistribución, análisis de incidencia fiscal.

1 Introduction

In this document, I present a proposal for the analysis of the distribution and redistribution of income in the presence of contributory pensions.[1] The analysis is challenging and has generated controversies in the literature (see, among many others, Atkinson et al. 1995; Blanchet et al. 2021; Breceda et al. 2008; Coronado et al. 2011; Goñi et al. 2011; Immervoll et al. 2008; Lindert et al. 2005; Lustig 2018; Lustig and Higgins 2017; Ranaldi and Milanović 2022). Many studies find that social security has a strong equalizing impact, but Blanchet et al. (2021), Coronado et al. (2011), Lustig and Higgins (2017), and Piketty et al. (2018) warn that this impact is often overestimated because individuals receiving a pension are typically assumed to have no compensating income in the counterfactual scenario without pensions, an assumption that is not warranted.

Lustig and Higgins (2017) coined the expression "false poor" to refer to elderly with relatively large lifetime income that are predicted to be poor in old age in the counterfactual scenario without pensions. This prediction is based on the assumption that individuals would not save for old age even if social security did not exist. As a result, the pension system looks highly redistributive. Coronado et al. (2011) identify basically the same issue, and recommend avoiding the analysis of per-period income —a "flawed concept" in their view— and focus on lifetime income.[2] Blanchet et al. (2021) and Piketty et al. (2018) mention that estimations of inequality using their "factor income" concept may be "artificially" large in aging populations due to the fact that the elderly tend to have little factor income.

I argue in the present paper that the challenges for the estimation of inequality posed by pensions are related to both the nature of pension income and the estimation of income from property of wealth in the counterfactual scenario without pensions. Regarding the nature of income, I propose adopting a standard intertemporal macroeconomics accounting that facilitates identifying correctly the components of income including, in particular, contributory pensions per-period income. I argue that pensions should not be computed as a component of income but as withdrawals from pension wealth and income from pensions should be computed as the return on pension wealth. This approach can be followed in the case of funded and unfunded pension programs, including public PAYG pensions. This measure departs markedly from the conventional approach used in the analysis of per-period income distribution. Regarding the counterfactual, the main challenge is to es-

[1] I use the expression "contributory pensions" in a broad sense, including pensions administered by private and public programs; funded —totally or partially— and unfunded; and defined benefits and defined contributions.

[2] In their words, "...Our goal is not to recreate a perfect measure of a flawed concept (annual income), but simply to demonstrate the large differences in measured progressivity that arise when using annual versus lifetime income."

timate the income from property of wealth individuals would have earned had the pension program not been present. I use a standard life cycle model to provide a consistent answer, valid for both per-period and lifetime income.

I consider a pension program that may redistribute income across individuals and/or across time. I follow a net fiscal system approach in that I consider the whole program, including both benefits and resources used to finance the program (Lambert 1993). In the tradition of Musgrave and Thin (1948), the basic methodology is to compare the distribution of income or wealth with and without the program. This comparison can be made, for example, using the Reynolds-Smolenski index, but the contribution in this document is not related to this choice so I will not discuss this point.[3]

Fiscal incidence analysis is usually done looking at the direct impact of the program, disregarding behavioral responses. The assumption is that the program does not impact on income *before* the program and hence income *after* the program can be computed as income before plus net transfers received from the program. But programs are known to induce behavioral responses like, for example, changes in labor supply or demand. Therefore, income *before* (*after*) is not necessarily the same as income *without* (*with*) the program. The before-after approach assumes it is. Of course, experts in the field are well aware that the non-behavioral assumption is a strong one. The justification for adopting it is twofold. First, it is extremely difficult if not impossible to spell out all the indirect effects that government programs have on individual income. Second, the non-behavioral approach (hopefully) captures the first order effects.[4]

I argue however that simple accounting implies that assuming that the before program income does not change when a government program is introduced amounts to assuming that all the adjustment takes place through consumption. In this sense, the decision the analyst must make is not on whether to assume any response but on where this response will be. I show some cases in which the assumption that income does not respond is probably too strong —particularly so in the case of capital income[5]— and propose options that are arguably more reasonable.

In studies of the fiscal incidence of an existing program, the analyst observes income

[3]An alternative strategy is based on the comparison of the inequality of pension benefits and income, using the progressivity index proposed by (Biggs et al. 2009). Several studies provide estimations of this index (Belloni et al. 2019; OECD 2009, 2013). Belloni et al. (2019) propose and estimate a related index, the Relative Social Security Wealth, that compares at the individual level social security wealth (defined as the expected present value of pension benefits) and lifetime income. As Biggs et al. emphasize, progressivity is different from the reduction of income inequality, since a highly progressive program may not reduce inequality much if, for example, it is small. The focus in the present paper is on income inequality.

[4]Bourguignon and Spadaro (2006) discuss the use of non-behavioral and behavioral micro-simulation models more generally.

[5]This assumption is also at odds with well established results in the empirical literature that analyzes the substitutability between private and pension wealth (Alessie et al. 2013; Attanasio and Brugiavini 2003; Attanasio and Rohwedder 2003; Feldstein 1974; Gale 1998).

(and wealth) with the program and has to infer income without the program. So the challenge in this case is to build a reasonable counterfactual for the economy without the program. The conventional non-behavioral approach assumes that (the unobservable) income without equals (the observed) income with the program minus benefits from plus contributions to the program. In turn, in studies of the impact of a new program, the analyst observes income without the program and has to build a counterfactual for income with the program. For the sake of concreteness, I will focus in what follows in the analysis of the incidence of an existing program, but the issues that arise and possible ways out are similar.

