Implicit redistribution in the Chilean Social Insurance System

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Abstract

Social insurance schemes usually carry a certain degree of implicit redistribution, as certain individuals receive more or less than the monetary equivalents of the contributions they have made. This is usually the case of defined benefit insurance programs. In contrast with traditional designs, Chile has followed a different approach in their pension and unemployment insurance schemes. In the case of retirement, a structural reform undergone in 1980 replaced the traditional PAYG defined benefit scheme with a program based on individual accounts and financial savings. Redistribution occurs mainly through an explicit solidarity pillar introduced in 2008, which provides targeted non contributory benefits to individuals with low pensions. The current UI scheme was introduced in 2002 following a similar structure of the pension system but with the inclusion of a solidarity fund. We use contribution histories to compute the level of lifetime redistribution implicit in these two programs. We find essentially no redistribution in the contributory pension pillar but the inclusion of the recently created Solidarity Pillar greatly improves the pension distribution. In contrast, the UI scheme implies fairly limited redistribution – and not necessarily a progressive one – as eligibility conditions are relatively restrictive and tend to favor individuals with relatively stable careers. We also analyze the counterfactual effect of having benefits calculated according to a defined benefit scheme. To make the two systems comparable, we incorporate a distribution neutral tax schedule (with a fixed tax rate) used to finance the solidarity benefits or the DB scheme deficit. The results show that the neutral financing scheme has only a marginal effect in reducing inequality. In contrast, the DB scheme has only a marginal impact in reducing overall income inequality but a significant redistributive impact in reducing the income gap between men and women.

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1. Introduction

Traditional social insurance mechanisms, like pensions or unemployment insurance (UI) schemes were designed to provide some degree of insurance against particular risks faced by individuals: they transfer resources from the good states of nature to bad states; individuals make contributions while they are working under the promise of receiving monetary benefits when they become unemployed, disabled or reach old age. Most often, these benefits are designed following a "defined benefit" approach, i.e., pensions are calculated so as to provide a certain replacement rate (a percentage) of the income stream received by the worker while working. In most cases, the benefits formulae carry a certain degree of implicit redistribution as certain individuals receive more or less than the monetary equivalents of the contributions they have made.

In contrast with the traditional designs, Chile has followed a different approach in their pension and unemployment insurance schemes.

In the case of pensions, a structural reform undergone in 1980 replaced the traditional PAYG defined benefit scheme with a program based on individual accounts, financial savings and competition between private providers. Benefits are calculated following actuarial formulae, so that individuals receive an expected pension stream equivalent to the present value of the contributions made while participating in the labor market. Redistribution occurs mainly through an explicit solidarity pillar introduced in 2008, which provides targeted non contributory benefits to individuals with low pensions.

The current UI scheme was introduced in 2002 following a similar structure of the pension system (savings and private administration, although through a unique provider) but with inclusion of a solidarity fund, which complements individual savings in order to provide defined benefits to participants who are fired and comply with certain density requirements.

In this article, we use contribution histories collected through the pension system to compute the level of lifetime redistribution implicit in the Chilean pension and UI schemes. As expected, we find essentially no redistribution in the contributory pension pillar but the inclusion of the recently created Solidarity Pillar greatly improves the pension distribution, implying a positive redistributive effect of the pension system as a whole. In contrast, the UI scheme implies fairly limited redistribution – and not necessarily a progressive one – as eligibility conditions are relatively restrictive and tend to favor individuals with relatively stable careers.

In section 2, we briefly present the main characteristics of the Chilean pension and UI schemes. In section 3 we provide the conceptual framework, data and methodological details, in section 4 we present out results and in section 5, we conclude.

2.- The Chilean pension and unemployment insurance schemes

In this article, we will concentrate on two main components of the Chilean Social Insurance system: the old age pension system and the unemployment insurance scheme. In this section we will briefly describe the main components of these two programs.

The Chilean pension system can be divided into three main components: the poverty-prevention, contributory and voluntary pillars.[2]

The contributory pillar was drastically reformed in 1980. The previous system was based on a series of pay-as-you-go schemes, with defined benefits calculated as a proportion of the wages received during the last period of employment. These schemes generated burgeoning deficits, reflecting major imbalances between the benefits promised and the contributions actually paid into the system. In 1980, the military government created a single national scheme based on individual accounts, in which each worker's savings were deposited and invested in financial instruments by specialized firms, known as pension fund managers (the AFP system). These fund managers are free to set their commission for the various services provided (collection and recording of contributions, investments, calculation and payment of benefits, and assistance to the public) and individuals can opt to change their AFP at any time.

Prior to the 2008 reform, the poverty-prevention pillar was based on two programs: (i) the non-contributory assistance pension system (PASIS); and (ii) the State guaranteed minimum pensions system (PMG). The latter targeted individuals who, despite having contributed for at least 20 years to the individual capitalization scheme, had failed to accumulate the minimum amount needed to retire.

Finally, a system of tax incentives is available for individuals who make additional voluntary contributions, through a special set of financial products, to supplement the mandatory savings made in the contributory scheme. Funds can be withdrawn before retirement, but persons doing so are penalized through an addition to their income tax liability at the time of the withdrawal.

In this article, we will only model the compulsory components of the pension system, including the solidarity benefits brought by the 2008 reform.[3]

At the end of 2002, Chile introduced a new unemployment insurance (UI) system, which combines self-insurance and social insurance. Under the system, workers and employers contribute to individual savings accounts (SA), whereas the government and employers make contributions to a common pool called the Solidarity Fund (SF). Individuals who become unemployed can draw benefits from their individual account; i.e., they support consumption during spells of unemployment drawing on savings accumulated while working. Upon depletion, and under certain conditions on the type of contract, the number of months of

[2] For more details on the Chilean pension system, including the 2008 reform, see Rofman et al (2010).

[3] More details on the pension calculation methodologies will be provided in section 3.2.2

contributions and the cause of termination, workers may draw from the Solidarity Fund in order to complete a pre-set schedule of benefits (5 monthly payments corresponding to 50%, 45%, 40%, 35% and 30% of previous salary).[4]

3.- Conceptual framework, methodology and data

3.1.- Conceptual framework[5]

Social Insurance programs redistribute income through explicit and implicit mechanisms. Implicit mechanism can operate though the benefit formulae, the covered population or eligibility conditions. First, high mortality rates may reduce the returns low income workers get for their contributions in pension programs when unified mortality tables are used (Garrett, 1995; Duggan et al. 1995; Beach and Davis 1998). Second, government transfers that contribute to finance SS in many countries favor the population that is covered by the programs, which in developing countries tends to be the better off (Rofman et al. 2008). Third, low densities of contribution may leave many workers ineligible for benefits. Low income workers have been shown to have particularly low densities of contribution (Forteza et al. 2009; Berstein et al. 2006). In this article, we focus on this last channel, i.e. the redistribution stemming from the fact that low income workers tend to have systematically shorter contribution histories. It should be clear that we will not assess the impact of different mortality rates and different coverage on implicit redistribution.

We focus on intra-generational redistribution that occurs within one cohort of worker under current pension and UI rules. Our empirical approach is based on running micro-simulations of lifetime income and SS contributions and benefits to assess SS redistribution.

We will consider the individual as the unit of analysis, but it should be noticed that redistribution in the SS system may look very different at the family level. Gustman and Steinmeier (2001) show that, when analyzed at the individual level, the U.S. social security looks very redistributive, favoring low income workers, but it looks much less so at the family level (see also Lambert 1993, p 14).

After projecting contributions and benefits, we construct lifetime transfers indicators based on the Social Security Wealth, defined as the net present value of the expected lifetime flows of contributions and benefits (Gruber and Wise, 1999, 2004; Coile and Gruber, 2001). To present the progressivity of both systems, we construct Lorenz and concentration curves, with and without the two social insurance programs.

Ideally, the assessment of the redistributive impact of social security programs should be based on the comparison of income distribution with and without social security.[6] This is not the

[4] More details on the UI benefit calculations will be provided in section 3.2.3

[5] This subsection draws extensively from the Concept Note: Concepts, data and analytical methods, prepared by Alvaro Forteza for the roject "Assessing Implicit Redistribution within Social Insurance Systems", December 2010.

same as comparing pre- and post-social security income (i.e. income minus contributions plus benefits), as social security could induce changes in work hours, savings, wages and interest rates. In this line, Huggett and Ventura (2000) simulate a fully fledged OLG model of Social Security calibrated with US data. Forteza (2007) follows a similar approach to study the redistributive impact of a social security reform in Uruguay. In a similar vein, albeit not to study redistribution, Jiménez and Sánchez (2007) estimate a structural life cycle model to assess the incentives to retire in the Spanish Social Security System. Auerbach and Kotlikoff (1987) represents a key antecedent in this line of inquiry. One possible drawback of these models is the assumption of full rationality, something that has been subject to much controversy, especially regarding long run decisions like those involved in social security. After all, the most appealed rationale for pension programs is individuals' myopia (Diamond, 2005, chap. 4). In principle, a model with hyperbolic preferences could do the job, but solving and calibrating these models is even more difficult than the already demanding standard optimization full rationality models.