The framework I present can be used to study the impact of pensions on the distribution of both current (per-period) and lifetime income and wealth. Similar frameworks have been used before to study the impact of pensions on the distribution of wealth (see, among many others, Belloni et al. 2019; Biggs et al. 2009; Bönke et al. 2019; Coronado et al. 2011; Fajnzylber 2012; Forteza 2014; Forteza and Mussio 2012; Moncarz 2015; E. N. Wolff 2015; Wroński 2022, 2023; Zylberstajn 2011), but not of per-period income, to the best of my knowledge.[6] The present paper aims at filling this gap. The life-cycle framework informs in non-obvious ways how current income should be computed. Building on standard life-cycle models, I propose a measure of pension income that departs from standard accounting in studies of the distribution of per-period income (Alvaredo et al. 2016; Blanchet et al. 2021; Breceda et al. 2008; Goñi et al. 2011; Immervoll et al. 2008; Lindert et al. 2005; Lustig 2018; Lustig and Higgins 2017).

The present paper is related to at least five strands of literature. First, it is related to a growing literature that, following the seminal paper of Feldstein (1974), analyzes the impact of pensions on the distribution of lifetime income and wealth (see, among others, A. J. Auerbach et al. 2022; Bönke et al. 2019; Feldstein 1976; Frick and Grabka 2010; Olivera 2019; E. Wolff 1987; E. N. Wolff 2015).[7] The present paper contributes mostly to the analysis of current income rather than wealth, but the approach I propose owes much to this literature and is, in my view, complementary and fully consistent with it. Second, this paper is related to the intertemporal macroeconomics literature and especially with life-cycle models, from which I borrow the basic general framework (for textbook presentations, see A. Auerbach and Kotlikoff 1987; Azariadis 1993; Croix and Michel 2002; Feldstein and Liebman 2002; McCandless and Wallace 1991). Third, it is related to the extensive literature on the distribution and redistribution of per-period income (see,

[6] Fullerton and Rogers (1991) discuss lifetime and annual perspectives on tax incidence. Having a different focus, they do not make specific proposals on how to compute per-period pension income or build an appropriate counterfactual in the absence of the pension system. The present paper aims at contributing on these two fronts.

[7] A. J. Auerbach et al. (2022) adopt a lifetime perspective, and introduce the concept of "lifetime spending power" (LSP), which is related but distinct of lifetime income.

among many others, Alvaredo et al. 2016; Atkinson et al. 1995; Belloni et al. 2019; Biggs et al. 2009; Blanchet et al. 2021; Breceda et al. 2008; Goñi et al. 2011; Immervoll et al. 2008; Johnson 1999; Lindert et al. 2005; Lustig 2018; Lustig and Higgins 2017; McGarry 2002). More specifically, the present paper builds on Coronado et al. (2011), Lustig (2018), and Lustig and Higgins (2017), trying to provide a way out of the "false poor" issue. Four, the present paper is related to the literature on microsimulation models and, in particular, to dynamic microsimulation modelling (Bourguignon and Spadaro 2006; Li and O'Donoghue 2013, 2014). Finally, this paper is related to the empirical literature on the substitutability between private and pension wealth (Alessie et al. 2013; Attanasio and Brugiavini 2003; Attanasio and Rohwedder 2003; Feldstein 1974; Gale 1998). By providing a life-cycle framework for the analysis of the distribution and redistribution of income, the present paper facilitates the incorporation of results from this literature with potentially sizeable effects on estimations of the distribution and redistribution of income that is associated to pensions.

I present in section 2 a brief discussion of the involved income and wealth concepts. Section 3 contains the proposal for the analysis of the redistributive impact of pensions. I present first the case of an actuarially fair pension program and then turn to the more challenging case of programs that are not actuarially fair. In order to focus on issues regarding the treatment of returns from wealth, I maintain the non-behavioral assumption for labor income.[8] The goal is to show that the non-response assumption regarding returns from wealth can be particularly problematic in the case of a pension program. In section 4, I discuss my proposal and confront it with other existing approaches. I also comment on several assumptions and discuss some simple extensions. The document ends with some concluding remarks in section 5.

2 Preliminaries: the distribution of what?

2.1 The setting

Consider a population of individuals who live T periods. Let a_{it} represent the wealth (or net assets) held by individual i at the beginning of period t, ra_{it} be the return from those assets, y_{it} be other sources of income, and c_{it} be consumption.[9] Individual i's per period budget constraints are:

$$a_{it+1} - a_{it} = ra_{it} + y_{it} - c_{it} \quad ;t = 1, ..., T \tag{1}$$

[8] This is not a key aspect of the proposal, but just a simplifying assumption adopted to focus on the main argument. I briefly discuss this point in section 4.

[9] For simplicity, I assume the rate of return r is constant.

In this setting, ra_{it} accounts for the return of wealth held in period t, no matter the specific form this wealth takes. It includes interest collected from bank deposits, dividends from bonds, rents from land or houses, etc. It does not include labor income, remittances from abroad, or transfers, which should be included in y_{it}. For the sake of brevity, I will often refer to y_{it} as labor income, even when other sources of income are included in this variable.

The intertemporal or life time budget constraint is computed from the T flow budget constraints (1):

$$\sum_{t=1}^{T} \frac{c_{it}}{(1+r)^{t-1}} = \sum_{t=1}^{T} \frac{y_{it}}{(1+r)^{t-1}} = \bar{y}_i \tag{2}$$

where, for simplicity, I have assumed that there are no bequests: $a_{i1} = a_{iT+1} = 0$, so life-time wealth equals the present value of life-time labor income $\bar{y}_i$.[10]

The intertemporal budget constraint (2) implies that the consumption bundles that the individual can afford depend on life-time wealth. The consumption possibilities do not depend on either the distribution of labor income in the life cycle —i.e. which of the infinite combinations of $(y_{i1}, ..., y_{iT})$ that satisfy equation (2) arise—, or how much individuals save in each period. The wealth saved in period t, a_{it+1}, allow the individual to defer consumption from period t to the future. But deferred consumption and the associated returns from savings do not move the consumption possibilites frontier determined by equation (2). Notwithstanding, analysts of inequality are usually interested in the distribution of per-period income, so they look at y_{it} and ra_{it}. Because of the lack of data, there is much less analysis of the distribution of wealth. In this document, I focus on the distribution of two variables: total per period income $(ra_{it} + y_{it})$ and life time wealth $(\bar{y}_i)$.