In turn, much of fiscal incidence analysis is done on the non-behavioral type of assumption. It is usually performed under the assumption that pre-tax income is not affected by the tax system. Because of this, it is often interpreted as an analysis of the impact effect of the fiscal system (Lambert, 1993, pp 153, 162, chap 11). One such example is Euromod. Sutherland (2001) warns: "EUROMOD is better-suited to analyzing some types of policy and policy change than others. Since it is a static model, designed to calculate the immediate, "morning after" effect of policy changes, it neither incorporates the effects of behavioural changes (i.e. behaviour does not change) nor the long-term effect of change. Thus it is not the appropriate tool for examining policy that is only designed to change behaviour, nor for policy that can only have its impact in the long term (e.g. some forms of pension policy). It is best-suited to the analysis of policies that have an immediate effect and which depend only on current income and circumstance." (Emphasis added). We will be using life cycle models that are better suited to analyzing the redistributive impact of SS policies than the typical static short run models used in most microsimulations. However, following standard practice in microsimulations, we will not model behavioral responses. Our approach is closer to the literature pioneered by Gruber and Wise (1999, 2004), who designed and computed a series of indicators of SS incentives to retire assuming no explicit behavioral responses.

In our view, these two approaches are largely complementary. The optimization models have the obvious advantage of incorporating behavioral responses, so not only the direct effects of policies are considered, but also the indirect effects that go through behavioral changes. However, in order to keep things manageable, these theoretically ambitious models necessarily make highly stylized assumptions regarding not only individual preferences and constraints,

[6] This is the equivalent to what Lambert (1993, p 266) suggests for the assessment of the impact of income taxes: "…the impact of an income tax can now be judged by comparing the "with-tax" income distribution with the distribution that would pertain in the tax's absence –the "no-tax" distribution rather than the "pre-tax" distribution." It is interesting to notice though, that ten of the eleven chapters of his classical book on distribution and redistribution of income are based on the assumption of invariant pre-tax income distribution.

but also social security programs. Given our goals, this is a serious drawback. We want to assess the lifetime implicit transfers in social security given the observed histories of contribution in Latin American countries. We are only beginning to characterize the very heterogeneous highly fragmented histories of contribution present in the region (Forteza et al. 2009) and pretty far from having optimization models that can fit these patterns. Whether these histories of contribution are optimal responses to social security rules and various shocks is something we cannot answer yet. But given social security rules, it is pretty clear that these patterns of contribution seriously condition effective net transfers to social security. Non-behavioral micro-simulations are based on exogenously given work histories and geared to providing insights on the social security transfers that emerge from those histories. Thanks to their relative simplicity, non behavioral models allow for a much more detailed specification of the policy rules and work histories than intertemporal optimization models. An additional advantage of micro-simulations is that the effects are straightforward, so no black-box issues arise. At the very least, we can expect to capture the first-order impact effects of social security on income distribution. The micro-simulation modeling can thus be seen as a first step in a more ambitious research program that incorporates behavioral responses in a more advanced phase.[7]

3.2.- Data and methodology

All the simulations were done using the *Base de Datos de Historia Previsional de Afiliados de la Superintendencia de Pensiones (HPA)*[8], a data base containing administrative information from a representative sample of participants in the Chilean pension system.[9] The data includes the entire history of contributions made since each individual's affiliation into the system and December 2009.

For the projection, a particular sample of individuals who were born between 1963 and 1967. These individuals were at most 18 years old when the new pension system was put in place, so that their entire contribution history occurred within the new system.

The observed contribution history until December 2009 (when these individuals were between ages 43 and 47) was complemented by projections based on two econometric methods: one for the (log) length of the contribution spell and one for the (log) non-contribution spell. The particular models are presented in the following subsections.

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[7] An example of this strategy is the retirement research line followed by Jiménez and collaborators in the case of Spain (Boldrin et al. 1999, 2004; Jiménez and Sánchez, 2007).

[8] The title translates to "Chilean Pension Supervisor database of contribution histories of participants".

[9] Superintendencia de Pensiones, Base de Datos de Historia Previsional de Afiliados, available in www.spensiones.cl. All results are the sole responsibility of the author and do not implicate the Chilean Pension Supervising Authority.

3.2.1- Projection of spells of contribution and non-contribution

A panel data fixed effect model was estimated for the entire HPA, using the history of contribution spells as the unit of analysis. The precise model was (both for contribution spells as for non-contribution spells):

Where indexes individuals, indexes the spells of each individual and the variable is measured at the beginning of the corresponding spell. The variable represents the individual fixed effects.

The results from these models are presented in the following table. Spells of contributions tend to be longer at older ages, but at a decreasing rate. The rate of increase with is higher among women than men, but not statistically significant. Later spells tend also to be longer. The spells of non-contributions tend to be shorter as individuals age (also at decreasing rate) but later spells are relatively longer than earlier ones.

Table 1 - Estimates from fixed effects linear models for the spells of contribution and non-contributions

	DV=ln(contribution spell)	DV=ln(non-contribution spell)
Age	5.634 (19.65)**	-11.643 (37.74)**
Age^2	-12.307 (32.20)**	4.512 (10.85)**
Age * Female	0.148 (0.30)	0.128 (0.23)
Age^2 * Female	0.159 (0.22)	-1.580 (1.97)*
Spell number	0.051 (41.73)**	0.075 (57.02)**
Observations	171868	147686
Number of id	24182	21561
R-squared	0.02	0.07

Note: Absolute value of t statistics in parentheses, * significant at 5%; ** significant at 1%. The variable *age* was divided by 100 before estimation and Age^2 by 10000.

Based on these models, the history of contributions for the subsample of individuals born in 1963-1967 was completed using the individual level prediction (including the estimated individual fixed effect). For example, the first predicted spell of contributions (indexed by *T*) was estimated as:

From this spell, the age at the beginning of the following spell of non-contributions was recalculated and the second model applied to obtain the predicted spell of non-contributions. This process was repeated until reaching the legal retirement age for each individual (age 60 for women, 65 for men).

3.2.2.- Income projection and pension calculation

A similar fixed effect model for the (log) covered earnings was estimated for the entire sample, according to the following specification.

In a similar way, the projected income was used to impute the covered earnings received during the post 2009 period for each individual in the subsample.

Given the imputed history of contributions, self-financed pensions were calculated for each individual, applying the formulas corresponding to the Chilean individual capitalization scheme. More precisely, the account balance was calculated until legal retirement age (*lra*) and then this balance was converted into an annuity, as a function of age, gender and the interest rate at retirement.[10]

Besides the contribution history, a key component of this calculation is the assumption on pension fund real rates of return ( ) and the annuity rate ( ). To facilitate comparability with other studies, we will assume a constant 3% for the real rate of return, for the annuity rate and for the discount rate introduced in the calculation of lifetime measures (see section 3.2.4).[11]

[10] The 2004 annuity static mortality tables were used both for the annuity estimation and the calculation of lifetime discounted measures.

[11] The natural alternative would have been to use the historical rates for the observed period (between 1981 and 2009), and a constant rate for the post-2009 period. The result of doing so (available from the author upon request) would have been to create significant differences in pension wealth between individuals with different lifetime income, as historical returns have significantly outperformed the administrative fees charged by fund managers. This results in greater wealth received by individuals with higher lifetime income. As a reference, the historical real rate of return on the C fund (the intermediate fund in terms of risk exposure) was on average close to 9% per year for the 1981-2009 period. The use of a constant interest rate (equal to the discount rate) and not including the administrative fee allow us to abstract from these considerations, which are not redistributive in nature.

As the Chilean pension recently underwent a significant reform that included the creation of a New Solidarity Pillar (NSP), we calculated the post NSP pension, using the following formula:[12]

3.2.3.- Unemployment Insurance simulation

For the simulation of the unemployment insurance program, the same set of projected histories of contributions was used. Some additional elements had to be introduced, mainly an imputation procedure for the type of contract and a set of assumptions about the take up behavior of Chilean workers, when they are exposed to an unemployment spell.

The data set used for the construction of simulated histories, extracted from administrative data of the pension system, does not include information about the type of contract for a particular employment relationship. As contributions and benefits from the Chilean UI system depend on this piece of information, it was necessary to apply an imputation procedure. Analyzing administrative data from the UI system, it was assumed that the first 8 contributions of every spell would be under a fixed term contract and the contributions from that moment on would be under an open ended contract.[13]

Take up in the pension system was simply assumed that all individuals retire at their legal retirement age. In the UI system, assumptions have to be made for those situations in which a covered individual is faced with the decision of actually apply for benefits and in some cases, choose between the two existing benefits schedules (withdraw the balance in the individual account or use a combination of individual account and solidarity fund). For simplicity, average observed take-up rates were used to simulate the different choices: 50% of eligible individuals who are exposed to an unemployment spell actually apply for benefits; of these, 80% of those who are eligible for the solidarity fund option actually choose this option.[14]

[12] The NSP provides a subsidized pension equivalent to US$150 for individuals without pension rights, older than 65, who have resided in Chile for at least 20 years and who belong to the 60 poorest fraction of the population. Individuals with pensions below US$510 are given a smaller subsidy, according to the formula. Only the pension level requisite was considered in this simulation, assuming that all participants with low pensions would be entitled. The reform also included other benefits, like a bonus to mothers for each live birth, that were not included in these calculations. See Rofman et al (2009) or Berstein et al (2009) for more details on the 2008 pension reform.

[13] This is a simplifying approximation. From the 2002-2010 data from the UI system, 34% of all contributions made within the first 8 months of a spell correspond to open ended contracts. This figure jumps to 75% for contributions after 8 months. With this assumption, the overall ratio is maintained in the UI data.

[14] In the simulation a random draw from a uniform distribution is compared with the corresponding probability to decide whether a person takes up the program and which option she chooses. It was further assumed that all individuals that complied with the contribution and balance requirements of the solidarity fund had been fired from their previous employment, an additional eligibility requirement.

For this simulation, a 3% real annual interest rate was used to compute the balance in the UI individual accounts.

Finally, it was assumed that once an individual reached retirement age, they would withdraw all the funds in their individual account in one lump sum payment.

With these considerations, the entire contribution and benefit withdrawal history was simulated for each individual in the sample.

3.2.4.- Computation of pre- and post-social-security lifetime income

Starting from the simulated histories and calculation of social security benefits, it is possible to compute lifetime measures of earnings, contributions and benefits. To do so, we essentially calculate net present expected value at age 18 of pre-social security labor income and contributions, pension and unemployment benefits and finally our measures of pre and post social security wealth.

More precisely the different measures presented in the next section are calculated according to the following formulae.[15]

Expected pre-SS lifetime labor income

The expected pre-SS lifetime labor income is the present value of the expected simulated labor income:

$$W(r) = \sum_{a=18}^{r-1} p(a)\, W(a)\, (1+\rho)^{-(a-18)}$$

where:

r is the legal retirement age, $p(a)$ is the probability of worker's survival until age a, conditional on being alive at age eighteen, $W(a)$ is labor income at age a, and ρ is the discount rate.

[15] Our formulas are adapted from the literature that studies incentives to retire (e.g. Blanchet and Pelé, 1999, p132). As discussed earlier, we are implicitly assuming no behavioral responses to the presence of social security programs: we assume that SS does not impact on the age at retirement, so we will use the same value of r to compute the pre- and post-SS labor income. We plan to do some sensitivity analysis changing the age of retirement. Also we will assume that the interruptions in labor history are exogenously given, independent in particular of the unemployment insurance program.

Lifetime Social Security Wealth:

$$SSW = PB + UB - SSC$$

$$PB = \sum_{a=18}^{a=\max age} (1-d(a))B(a,r)(1+\rho)^{-a} + \sum_{a=18}^{a=\max age} d(a)PI(a)(1+\rho)^{-a}$$

$$UB = \sum_{a=18}^{r-1} (1-d(a))UB(a)(1+\rho)^{-a} + \sum_{a=18}^{r-1} d(a)UI(a)(1+\rho)^{-a}$$

$$SSC = \sum_{a=18}^{r-1} (1-d(a))C(a)(1+\rho)^{-a}$$

Where $\max age$ is the maximum potential age, $B(a,r)$ is the amount of retirement benefits at age a conditional on retirement at age r, $d(a)$ is the probability of worker's dying at age a, $PI(a)$ is the pension balance left by the worker to his/her beneficiaries in case of dying at age a,[16] $UB(a)$ is the unemployment benefit collected at age a, $UI(a)$ is the UI balance left by the worker to his/her beneficiaries in case of dying at age a, and $C(a)$ is the amount of contribution to social security at age a;

Expected post-SS lifetime labor income

$$PostSSlifetimelaborincome = \overline{V}(r) + SSW$$

[16] Under the Chilean pension system, when a person dies before retirement, the balance on her account can be used to finance survivorship benefits for eligible family members or becomes part of the inheritance if no eligible members are present. In that sense, the social security contributions are not lost when a person dies before retirement. A similar rule applies to the balance in the individual UI account when a worker dies before retiring. It is important to account for this inheritance effect; if inheritance was not considered, social security wealth would be negative in many cases, as individuals who died before retirement would have contributed without receiving any benefit from those contributions. This is unrealistic under the Chilean pension system. Furthermore, this effect would rise with lifetime labor income, creating the appearance of a redistributive effect. This argument is presented with more detail in Appendix 2.

4. - Social Security and lifetime redistribution

After projecting pensions and UI benefits for all the individuals in the sample, the lifetime measures of Pre-SS labor income (PSSLI), Pension Wealth (PW), UI Wealth (UIW) and Social Security Wealth (SSW) described in section 3 were calculated and the different distribution measures were constructed.[17] In this section we present the results from these calculations.

4.1.- Lifetime income and pension wealth

Figure 1 presents the Lorenz curves for the lifetime pre-SS labor income. The Gini coefficient corresponds to 0.499 (with a 95% confidence interval given by 0.490 and 0.508).

Figure 2 presents the scatter plots of PW against PSSLI, separately for men and women. In both cases, the figure has two parts. There is a perfectly linear negative slope starting from a positive social security wealth and ending when the SS wealth reaches zero. The relationship between lifetime income and SS wealth is flat at the zero level.

The reason for this relationship is very simple. Under the assumptions made to estimate pensions and calculate lifetime income (a unique and constant rate for returns, annuities and discount rate, zero administrative fees and including survivorship benefits or inheritance), the expected present value of pension benefits is, in general, equal to the expected present value of contributions. This is a direct result of the actuarial nature of pension benefits under the Chilean pension system (see Appendix 2). The initial positive wealth with negative slope comes from the New Solidarity Pillar which provides non contributory benefits for individuals with low pensions. The amount of these benefits, by design, decreases linearly with the level of pension which, by the actuarial nature of benefits, is proportional to lifetime income.

A second conclusion that stems from the comparison between men and women in figure 2 is the higher SS wealth of women, relative to men. This does not mean that women have higher pensions than men (which in reality is just the opposite) but that women would receive higher non contributory benefits on top of the actuarially calculated pension benefits. These tend to be higher for two reasons: women retire earlier (legal retirement age is 60 for women and 65 for men) and they live longer. Both components tend to reduce the actuarially calculated pensions and thus increase the expected present value of benefits from the SP. [18]

Figure 3 presents the Lorenz curve for the lifetime post-SS labor income. In this case, the Gini coefficient is smaller than with the pre SS labor income (0.462 instead of the 0.499 for the pre SS case), suggesting that the redistribution occurring through the pension system is in fact

[17] All income measures were expressed in US$ of December 2009.

[18] See Fajnzylber (2009) for a more detailed analysis of the 2008 pension reform on the pension gender gap in Chile.

progressive.[19] This is pretty clear from the very well defined NSP design, aimed at individuals with low lifetime labor income.

Figure 4 presents both the Lorenz curve for lifetime pre-SS labor income and the concentration curve for post-Pensions labor income. It is clear that the income distribution is made more equal with the existence of the pension system. To see this, we computed the Reynolds-Smolensky-type index of net redistributive effect. The existence of the pension system results in an index of 3.769, reflecting a significant reduction in lifetime income inequality.

4.2.- Lifetime income and UI wealth

Following the same structure of the pension analysis, figures 5 to 7 show the corresponding distributional effects of the existence of the UI scheme.

Figure 5 shows the scatter plot of UIW against PSSLI, separately for men and women. As in the pension case, it can be seen that the UI scheme presents a progressive contribution to the income distribution, as individuals with higher lifetime income tend to exhibit lower UI wealth. In fact, most individuals exhibit negative pension wealth with only individuals in the bottom part of the income distribution benefiting from a net surplus from the UI scheme.[20] In this case, all redistribution operates through the solidarity fund. Individuals with open ended contracts contribute 0.8% of their covered wage into the solidarity but only withdraw funds from it if they become unemployed, are eligible for the SF benefits and choose this option. Individuals with higher lifetime income could receive fewer benefits from the SF because they are exposed less frequently to unemployment spells and when they are they are not eligible for SF benefits (because the balance in their individual accounts exceeds the maximum level to be eligible for SF benefits).[21]

No significant differences can be seen between men and women in terms of the progressivity of the UI scheme.