2.2 An example

Suppose that the population lives two periods and is composed of two type of individuals, $i \in \{A, B\}$, with the same labor income in both periods, $y_{At} = y_{Bt} = y_t$, but different preferences. Specifically assume that A is more impatient and hence consumes more than B in the first period. As a result, A saves less than B: $0 < a_{A2} < a_{B2}$.

How should we analyze the distribution of income/wealth in this case? We would conclude that the distribution is totally egalitarian if we based our assessment on either lifetime wealth or labor income. However, if we analyzed the distribution of total per-period income, we would conclude that individual A is "poorer" than individual B in the second period: $y_2 + ra_{A2} < y_2 + ra_{B2}$.

Furthermore, the difference between A and B in the second period is even higher if we consider the distribution of purchasing power rather than of income. B has an even

[10] With bequests, the right hand side of equation (2) is $\bar{y}_i + a_{i1} - a_{iT+1}$.

larger purchasing power because the stock of wealth saved in the first period is available to finance consumption in the second period. So the second period purchasing power will be $y_2 + ra_{A2} + a_{A2} < y_2 + ra_{B2} + a_{B2}$.

This is an example in which inequality arises because of different preferences rather than of different initial wealth or non-wealth income. Because of this, some analysts could be inclined to choose measures that indicate that the distribution is equalitarian. The only difference between A and B is, after all, that A preferred to consume more than B in his first period of time. Notwithstanding, in this document, I am agnostic regarding which is the best measure to consider. Given the methodological aims of this note, I do not pronounce any judgement regarding how appropriate these different descriptions are. My only goal is to present internally consistent ways of characterizing inequality, and all of the above are consistent, even if they yield different pictures.[11]

3 The redistribution of income and wealth

3.1 An actuarially fair pension program

Consider again individuals who live T periods. Individual i works and pay contributions τ_{it} until he retires and starts receiving a pension p_{it} in period t_p. In this example, y_{it} represents labor income *strictu senso*.

Saving in the pension program is compulsory, but individuals can also save privately. I then write two per period budget constraints, one for the accumulation of pension wealth (a^p_{it}) or "mandatory savings" and the other one for "voluntary savings" (a^v_{it}):

$$a^p_{it+1} - a^p_{it} = ra^p_{it} - p_{it} + \tau_{it}, \qquad t = 1, ..., T \tag{3}$$

$$a^v_{it+1} - a^v_{it} = ra^v_{it} + y_{it} + p_{it} - \tau_{it} - c^p_{it}, \qquad t = 1, ..., T \tag{4}$$

where c^p_{it} stands for consumption in the economy with the pension program.

Equations (3) and (4)) can be added to compute total savings:

$$(a^p_{it+1} + a^v_{it+1}) - (a^p_{it} + a^v_{it}) = r(a^p_{it} + a^v_{it}) + y_{it} - c^p_{it} \tag{5}$$

The intertemporal budget constraint is

$$\sum_{t=1}^{T} \frac{c^p_{it}}{(1+r)^{t-1}} = \bar{y}_i + ssw_i \tag{6}$$

[11] Slemrod (1992) discusses the potential issues in using snapshot measures of income. Fullerton and Rogers (1991) argue that both annual and lifetime perspectives should be considered in assessing the fairness of a tax system. Notwithstanding, both Slemrod and Fullerton and Rogers arrive to similar conclusions in their empirical analysis using annual and longer period income (averages of income over 1979 to 1985, the former, and lifetime income, the latter).

where ssw_i stands for the social security wealth and is computed as follows

$$ssw_i = \sum_{t=1}^{T} \frac{p_{it} - \tau_{it}}{(1+r)^{t-1}} \tag{7}$$

The intertemporal budget constraint, and the expression of social security wealth as a discounted sum of benefits net of contributions, follow directly from substituting repeatedly the per-period budget constraints (4) and assuming that there are no bequests ($a^v_{i1} = a^v_{i,T+1} = 0$).[12]

Because the program is actuarially fair, i.e. $ssw_i = 0$, it has no impact on life-time income (equation (6). This implies that individuals should consume the same with and without the program: $c_{it} = c^p_{it}$ (see, for example, Azariadis 1993).[13] Using this in the flow budget constraints (1) and (5) I get that:

$$a_{it} = a^p_{it} + a^v_{it} \tag{8}$$

Therefore, assets accumulated in the economy without the program are equal to *total* assets in the economy with the pension program, and hence the unobserved returns from wealth in the economy *without* the pension program can be computed as $r(a^p_{it} + a^v_{it})$. Notice the difference with the common non-behavioral assumption that income in the economy *without* the program is equal to income *before* the program in the economy *with* the program. The assumption of unresponsive income implies an assumption of responsive consumption. Macroeconomics in turn predicts that it is consumption what should not respond in this case, while savings, and hence income from past savings, should accommodate.

This also implies that contributions to the program are actually "mandatory savings" and pensions paid by the program are the returns from those savings. Therefore, total per period income both *without* and *with* the program should be computed as $r(a^p_{it} + a^v_{it}) + y_{it}$. Also, total lifetime income both *without* and *with* the program equals $\bar{y}_i$. The program has no impact whatsoever in the distribution of income.

Lustig and Higgins' "false poor" is the best example I am aware of the errors caused by the assumption that returns from wealth do not respond to the existence of a pension program (Lustig and Higgins 2017). Suppose that individual i retires in period t_p so $y_{it} = 0, t \geq t_p$, and pensions are such that i has decided not to save for retirement, out of the pension program: $a^v_{it} = 0, t \geq t_p$. This individual plans to live in retirement exclusively on pensions (something that is very common for large swaths of the population in many countries). The non-behavioral assumption applied to voluntary savings would imply that

[12] Net meassures of ssw are used, among others, by Gruber (1999) and collaborators. Feldstein (1974) estimates both net and gross measures and E. N. Wolff (2015) uses a gross measure. In my framework, the net meassure follows naturally.

[13] This result can be challenged on several grounds, including distortionary taxation, credit rationing and myopia, to name a few. I briefly comment on these issues in section 4.

income in the counterfactual economy without pensions would be zero from t_p onwards. In this view, the pension program would be taking many people out of extreme poverty in old age, including individuals who have a high lifetime income and simply decided not to privately save because the compulsory pension program made them save enough in the program. According to conventional macroeconomics, this is not a reasonable counterfactual for the economy without pensions. It is more sensible to predict that individual i would save for old age in the economy without pensions.

To see how the "false poor" would bias the fiscal incidence analysis, consider again the example in section 2.2, and assume that contributions to social security are exactly equal to the savings that individuals A are willing to make without the program. Conventional macroeconomic analysis suggests that the introduction of such a pension program would cause that the individual A stopped saving voluntarily and the individual B reduced voluntary savings to $a_{B2} - \tau$. With the non-behavioral assumption, the pension program would appear to raise individuals second period income from 0 to p and from ra_{B2} to $ra_{B2} + p$ in the cases of individuals A and B, respectively. Therefore, the actuarially fair pension program would appear to be reducing inequality, which is of course misleading.

3.2 The general case

In a non actuarially fair pension program the rate of return in the pension fund is not necessarily equal to the market interest rate. Furthermore, it will typically vary across individuals. It can be computed as the internal rate of return of the flow of funds to social security:

$$\sum_{t=1}^{T} \frac{p_{it} - \tau_{it}}{(1+\rho_i)^{t-1}} = 0 \tag{9}$$

Therefore, the flow budget constraints are now as follows:

$$a^p_{it+1} - a^p_{it} = \rho_i a^p_{it} - p_{it} + \tau_{it}, \qquad t = 1, ..., T \tag{10}$$

$$a^v_{it+1} - a^v_{it} = r a^v_{it} + y_{it} + p_{it} - \tau_{it} - c^p_{it}, \qquad t = 1, ..., T \tag{11}$$

The intertemporal budget constraint is still given by equation (6), but $ssw_i \neq 0$ if $\rho_i \neq r$. A non actuarial pension program does change individuals lifetime wealth and hence induces changes in consumption. Therefore, I now introduce some hypothesis regarding the choice of consumption.

Suppose individuals choose consumption to maximize utility subject to the intertemporal budget constraint:

$$\begin{array}{ll} \underset{c_{it} \geq 0}{Maximize} & \sum_{t=1}^{T} \beta^t u(c_{it}) \\ s.t. & equation\ (6) \end{array} \tag{12}$$

where $ssw_i = 0$ in the economy without the pension program or in an economy with an actuarially fair pension program.

The first order conditions for a solution are:[14]

$$\frac{u'(c_{it})}{\beta u'(c_{it+1})} = 1 + r \tag{13}$$

Using the Euler condition (13) and the intertemporal budget constraints (2) and (6), I compute the consumption series for individual i in the economy without and with the pension program, respectively.[15] I then compute assets in the economy without the pension program a_{it} substituting the estimated c_{it} in the flow budget constraint (1). Similarly, I compute assets in the pension program a_{it}^p and voluntary savings a_{it}^v substituting the estimated c_{it}^p in the flow budget constraints (10) and (11).

With these elements, I have all I need to compute income in period t without and with the program:

$$\begin{array}{ll} ra_{it} + y_{it} & \texttt{without the pension program} \\ ra_{it}^v + \rho_i a_{it}^p + y_{it} & \texttt{with the pension program} \end{array} \tag{14}$$

In turn, lifetime income is defined as

$$\begin{array}{ll} \bar{y}_i & \texttt{without the pension program} \\ \bar{y}_i + ssw_i & \texttt{with the pension program} \end{array} \tag{15}$$

and computed using the intertemporal budget constraints, equations (2) and (6).[16]

In order to do these computations, I must simulate the whole series of labor income y_{it}, contributions τ_{it} and pensions p_{it}. The details of these simulations depend of course on the specific norms of each pension program.

Admittedly, these computations require making some assumptions regarding individuals life cycle that look quite strong, especially when only cross section information is available. But it does not seem possible to elude doing this type of computations if one wants to assess the redistributive impact of a pension program. In any case, it is always possible to analyze how sensitive the results are to different sets of assumptions.

3.3 Some implementation challenges and extensions

The most challenging steps in implementing the methodology presented in subsection 3.2 are the simulation of non financial income y_{it}, taxes paid to finance the pension program τ_{it}

[14] I assume an interior solution.

[15] To have an operational expression, I have to assume a specific functional form for the utility function. Common choices are the CRRA, $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$, and the log function $u(c) = ln(c)$.

[16] Notice that, as pointed out by Fullerton and Rogers (1991), per-period income includes capital income (equation (14)), but lifetime income does not (equation (15)).

and pensions received p_{it} during the whole life time, i.e. for $t \in [1,T]$. No general rules can be provided to do these simulations, but some considerations are relevant in most cases:

1. Pension experts usually estimate age income profiles either from longitudinal or even cross sectional data and then apply these profiles to each individual using the observations available about individual income. If the information is cross sectional, like in most household surveys, there will be only one observation per individual.

2. Taxes paid to finance the program τ_{it} should ideally include not only contributions to social security (both personal and employer contributions), but also other taxes that finance the program. Many pension programs that are usually referred to as PAYG are actually hibrids that combine PAYG financing and general government revenues (including ear-marked taxes). Tracing individual tax payments that finance the program is of course challenging. It is also very specific to each program and country, so no general guidelines can be provided.