In contrast with the pension system, figures 6 and 7 show that the UI scheme does not imply a significant change in the lifetime income distribution. The corresponding Reynolds-Smolensky-type index of net redistributive effect was estimated at 0.097, reflecting a positive but small reduction in lifetime income inequality.[22]

[19] The gini 95% confidence interval [0.453 ; 0.470] does not overlap with the gini confidence interval for the pre-SS lifetime income case. A formal test of equality of ginis was rejected at any significance level.

[20] It is important to remember that our analysis is only based on lifetime contributions and benefits. A more precise welfare analysis should take into account the consumption smoothing property of the UI scheme, the main reason it is put in place. Berstein et al (2010) conduct this type of welfare analysis.

[21] Given our assumption of a constant take-up probability, the differences could not come from different behavioral assumptions.

[22] In fact, the formal test of the difference suggests a small but statistically significant reduction in the coefficient between pre and post-UI income wealth at any confidence level.

This is the result of the fact that the magnitude of the UI wealth (either positive or negative) is small relative to lifetime income. As has been reported in previous work, the solidarity fund is not used very frequently, giving little scope for a significant redistributive effect.

4.3.- Lifetime income and post social security wealth

Figures 8 to 10 show the combined effect of pensions and UI benefits (generally labeled social security wealth, SSW).

As the importance of the UI is small relative to the pension system, the results from the SS wealth are qualitatively the same as the ones from the pension wealth, except that the combined redistribution is slightly more progressive than redistribution coming only from the pension system (the Reynolds-Smolensky-type index of net redistributive effect is 3.876 for the combined case, in comparison with 3.769 in the pension case).

4.4.- A counterfactual Defined Benefits scheme and Tax financed benefits

So far, the discussion has evolved around the current Chilean pension scheme, which is a combination of a financial defined contribution program based on individual accounts and a solidarity pillar with explicit tax financing and a well defined targeting scheme. There is no implicit redistribution between individuals at the pension level, as the higher-than-actuarial benefits are financed entirely out of general revenues, the source of which has not been modeled.

In this section, we extend the previous analysis by incorporating a simple tax financing rule equivalent to a tax that is fixed proportion of lifetime income. The tax rate is fixed so as to balance the fiscal budget associated with the pension cohort under analysis. More specifically, the tax rate will be calculated as the ratio between the average pension wealth (PW) and the average Pre-SS labor income (PSSLI).

In addition, we present the same indicators for a counterfactual pension system, of the defined benefit type. To fix ideas, we use the same parameters as the Chilean Social Security Service, the largest DB scheme before the 1980 reform that introduced the current DC scheme. This exercise provides us with a stylized comparison of the winners and losers in a DB scheme, vis-a-vis a DC program with a solidarity pillar. To be consistent, the comparison will be done adjusting the tax rate so as to balance both schemes.

Pension benefits under this alternative scheme will be calculated as a certain fraction (the replecament rate, RR) of the average covered income of the 5 years prior to retirement:

The replacement rate is a function of the number of contributions made before retirement. We assume that individuals must have contributed at least 10 years to be eligible for benefits (RR is zero if). With 10 years, the replacement rate is equal to 50% and each additional year of contributions raises the replacement rate by 1%, with a ceiling equal to 70% (RR is 70% if . If the result of this calculation is lower than a certain level (which we have fixed at the same value of the minimum benefit under the NPS, i.e. US$150), than a minimum pension rule applies, raising the pension to this level.

Tax financed benefits

Applying the tax rate formula above, we find that a 5.14% tax rate should be applied to income in order to finance the benefits of the New Solidarity Pillar. We apply this tax rate to compute pension wealth as the previous measure of pension wealth minus the tax component.

Figure 11 shows the equivalent to figure 2, but for PWAT instead of PW. The results are quite different from the previous analysis, in the sense that we can now clearly observe the redistributive impact of the New Solidarity Pillar. Under the assumed tax schedule (the same for every level of income), a large fraction of the individuals with positive pension wealth are now net contributors into the system, as the amount of taxes paid is higher than the benefits received. Only the individuals in the lower part of the lifetime income distribution are net beneficiaries of the scheme. This fraction is larger among women, as their pensions tend to be lower (for a given level of PSSLI) due to their earlier retirement and higher life expectancy and the corresponding NSP benefits higher.

Figure 12 presents the results equivalent to Figure 4, but for after tax post-Pensions labor income. The Reynolds-Smolensky-type index of net redistributive effect is equal to 3.9627, which is slightly higher than the pre-tax equivalent (3.769). This reflects a significant reduction in lifetime income inequality (higher than the pre-tax equivalent). Consistently, the gini coefficient for the after tax post-Pensions labor income is equivalent to 0.4597, slightly lower (but with a statistically significant difference) than the pre-tax equivalent (0.4617).[23]

In summary, allowing for a relatively neutral tax financing slightly improves the redistributive effect of the DC-NSP pension scheme.[24]

[23] Numerical results, including standard errors, are summarized in table 1 at the end of this section.

[24] Clearly, where we to assume a more progressive tax financing scheme, the redistributive impact would be even higher. As the goal of this article is to isolate the redistributive impact of social insurance, we assumed a tax scheme with a constant marginal tax rate.

The Defined Benefit scheme

Using the DB formula described earlier, we recalculated pensions for each individual in the sample and constructed figures 13 and 14, equivalent to figures 11 and 12 but for a DB pension scheme, after the inclusion of a constant tax rate.[25]

In this case, the budget-balancing tax rate would be equivalent to 11.92%, reflecting the fact that under the assumed rules, the system runs into deficits at the cohort level. Part of this result comes from the fact that subsidies (benefits above the actuarial equivalent of contributions made) are potentially paid to individuals in the entire income distribution. This can be seen in figure 13a, which shows the pre-tax Pension wealth under the hypothetical DB scheme. We can see that most individuals have positive (pre-tax) pension wealth and that this tends to exhibit an upward sloping curve, crossing the vertical axis around zero; individuals with higher lifetime labor income tend to receive subsidies that are approximately proportional.

The slope of this relationship is much higher for women, reflecting the fact that under a DB scheme, an earlier retirement and higher life expectancy imply higher pension wealth, rather than lower (as benefits are, in general, not actuarially adjusted for these two factors). In addition, women tend to exhibit lower densities of contributions than men, but especially during the earlier part of their careers. This fact tends to increase the difference between DC and DB benefits, as early contributions are extremely important under a DC scheme, whereas late contributions (including the density of contributions and their covered wage) are more important in DB schemes.

Figure 13b shows the same measure but after withdrawing the tax required to finance the budget deficit associated with the previous figure. As the tax rate is above the slope of the income-subsidy relationship for men (left part of figure 13a), most men end up being net contributors into the system, whereas most women receive a cross subsidy from the scheme. Particularly, women in the middle part of the lifetime income distribution seem to be the most benefited by the DB scheme, whereas high income men are some of the main contributors into the scheme.

Finally, figure 14 shows the overall effect of the DB scheme on the concentration curve of the after tax post pensions labor income distribution. The result is that lifetime income inequality is practically unchanged by the introduction of the DB scheme assumed in this exercise. The gini coefficient for the after tax post pension income distribution is equal to 0.4943, which

[25] Notice that we assumed that under this counterfactual DB scheme, there are no survival benefits for individuals who die before reaching retirement age. This assumption is made to facilitate calculations. The results under the alternative assumption that heirs receive the equivalent to the DC balance when a person dies while active are almost identical to the ones presented here. For instance, the budget balancing tax rate would be 12.71%, instead of 11.92%. The gini coefficient for Post tax Post Pension labor income would be 0.4944, instead of 0.4943. In other words, the inheritance component is almost proportional to lifetime labor income so the increased benefits are upset by the increased tax rate associated with them. This could change if income related mortality tables where used instead of the current tables, fixed for all individuals of the same gender.

represents a small (thought statistically significant) reduction in inequality, relative to the pre-social security income distribution. Consistently, the RS index is relatively small (0.8461) in this case.

The intuition seems to be, from figure 13, that the lower tail of the income distribution is not much affected by the DB scheme (probably because their benefits are closer to an actuarial calculation, as in a DC program). In the rest of the income distribution, there is substantial redistribution from men to women, but which tend to offset each other along the income distribution curve.