3. Pensions can be computed using the simulated labor income and the pension rules.

4. In this presentation, I assumed that the age at which individuals die is certain. Under this assumption, T can be computed as life expectancy at birth.[17] A simple extension would be to introduce uncertain longevity, in which case the survivor function should be used to compute social security wealth and the implicit rate of return ρ_i (Gruber and Wise 1999).

   Assuming individuals can buy actuarially fair life insurance, the intertemporal budget constraint they face is

$$\sum_{t=1}^{T} \frac{S_t}{(1+r)^{t-1}} c_{it}^p = \sum_{t=1}^{T} \frac{S_t}{(1+r)^{t-1}} y_{it} + ssw_i = \bar{y}_i + ssw_i \tag{16}$$

$$ssw_i = \sum_{t=1}^{T} \frac{S_t}{(1+r)^{t-1}} (p_{it} - \tau_{it}) \tag{17}$$

   where S_t is the probability of surviving until t, T is the age at which the probability of dying is assumed to be one (the last age in the mortality table) and, as before, I have assumed that there are no bequests: $a_{i1} = a_{iT+1} = 0$, so expected life-time wealth equals the expected present value of life-time labor income $\bar{y}_i$.

   The per period budget constraints are now

$$S_{t+1} a_{it+1}^p = S_t[(1+\rho_i) a_{it}^p - p_{it} + \tau_{it}], \qquad t = 1,...,T \tag{18}$$

$$S_{t+1} a_{it+1}^v = S_t[(1+r) a_{it}^v + y_{it} + p_{it} - \tau_{it} - c_{it}^p], \qquad t = 1,...,T \tag{19}$$

[17] It is at birth because the lifetime flow of consumption is being considered.

and the returns from social security can be computed solving

$$\sum_{t=1}^{T} S_t \frac{p_{it} - \tau_{it}}{(1+\rho_i)^{t-1}} = 0 \tag{20}$$

Finally, per-period income —i.e. $ra_{it}^v + \rho_i a_{it}^p + y_{it}$— can be computed solving the system of equations (13) and (16) to (20).[18] To compute income without social security it suffices to substitute $p_{it} = \tau_{it} = 0, \forall\{i,t\}$ in the same system of equations.

5. Following common practice in the analysis of the distribution of income, I have treated income flows as deterministic variables (for example, y_{it} stands for the non-capital income individual i earns "for sure" in period t). However in reality income flows are random and we only observe realizations of the underlying stochastic processes. Assessing inequality on the basis of observed income in a particular period may lead to an overestimation of inequality because part of it is only the result of temporary fluctuations (A. J. Auerbach et al. 2022; Fullerton and Rogers 1991). This issue is expected to be much less relevant in estimations of lifetime income and lifetime spending power. Coronado et al. (2011) show that inequality of lifetime income is smaller than of annual income in the US.

   One possible extension of the model in the present paper would be to treat income as random variables and estimate inequality of expected (as opposed to realized) per-period income. Such measure would avoid imputing inequality to temporary fluctuations and still estimate inequality of per-period income. Of course, simulating a consistent fully stochastic model is a challenging endeavor (Bourguignon and Spadaro 2006).

6. So far, I have assumed that all contributors get a pension. However, DB pension programs have vesting period conditions and those who do not fulfill these conditions are not entitled to a contributory pension. In this case, contributions become a pure tax.

   If individual i is not entitled to a pension, then $p_{it} = 0$ and $\rho_i = -1$.[19] Substituting in equations (10) and (11), I get

$$a_{it+1}^v - a_{it}^v = ra_{it}^v + y_{it} - \tau_{it} - c_{it}^p \ , \ t = 1, ..., T \tag{21}$$

   Social security assets and income are zero in this case and the individual income with social security is $ra_{it}^v + y_{it} - \tau_{it}$, where a_{it}^v can be computed as before.

[18] The Euler equations (13) remain unchanged, despite of uncertain longevity, thanks to the assumption of a complete set of actuarially fair insurance contracts.

[19] More precisley, $lim_{p_i \to 0} \rho_i = -1$, where $p_i = max\{p_{i1}, p_{i2}, ..., p_{it}, ...\}$. We use here that the first and last terms of pension cash flows are negative and non-negative numbers, respectively.

7. For ease of exposition, I have assumed no bequests, i.e. $a_{i1} = a_{iT+1} = 0$. Dropping this assumption implies that the intertemporal budget constraint is

$$\frac{a_{iT+1}}{(1+r)^{T-1}} = (1+r)a_{i1} + \bar{y}_i + ssw_i - \sum_{t=1}^{T} \frac{c_{it}^p}{(1+r)^{t-1}} \tag{22}$$

Standard macroeconomic models provide concrete guidance on how to include a bequest motive. I only want to point out here that allowing for non-zero initial and final assets can be useful to calibrate reported income from wealth. Probably the simplest possibility is just to assume that $a_{i1} = a_{iT+1}/(1+r)^T$ —i.e. the bequest received equals the present value of the bequest left to the next generation—, without assuming that the bequest is zero.

4 Discussion

The literature has not come to an agreement regarding how to compute pension income (Alvaredo et al. 2016; Blanchet et al. 2021; Breceda et al. 2008; Coronado et al. 2011; Goñi et al. 2011; Immervoll et al. 2008; Lindert et al. 2005; Lustig 2018; Lustig and Higgins 2017; Piketty et al. 2018; Saez and Zucman 2016). Different concepts and measures lead to different estimations of the distribution of income in the presence of pensions and of the redistribution of income caused by pensions. In the present paper, I propose an analytical framework that provides a consistent answer to the questions of how is per-period and lifetime income distributed in the presence of pensions and what is the specific impact of pensions on the redistribution of income. I build on the insights of Coronado et al. (2011), Lustig (2018), and Lustig and Higgins (2017) and recommend solutions that are complementary to theirs.

Coronado et al. (2011) present estimations of the Gini coefficients without and with social security using annual and lifetime income in the US. They estimate falls in the Gini coefficient from 0.64 to 0.55 and from 0.40 to 0.37, when annual and lifetime (capped) income is used, respectively.[20] The apparently strong equilizing effect of social security in annual income mostly stems from the low income retirees are assumed to have in the no-pensions scenario, something that does not necessarily occur when lifetime income is used. Coronado et al. attribute the problem to using annual as opposed to lifetime income, and hence recommend —or at least suggest— moving to the latter.[21] I agree on that the measurement issue associated to annual income does not arise with lifetime income, but I

[20] See table 1 in Coronado et al. for other estimations that yield even lower progressivity of social security. All of these use different concepts of lifetime income.

[21] In their words, "...Our goal is not to recreate a perfect measure of a flawed concept (annual income), but simply to demonstrate the large differences in measured progressivity that arise when using annual versus lifetime income."

argue that this is not an issue related to using annual income but to an incorrect accounting of annual income and its counterfactual. A contribution of the present paper is precisely to provide a way out of this conundrum without abandoning the analysis of the redistribution of per-period income.

Lustig (2018, see particularly section 2.2) also carefully addresses the challenges involved in assessing the redistributive impact of pensions and recommends building three scenarios. In scenario 1, pensions are treated as "deferred income" and hence contributions are a form of forced savings. In scenario 2, pensions are treated as a mix of deferred income and government transfers. Lustig argues that this "hybrid" scenario is relevant "when the contributory pension system is in deficit and part of pensions are funded out of general revenue" (Lustig 2018, p25). In scenario 3, contributions are treated as taxes and pensions as transfers. In the present paper I provide concrete guidance regarding when, why and to what extent pensions should be treated as deferred income and government tranfers. As such, my analysis provides specific recommendations for how to weigh deferred income and government transfers in general (including the "hybrid" scenario and the other limiting two). Notice that current fiscal deficit is not one of the guiding criteria. These recommendations are based on conventional intertemporal macroeconomic theory, providing not only solid grounds to the recommendations but also potentially useful links to this literature.

Following Musgrave and Thin (1948), I propose to assess impact of pensions on income distribution comparing inequality of income with and without the program. This is a net fiscal incidence approach (Lambert 1993) that uses a microsimulation model (Bourguignon and Spadaro 2006). As Blanchet et al. (2021, pp 57-8) explain, fiscal incidence analysis should not be confounded with purely accounting frameworks, like the one developed within the DINA project. In their view, fiscal incidence analysis requires many behavioral assumptions, with "far from obvious" effects, and typically yield different pretax and post-tax total income, which is at odds with an accounting framework like DINA. They conclude that counterfactual studies can use DINA series, but warn that these series "are not meant to answer such questions directly".[22] In other words, accounting frameworks are necessary but not sufficient to assess the redistributive impact of fiscal interventions, pensions and social security. In accordance with this recommendation, in the present paper I propose an analytical framework that includes both an accounting framework and a minimum set of behavioral assumptions.

A behavioral assumption that is key in the proposal in this paper is that individuals do not save the same with and without pensions. The theoretically-based empirical literature that measures the substitutability between private and pension wealth provides strong ev-

[22] I think Blanchet et al. warning also applies to other related accounting frameworks like those proposed in Atkinson et al. (1995), Eurostat (2010), Lustig (2018), Lustig and Higgins (2017), and United Nations (2009).

idence in this regard (Alessie et al. 2013; Attanasio and Brugiavini 2003; Attanasio and Rohwedder 2003; Gale 1998). Adopting a life-cycle framework and conceptualizing pension income as the return of mandatory savings facilitates the use of findings in this related literature to study the impact of pensions on the distribution and redistribution of income.

While motivated by issues in the assessment of the *redistributive* impact of pensions, the framework provided in the present paper also matters for analysis of the *distribution* of income in the presence of contributory pensions. I propose a conceptualization of pension income and wealth that departs from measures commonly used in the literature of income distribution. The computation of income I suggest is summarized in expressions (14). The conventional practice is to use a concept of disposable income contained in the right hand side of equation (11): $ra^v_{it} + y_{it} + p_{it} - \tau_{it}$. In this conventional accounting, pensions are treated as government transfers and social security contributions as taxes.[23]

Blanchet et al. (2021), Piketty et al. (2018), and Saez and Zucman (2016) carefully discuss several conceptual and practical challenges associated to the measurement of wealth and the associated income. Regarding pensions, they distinguish between funded and unfunded pension programs, and include the former but not the latter in their computation of pension wealth. Hence, pension income is not computed as the return of pension wealth but as transfers, save for relatively minor funded programs. They provide several rationales for this choice:

1. They argue that "Unfunded defined benefit pensions are promises of future payments which are not backed by actual wealth" (Saez and Zucman 2016, p. 5).[24] In my view, the exclusion of unfunded pension programs from wealth cannot be based on that they are "promises of future payments"; most financial assets are promises and yet are included as part of wealth. In fact, following United Nations (2009) they include other assets owned by households in their computation of wealth, including financial assets that are also promises of future payments.

2. They argue that governments make other promises, like future Medicare benefits and government spending in education, that should be included as part of individuals' wealth, if Social Security promises are. This is obviously difficult as "it is not clear where to stop" (Saez and Zucman 2016, p 5). While discussing the challenges involved in health care and education is beyond the scope of the present paper, I think

[23] In the case of private pension programs, like many occupational schemes, these are not strictly government transfers, but are transfers anyway, and strongly regulated by law.

[24] They do not mention unfunded defined contribution pensions, probably because this is not relevant for the US. Blanchet et al. (2021) and Piketty et al. (2018) also argue that unfunded pension programs should not be computed as wealth without mentioning whether the programs are defined benefits or contributions. In any case, since the argument seems to be based on the financial regime (unfunded) and not on how risk is shared (defined benefits or contributions), I interpret that unfunded defined contributions plans are also excluded from wealth in DINA computations.

that contributory pensions are fundamentally different from health and education in that pension programs basically substitute private voluntary savings and represent contracts between workers and the sponsors of the programs by which workers contribute for a while to get the right for a pension benefit in the future. This is (mostly) not the case of health and education.