Table 1 – summary of results for the pension system

	Gini coefficient	Diff in Gini coeff (relative to pre-SS labor income)	RS index (relative to pre-SS labor income)
Pre-SS labor income	0.4991 (0.0046)*		
Pre tax Post Pension labor income (DC+NSP scheme)	0.4617 (0.0043)*	- 0.0375 (0.0008)*	3.7691
After tax Post Pension labor income (DC+NSP scheme)	0.4597 (0.0043)*	- 0.0394 (0.0008)*	3.9627
After tax Post Pension labor income (DB scheme)	0.4943 (0.0045)*	- 0.0048 (0.0010)*	0.8461

Note: Standard errors in parenthesis. (*) represents statistical significance at the 1% significance level.

5 Conclusions

The introduction, in 1980, of the individual accounts system drastically reduced all forms of redistribution within the contributory pension systems. All benefits are actuarially calculated at the individual level and even if a worker dies before retiring, her funds are used to finance survivorship benefits or become part of her inheritance. The more recent reform, approved in 2008, greatly extended the level and quality of coverage provided by the non contributory component of the pension system. As this program is clearly targeted towards individuals with lower pensions, the lifetime income distribution is made unambigually more equal with the combination of the contributory and non contributory components.

As expected, the simulations in this article confirm that the individual accounts components of both the pension and UI schemes in Chile do not generate redistribution between individuals. The inclusion of solidarity benefits (both in the pension and the UI schemes) create a clearly progressive effect of social security on the distribution of lifetime income. This is a result of explicit targeting of public subsidies under the New Solidarity Pillar (pension scheme) and of some implicit targeting under the rules of the solidarity fund (UI scheme).

Incorporating the financing source of subsidized benefits, through a neutral fixed tax rate for all individuals marginally increases the redistributive effect of the overall DC+Solidarity Pillar pension scheme. Given the actuarial calculation of benefits, there isn't significant redistribution between men and women, except for the fact that the solidarity pillar tend to benefit more women (for a given level of lifetime income), as women retire earlier and live longer and as subsidies are greater for individuals with lower pensions.

In stark contrast, the introduction of a traditional defined benefit scheme, in which pension are a fixed function of the number of contributions and income during the years prior to retirement, does not seem to substantially reduce overall lifetime inequality. The main redistributive effect of this type of scheme seems to be the equalizing effect between men and women. This is the result of two design elements: (i) as defined benefits are, in general, not affected by earlier retirement or higher life expectancy, women receive higher pension wealth for the same level of lifetime income; (ii) the timing of benefit calculations under a DB scheme tends to favor women, as the early interruption in their career has a lower impact on pensions than under an actuarially fair DC program.

It is important to remember that our analysis has focused on lifetime labor income, without considering other sources of income. In principle, if some of the individuals with low labor market attachment are in that situation because they are independent workers or entrepreneurs, the results might seem misleading (the redistribution might not necessarily be going to the least well off individuals). Similarly, it is possible that some of the individuals (particularly women) exhibiting low lifetime income are part of high income households with only one salaried adult. However, the New Solidarity Pillar complements the low pension eligibility requirement with a means-testing procedure (which is not modeled in this article) which operates through a special targeting instrument. In that sense, we expect that the results would be robust to the inclusion of other sources of income and a household level approach.

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APPENDIX 1 – FIGURES

Figure 1 - Lorenz curves of lifetime pre-SS labor income
(Gini = 0.499 , 95% c.i.=[0.490 ; 0.508])

Figure 2 - Plot of PW versus pre-SS labor income (by gender (women labeled 1))

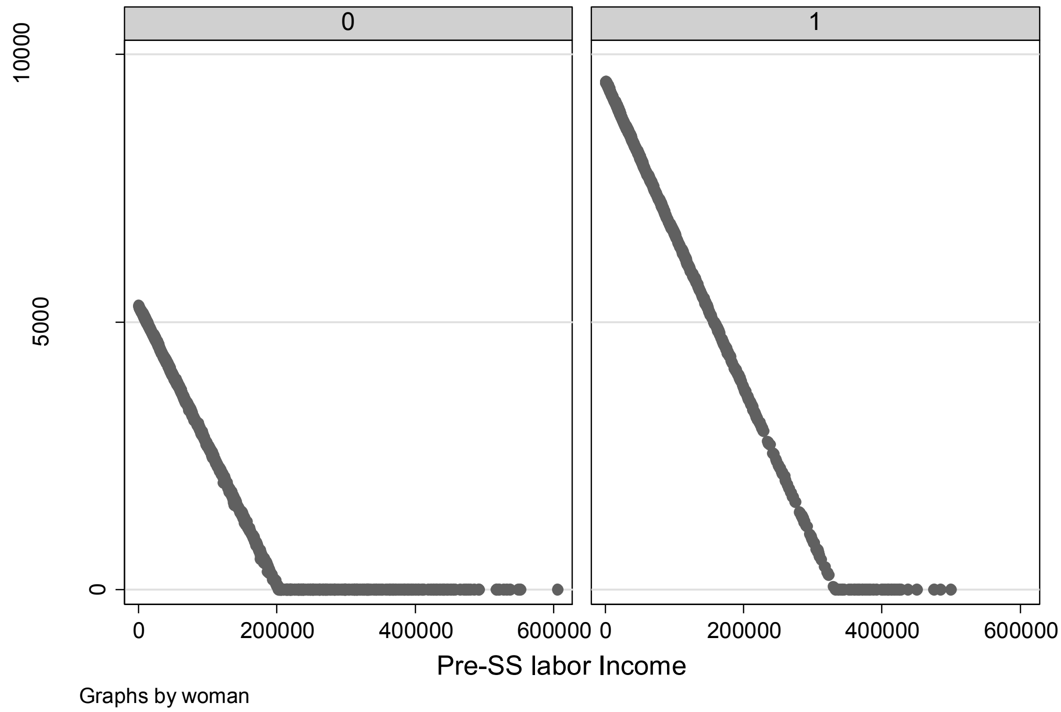


Figure 3 - Lorenz curve of lifetime post-Pensions labor income (Gini = 0.462, 95% c.i.=[0.453 ; 0.470])

Figure 4 - Lorenz curve of lifetime pre-SS labor income and concentration curve of post-Pensions labor income (RS index = 3.769)

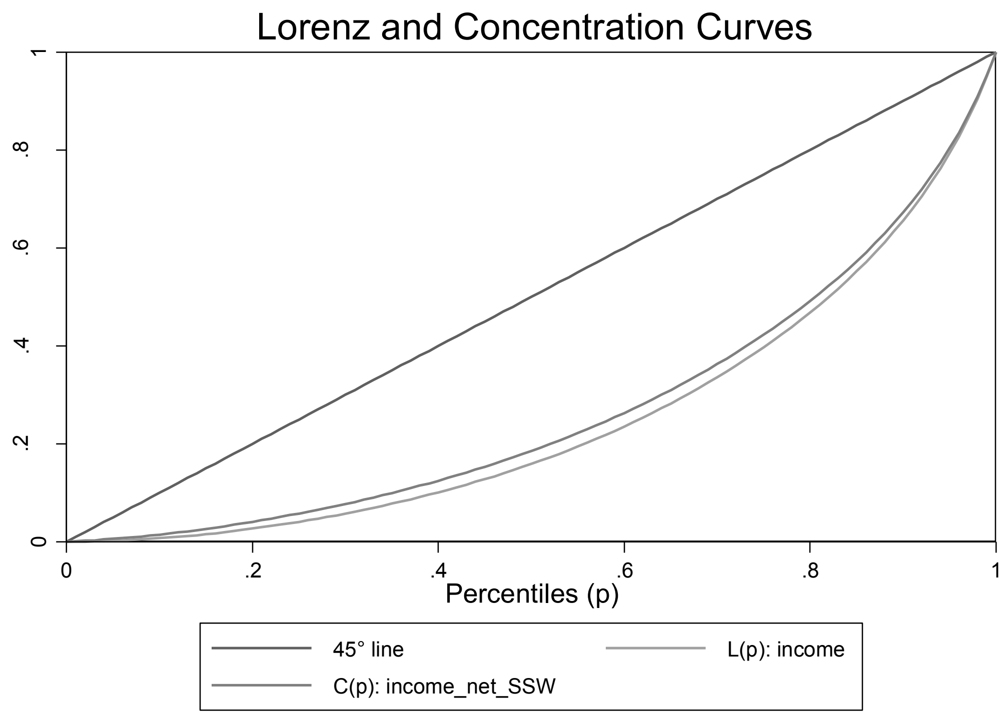


Figure 5 - Plot of UIW versus pre-SS labor income (by gender (women labeled 1))

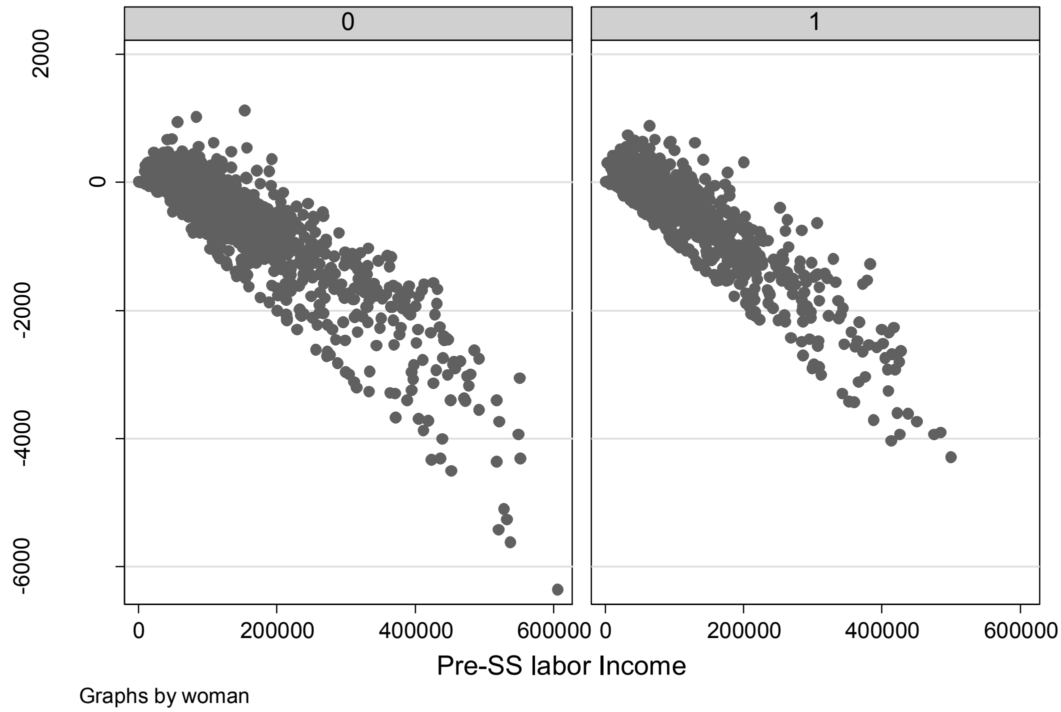


Figure 6 - Lorenz curve of lifetime post-UI labor income
(Gini = 0.498, 95% c.i.=[0.489 ; 0.507])

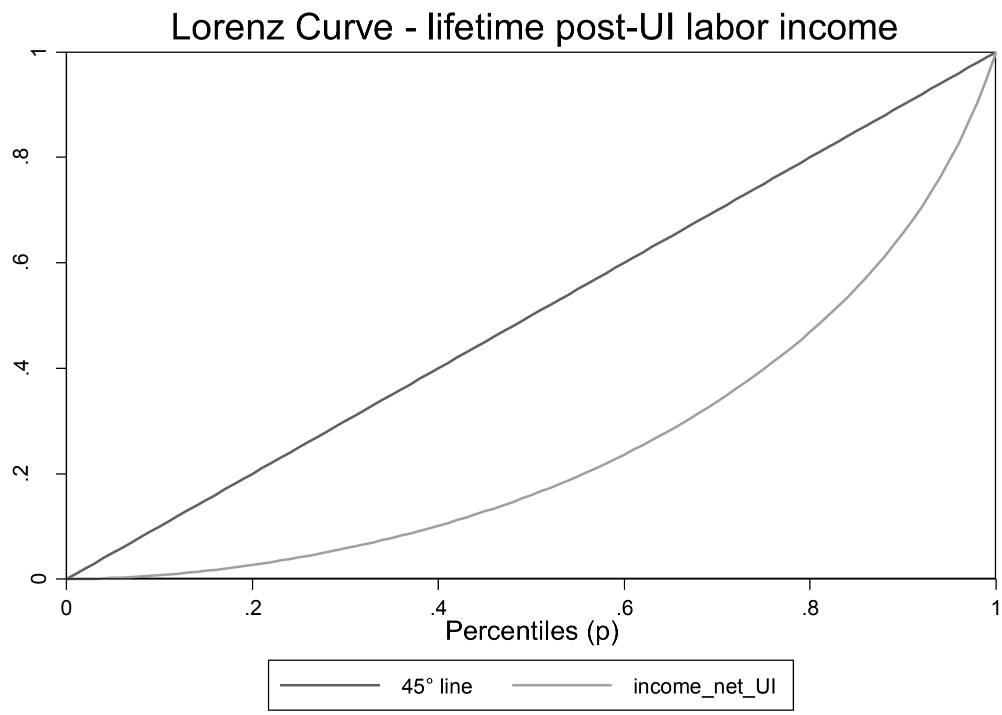


Figure 7 - Lorenz curve of lifetime pre-SS labor income and concentration curve of post-UI labor income. (RS index = 0.097)

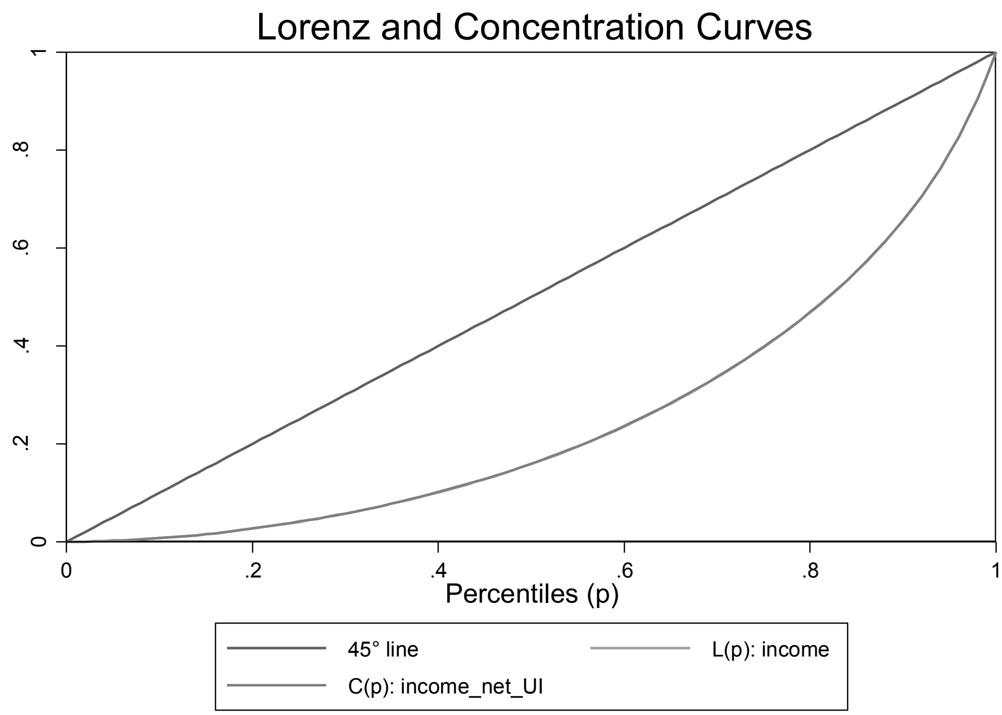


Figure 8 - Plot of SSW versus pre-SS labor income (by gender (women labeled 1))

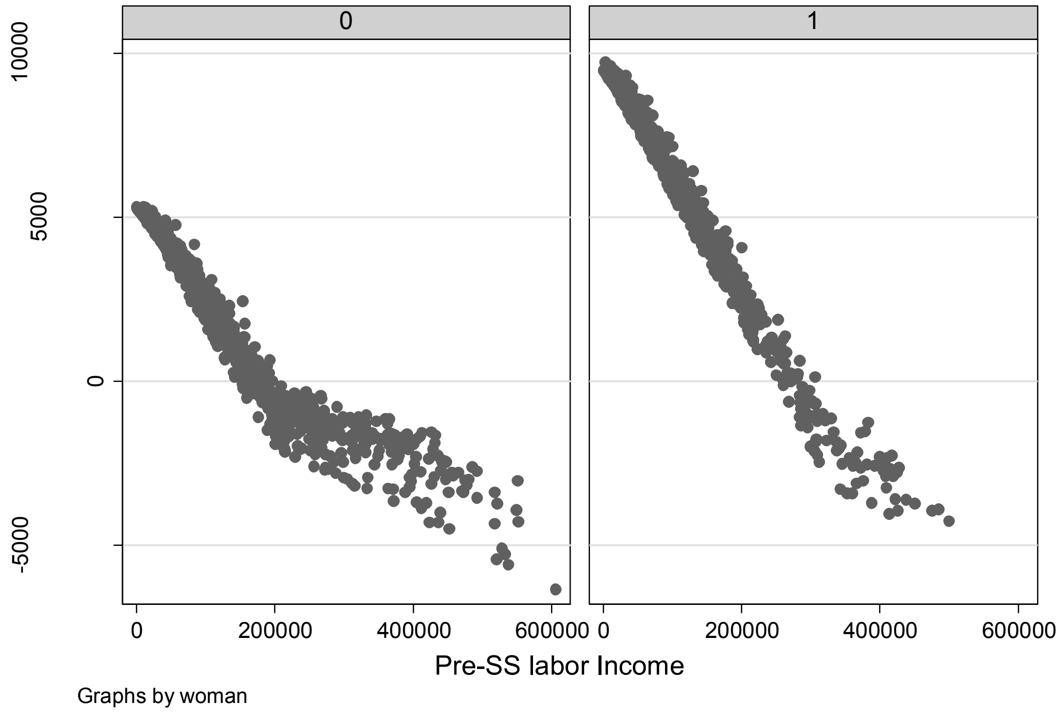


Figure 9 - Lorenz curve of lifetime post-SS labor income
(Gini = 0.461, 95 c.i.=[0.452 ; 0.469])