3. They also argue that Social Security payments, as well as other government promises, are not wealth since these "assets (...) cannot be sold on a market" (Blanchet et al. 2021, p 72). Similarly, explaining why they do not include human capital in their computation of US wealth, Saez and Zucman (2016, p 5) argue that it "cannot be sold on markets". However, most funded pension contracts cannot be sold either, and yet Blanchet et al.; Piketty et al.; Saez and Zucman include them in individuals' wealth.

4. Even if human capital is not included in a computation of wealth the returns on human capital are implicitly included in the computation of income through labor income. In this sense, even if controversial, the decision to exclude human capital from computations of wealth may not have a strong impact on the computation of income. Things are very different in the case of pensions. Omitting the income associated to pension wealth leads to "false poor" and "artificially large" inequality issues.

Other highly influential papers and reports that adopt the "conventional" approach include Atkinson et al. (1995), Lustig (2018, in the "pensions-as-government-transfers" or ceq-pgt scenario), Eurostat (2010) and United Nations (2009). The System of National Accounts, uses this notion in the "secondary distribution of income account" construct (United Nations 2009, chapter 8).[25] The European System of Accounts acknowledges the missing pension wealth, but does not incorporate pension entitlements and does not compute the associated income in their core accounts.[26]

In an attempt to decompose total income into capital and labor income, Ranaldi and Milanović (2022) face the challenge of allocating pensions. They present two estimations, one in which pensions are classified as labor income and another one in which some but not all pensions are classified as capital income. In the second estimation, they include "occu-

[25]However, Blanchet et al. (2021) point out that the SNA 2008 treats unfunded employers' pensions, but not Social Security pensions, as wealth. I agree on that there is an inconsistency in treating unfunded employers' pensions differently from public unfunded Social Security pensions.

[26]In their words, "Estimates of the outstanding amounts of entitlements under social security pension schemes as well as of any other employment-related defined benefit pension scheme provided by general government are not included in the core national accounts but are recorded in the supplementary table for accrued to-date pension entitlements shown in Table 17.5" (Eurostat 2010). The income that should be associated to these entitlements is not even mentioned.

pational and private" pensions as capital income, on the grounds that they are "received as a return on forced or voluntary saving made during the working life". Other pensions are assigned to labor income. The two estimations differ from the proposal in the present paper. In my view, the legal status of the pension program —private, occupational, public— is irrelevant for the computation of pension income. The inclusion of "occupational and private" pensions as part of capital income in Ranaldi and Milanović second estimation is closer to the proposal in the present paper, but the computation is very different since they identify pensions with income. In the approach proposed in this paper, pensions are a mix of returns and disinvestment from pension wealth. Income from pensions is only the return of pension wealth.

In countries with large contributory pension systems, measured inequality of income may be considerably different using the concept proposed in the present paper and the more standard conceptualization of pension income used in the above mentioned literature. Commenting DINA series, Blanchet et al. (2021, pp 56-57) point out that "cross-sectional inequality of factor incomes looks artificially large in countries and time periods with an older population" (see also Piketty et al. 2018). The "artificially large" inequality in "pretax factor income" stems from the fact that the elderly have little factor income and hence look as "poor" in this accounting.[27] The distribution looks more equal using "pretax income" because pensions are added to the small factor income of the elderly. In my view, this is another appearance of the "false poor" issue. The DINA framework does not compute returns from pension wealth, treats pensions as income (not considering its mixed nature as income and wealth disinvestment) and assumes capital income is the same "before" and "after" pensions.

It goes without saying that the proposal for computing per-period social security income contained in this paper does not address several important concerns and methodological challenges discussed in the literature (see, among many others, Atkinson et al. 1995; A. J. Auerbach et al. 2022; Blanchet et al. 2021; Coronado et al. 2011; Fullerton and Rogers 1991). It is only geared at solving conceptual issues regarding (i) the nature of pensions, contributions and social security income and (ii) the simulation of capital income in counterfactual scenarios without pensions. Other important concerns that have been highlighted and addressed elsewhere include (i) the impact of fluctuations in measures of realized per-period income, (ii) the computation of home work, (iii) the relevance of household as opposed to individual income, and (iv) the impact of hump-shaped age-income profiles (Coronado et al. 2011; Fullerton and Rogers 1991). The DINA project tackles a key challenge in the estimation of the distribution of income which is the gap be-

[27] "Pretax factor income" and "pretax, post-replacement income" (also called "pretax income", for short) account for income "before" and "after" the operation of the pension system, respectively. The "pretax income" is computed as the "pretax factor income" plus pensions minus contributions.

tween income measured using surveys (and other sources) and national accounts. Blanchet et al. (2021) also carefully discuss other important methodological challenges, including (i) the unit of observation (individuals, households, tax units, adults vs adults and children, equivalence scales), (ii) prices and currency conversion, (iii) the computation of net foreign income, (iv) consumption of fixed capital, and (v) the separation of income from households, corporations and general government. I fully agree with these points and only briefly address some of them in section 3.3.

The methodology proposed in this paper rests on some maintained assumptions which I now discuss.

1. Exogenously given interest rate. According to macroeconomics, pension programs should modify the interest rate, unless the programs are fully funded and actuarially fair. The assumption I have made that the interest rate is exogenous could be questioned on these grounds. However, it can be reconciled with conventional macroeconomics assuming that we are modeling a small open economy with perfect mobility of capital. The economy we are modeling is price taker in financial markets.