Figure 10 - Lorenz curve of lifetime pre-SS labor income and concentration curve of post-SS labor income (RS index = 3.876)

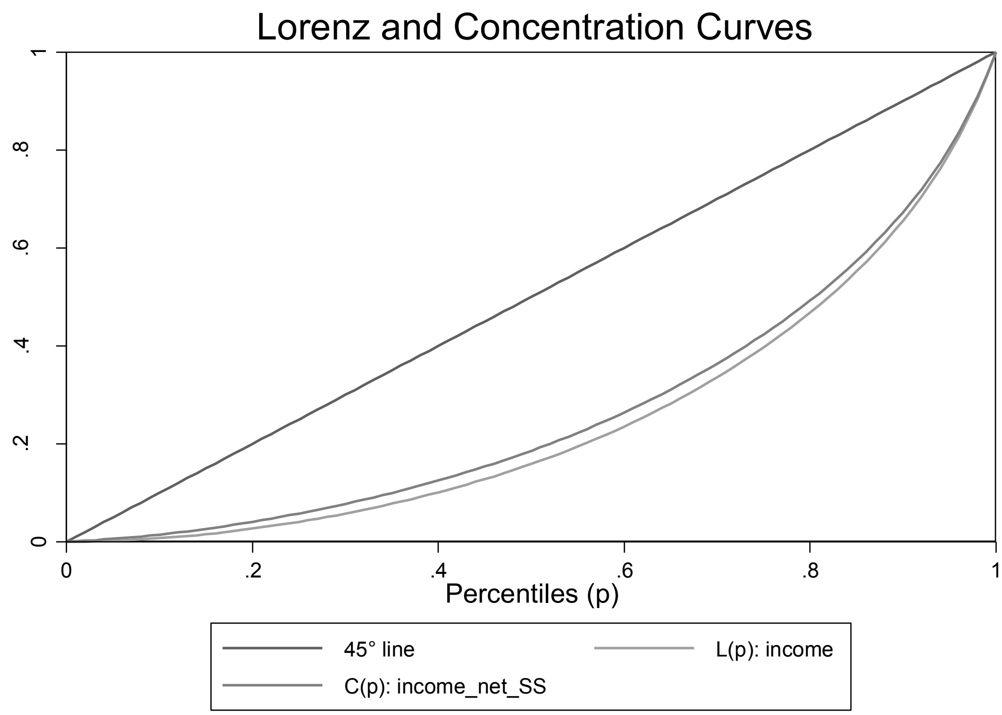


Figure 11 - Plot of PW (after 5.13% tax on labor income) versus pre-SS labor income (by gender (women labeled 1))

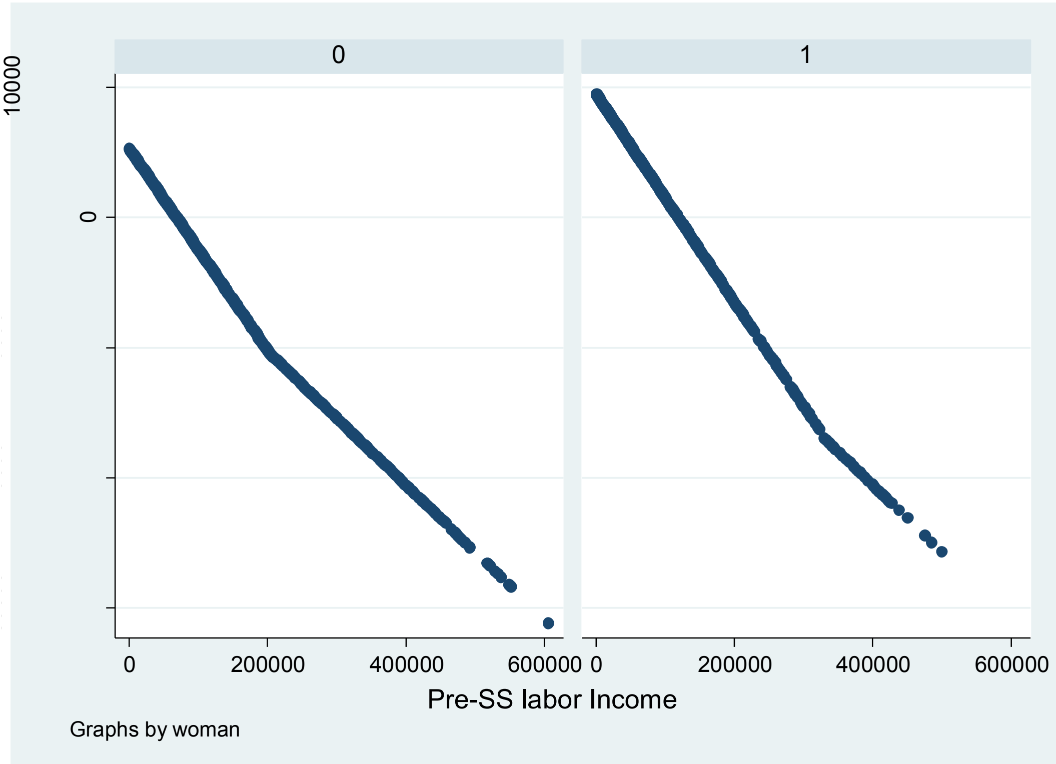


Figure 12 - Lorenz curve of lifetime pre-SS labor income and concentration curve of after tax post-Pensions labor income (RS index = 3.963)

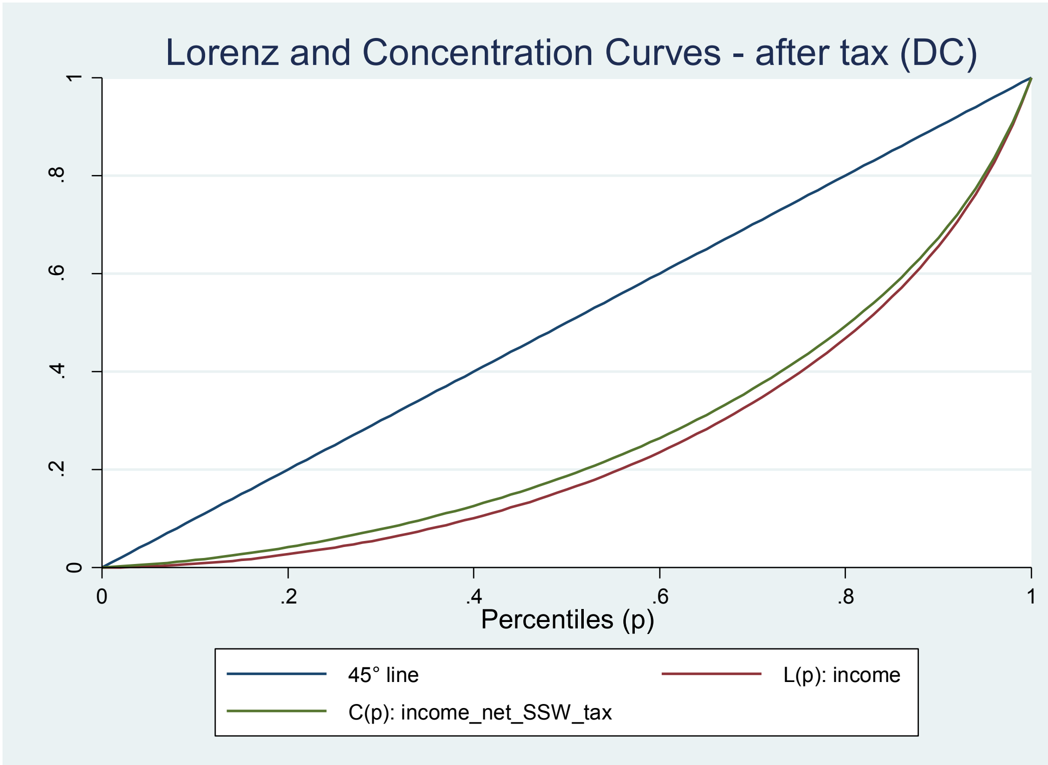


Figure 13a - Plot of PW (<u>before tax</u>) versus pre-SS labor income under <u>DB scheme</u> (by gender (women labeled 1))