2. Nonresponsive non-capital income. For simplicity, and following common practice in the analysis of redistribution of income, I assumed that social security has no impact on non-capital income (see, for example Alessie et al. 2013).[28] However Gruber and Wise (2002) and Jiménez Martín and Sánchez Martín (2007), among many others, show that pension programs induce individuals to retire earlier, affecting labor income. Also, as Feldstein (1974) noticed, this behavioral response in labor supply may induce individuals to save more, countervailing the direct effect of pensions on savings emphasized in this paper. If one is concerned about this possibility in a specific application, it is possible to simulate different retirement ages in the economy with and without pensions. This provides a clear idea of the sensitivity of the results to the assumption that labor income is exogenous.

3. Rationality. The methodology I propose assumes individuals choose consumption and savings maximizing expected utility subject to an intertemporal budget constraint, using efficiently all the information they have. In particular, the counterfactual I propose for the economy without pensions rests on the hypothesis that without the pension program individuals would save for old age. However, it is often argued that one of the reasons why pension programs are needed is that individuals behave myopically and may not save enough for old age (see Barr 2001, among others).

[28] Bourguignon and Spadaro (2006) mention several surveys of an extensive literature that use non-behavioral microsimulation models —arithmetical MSM— to study reforms of tax-benefit systems and public spending in education or health.

This type of concerns might be addressed assuming hyperbolic preferences. But this is not the same as just assuming that a pension program does not impact on financial income, as it is usually done in non-behavioral fiscal incidence analysis.

4. Lagged response and counterfactuals. It can be argued that individuals will not immediately adjust savings decisions when there is a change in pension programs. In particular, cohorts that are alive when a reform takes place will of course not fully adjust. The methodology is not designed for the analysis of pension reform dynamics. The goal is to compare the distribution of income with and without the program so I focus on the steady states. What this methodology provides is a systematic way of building a reasonable counterfactual for the observed economy.

5. Credit rationing. For the sake of simplicity, I have assumed that individuals have complete access to credit, but this is not a fundamental attribute of the framework. Credit rationing might induce paths of consumption and savings different from what I have assumed in this document. This could be particularly relevant for the analysis of the redistributive impact of pensions if low income households tend to be more credit rationed than middle and high income ones. Attanasio and Rohwedder (2003) report much smaller substitutability between private and pension wealth among low income individuals and hypothesize this might be due to credit rationing. Their results could be used in simulations of the redistributive impact of pensions based on the framework proposed in this paper assuming that low income individuals experience credit rationing to a larger degree than middle and high income individuals.

6. Save for a brief comment in item 5 of section 3.3, I assumed that the flow of income is certain. Appart from the behavioral implications of uncertainty that I am not analyzing, this assumption implies that I am measuring ex-post redistribution, i.e. the redistribution that is associated to a given realization of the income shocks. Addmitedly, this option is controversial, but I think it is appropiate to study the impact of pensions on income of individuals who happened to have good and bad income shocks. In particular, I am interested in studying how the pension program impacts on the distribution of income when some individuals do not achieve the minimum number of periods of contributions required to access a pension. As I showed in subsection 3.3, item 6, contributions to the pension program are pure taxes for these individuals, so they become poorer in the presence of the program. In turn, it has been reported that low income individuals face a comparatively high risk of not fulfilling the access conditions (Bucheli et al. 2010; Zunino et al. 2020). So this is a potentially important channel of regressivity in social security.

5 Concluding remarks

I make two main points in this document, regarding the **accounting** and the **counterfactuals** in fiscal incidence analysis of pension programs.

Regarding accounting, I argue that contributions and pensions should not be computed as income, but as investment. For the same reasons a purchase of a bond is not registered as a decrease of income, a contribution to a pension program should not be computed as a reduction in disposable income. Also, for the same reasons individuals income is not increased when individuals sell a bond, it is not increased when the individual "withdraw" a pension from his pension fund. The bond sale and the pension are disinvestments that will affect the following period income, but the operations of selling a bond and receiving a pension do not have the nature of income. The concept of income that should be associated to the pension program is the flow of returns from the pension wealth. Contributions and pensions have the nature of "deposits" to and "withdrawals" from the pension wealth.

Notice that it is not necessary that a pension fund exists for this to be a valid representation. In unfunded or PAYG programs, there are no explicit assets backing the social security promise of a future pension, but the promise is a debt for the sponsor of the program and wealth for contributors.

The second point I make is that the common assumption that the non-pension income from wealth does not change when a pension program is introduced or significantly reformed does not look appropriate in many relevant cases. Standard macroeconomics suggests that pension wealth will most likely crowd out private wealth. In particular, if the program is actuarially fair, it could be argued that the most reasonable prediction would be of total crowding out so the program should have no effects on income. Whether the crowding out is total or partial —or even there is some crowding in— depends on preferences, the functioning of financial markets and characteristics of the program, and is ultimately an empirical question, but the non-behavioral assumption that there is no response is extreme indeed. It amounts to assuming that there is no crowding out at all. Several empirical studies show varying but sizeble levels of crowding out in at least some segments of the population (Attanasio and Brugiavini 2003; Attanasio and Rohwedder 2003).

In practical terms, the no response assumption implies that many retirees who earned high wages when they were active and are receiving good pensions in retirement are assumed to become poor without the program. While this assumption can be justified to some extent arguing myopia, it looks like an extreme assumption that requires at least some more careful justification.

As mentioned before, the proposal in the present paper is based on a long tradition in intertemporal macroeconomics and is also fully consistent with traditional analysis of the distribution of wealth (see, among many others, Alessie et al. 2013; Attanasio and

Brugiavini 2003; Azariadis 1993; Croix and Michel 2002; Feldstein 1974; Feldstein and Liebman 2002; Gale 1998; Kotlikoff and Wise 1987; E. Wolff 1987). But it departs from many highly influential papers and reports that study the distribution and redistribution of per-period income (Atkinson et al. 1995; Blanchet et al. 2021; Eurostat 2010; Lustig and Higgins 2017; Piketty et al. 2018; Saez and Zucman 2016; United Nations 2009). I hope this paper contributes to build a bridge between these two important strands of the economic literature.

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