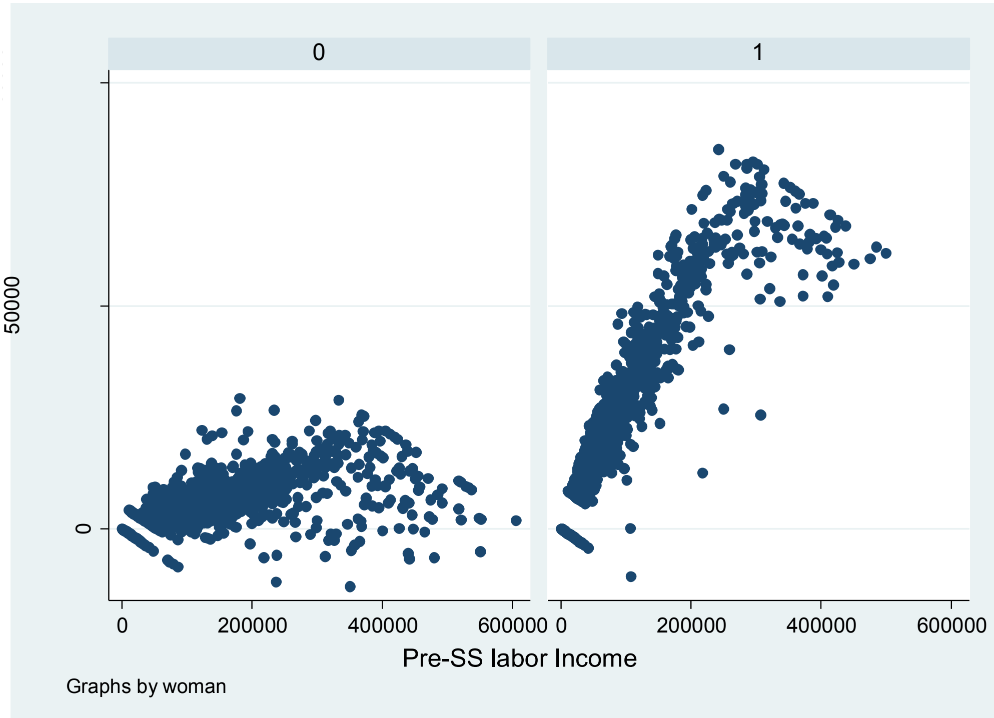
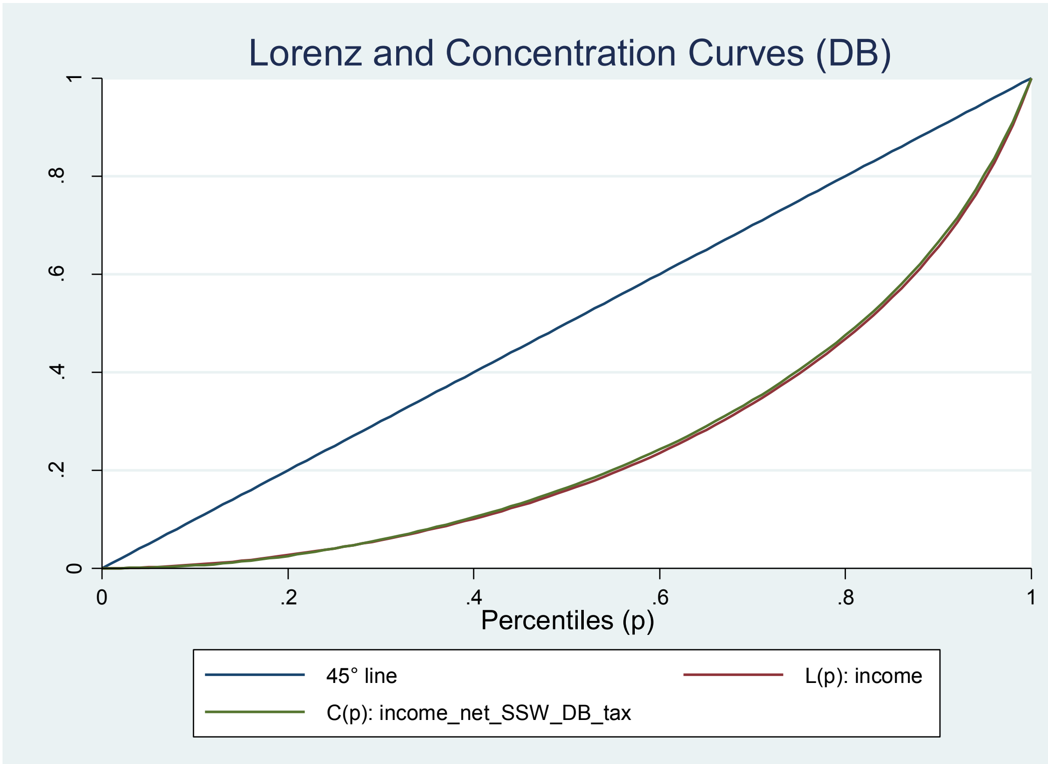


Figure 13b - Plot of PW (<u>after 11.92% tax</u> on labor income) versus pre-SS labor income under <u>DB scheme</u> (by gender (women labeled 1))

Figure 14 - Lorenz curve of lifetime pre-SS labor income and concentration curve of <u>after tax</u> post-Pensions labor income under <u>DB scheme</u> (RS index = 0.846)



APPENDIX 2 – Social Security wealth in an actuarial DC system

In an FDC system, a worker contributes a fixed percentage (that we will call) of their income ( ) to an individual savings account. These contributions earn a financial rate of return over time ( ) until the moment the person retires ( ). At retirement, the balance in the account is then equal to

With this balance, the person (who we assume without legal beneficiaries) would be able to buy a regular annuity (a fixed monthly amount until death) equivalent to[26]

The annuity factor is such that the expected present value of pensions paid to the individual until death is equivalent to the balance in the account:

where is the probability of being alive at age , conditional on being alive at age (which in the Chilean depends on the gender of the individual and the particular mortality table used), is the maximum age used for calculations (110 in the Chilean case) is the annual real interest rate on annuities.

We define pension wealth (*PW*) as the expected present value at age 18 of pensions paid to the individual minus the expected present value of contributions paid into the system.[27]

[26] This analysis is made under the assumption that the worker does not have beneficiaries so that the obligations to the annuity provider end when the worker dies. Accounting for beneficiaries would lead to the same qualitative results but require more complex notations and calculations.

where is the probability of being alive at age , conditional on being alive at age , and is the annual discount factor.

If we assume that all interest rates are constant and equal (=), pension wealth is then equivalent to

where we used the property of conditional expectations (if) and the fact that pensions are only paid starting at retirement age and contributions are only paid up to retirement age. The first summation term is equivalent to the balance at retirement ( ) under the assumption of a constant annuity rate (equal to). The second summation term is similar to the definition of the balance at retirement, except for the probability terms ( ). As the survival probability until an age smaller than retirement is greater than the survival probability until retirement, we have:

This means that, under these definitions, PW would always be negative, meaning that the contributions made are greater (in expected present value) to the benefits received.

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[27] We abstract from administrative fees and higher-than-discount-rate financial returns. In theory, the administrative fee is a reward for making active management that would allow the participant financial returns over the discount rate earned. In this analysis, we are assuming that the financial return is constant and equal to the discount rate which is equivalent to assuming that the administrative fee and the additional returns are exactly compensated.

The reason behind this result is that we are only considering pension benefits directly paid to the worker. In practice, under a typical FDC system, when a person dies before retiring the balance in the account is either used to paid survivorship benefits or becomes part of the inheritance of the worker. A comprehensive view of pension wealth should probably include this inheritance, which would require adding a term to pension wealth:

where the expression ( ) is the probability of dying at age , conditional on being alive at age 18. With some additional algebra, one can demonstrate that under this definition is in fact equal to 0 in a DC scheme with constant and identical interest rates. To see this, let us remember that

So PW is equal to

If we only look at the contribution made at age 18, this will show only in the following terms:

Similarly, the contribution at age (for between 18 and) will show up only in the following terms:

Extending the argument to all active ages, we have

A simplifying alternative to having to calculate the expected inheritance is to assume that the probability of dying before retirement is zero, i.e. if . Under this simplifying assumption, we have that the expected present value of inheritance is zero and the earlier version of is equal to zero, as both summations terms in the resulting expression are equal to the balance at retirement: