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A progressiveness test for redistributions between generations and application to 3 countries[1]

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Abstract

Discontent with old-age pensions is increasing. However, many policy responses have a redistributive impact across generations whose sign and extent is seldom available for debate. This paper argues that the intergenerational impact of policies can be measured in part by comparing the distributions of consumption in the present, for the elderly and for those in their prime age, and that this comparison is empirically feasible. The paper takes a first step in this direction by providing a model that formalizes the argument. It also presents and compares preliminary empirical measures of the distribution of expenditure for two age groups (elderly and prime-age) in three countries. A preliminary finding for Mexico is that it may be progressive to expand PAYG-financed pensions like PAM. In contrast, the same policy in Colombia appears to create inequality across generations. In Chile, the preliminary finding is that below the 61st percentile of the distribution, prime-age adults have a slightly lower standard of living than the elderly, and that this ordering reverses starting at the 68th percentile. This result is used to evaluate a policy proposed in August 2017, which would raise contributory pensions by 20% with a new 2% tax on earnings.

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1. Introduction

Discontent with old-age pensions is increasing around the world, accompanied in some cases with large street protests. After the 2008-9 recession, a set of countries with large public debts (explicit and implicit) have undergone fiscal consolidation. Several of them have reduced pensions compared to promises, for example by decreasing benefit indexation from wage inflation to price inflation, allowing them to avoid an increase in taxes on earnings by the active generation.[3] A pressing issue in those countries is whether those policies are regressive or progressive across generations.

In another important groups of countries real earnings have risen unusually fast over the last few decades, lifting large groups from poverty in self-employment with few contributions, towards middle-class jobs with social security coverage. However, individuals who achieved these new status only in the latter part of their working life are too old to make up for low earnings and for long gaps in contributions in their early careers. Their contributory pensions appear pitiful now compared to their new status, leading to protest. A pressing issue in these countries is if it is progressive to legislate a permanent increase in benefits to the old, financed by permanently higher taxes on earnings.

These examples shows the importance of developing methods to determine whether a given policy change is likely to have a progressive or regressive impact on equity between generations, and the size of the impact, in empirically feasible ways. The OECD has taken a first step in this direction by providing data on average income by age group[4]. According to that data, the current elderly are relatively better off than the current prime-age generation in Canada, France, Italy, Poland and Spain[5].

This paper argues that it would be better to compare the distributions of consumption in the present, for the elderly and for those in their prime age, in the cross section. It also argues that computing these distributions is empirically feasible and that comparing them is meaningful.

The general intuition can be gleaned from defining historical episodes in pension policy. In Western Europe, the Second World War wiped out the savings of those generations that as of 1945 were too old to cope, throwing many of them into relative poverty. It is intuitive that it was progressive across generations to increase or create a pension benefit to help the poorer (older) generation, financed with a permanent tax on earnings of those in prime-age, i.e. by pay-as-you-go. One example is the AOW pension in the Netherlands, created in 1946 (Anderson 2004).

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[3] See for example the Spanish reform of 2013 (Sanchez, 2014).

[4] The OECD's called this approach the "societal perspective" on elderly welfare in *Pensions at a Glance 2013*, p. 61.

[5] See *Pensions at Glance 2013*, Chapter 5 and *Pensions at a Glance 2017*, Chapter 6 (OECD, 2013, 2017).

In the United States, the Great Depression wiped out the savings of many generations who found themselves to be too old to make up for the losses. Social Security was created with the intent of helping them. However, in contrast to the Western European case, where the new pensions were provided with universal eligibility and were flat or targeted ("non-contributory"), the U.S. added a "contributory" feature to Social Security, which introduced regressiveness in the within-generation dimension. [6, 7]

Given that the desirable direction of further redistribution is identified, how far should that redistribution proceed? Although part of the answer would come from measuring relative consumption, a more complete answer should also take into account the efficiency effects of more redistribution, such as the size of the employment shift to uncovered jobs, the increase in under-reporting of earnings and the scale of shifts to jobs with less hours[8]. It would also take into account the impact of the policy on intra-generational distribution.

Within this general program, this paper takes a modest first step towards formalizing this intuition for the case of a single representative agent in each generation, in the absence of efficiency effects. The paper's model identifies a "test" that measures whether a given policy change may increase or decrease intergenerational equity, under some assumptions. The model finds that this test compares the contemporaneous consumption levels of the main age groups, although it also identifies as important other factors.

Empirical applications must inevitably take into account that there is a distribution of consumption among the elderly, and another distribution among those in prime age. The paper points out that if the two distributions of consumption do not cross, it is possible to make policy statements based on first-order stochastic dominance. If they cross, identification of the crossing points also provides valuable information for policymaking.

Fortunately, expenditure surveys are needed to update the weights of the Consumer Price Index, so they are available in most economies. Regarding durable goods, modern consumer expenditure surveys include an estimate of the consumption of the services of

[6] Expansion of contributory pay-as-you-go pensions must be regressive in the within-generation dimension initially: the contributory principle requires granting larger subsidies to those who made larger contributions in the past, i.e. to those who had higher earnings in the decades before the policy change. This implies larger subsidies for the more affluent among the initial old. If these initial subsidies are financed through a tax on earnings, then the less affluent members of the younger generations pay a portion of those initial subsidies.

[7] Social Security was regressive within-generation initially, because segments of the initial old, specifically women and non-whites, were largely excluded from benefits in the first 3 decades (Foner and Garraty 1991, Engelhardt and Gruber 2004, Barr and Diamond 2008 p. 116-118). At maturity, Social Security had a complex mixture of progressive and regressive features within-generation (Gustman and Steinmeier 2001).

[8] The size of these efficiency costs are an empirical matter, and should be compared with the efficiency costs of the alternative policy. These costs depend on features of the economy and of policies such as the personal income tax system and the design of transfers, not just of the design and parameters of the pension schemes (mandatory contributory and non-contributory).

those goods. For these reasons, this paper obtains proxies consumption from household expenditure data. Of course, all data sources have limitations.

Comparison of the relative standard of living across age groups faces many challenges, even after adjusting by household size with the respective national equivalence scale. First, the elderly's budget includes a variety of financial resources apart from pensions. Even with zero income, they can spend away voluntary wealth, including housing. They also have non-pension income, such as intracouple transfers, intrahousehold transfers, age-based public transfers and tax expenditures and capital income, mostly imputed rental income from home ownership net of maintenance expenditures. Another resource in which the elderly differ is in their use of time. Theory suggests that consumption is an output produced at home from two inputs: time and expenditure on goods and services purchased in the market. Since retirement from paid labor frees time, retirees can supply more time towards home production. Conversely, the expenditure of prime-age individuals needs to be adjusted downward to take into account the shorter time they can devote to home production of consumption. Evidence for the U.S., Spain and Germany confirms the importance of an adjustment for home production. The elderly also differ from younger age groups in several dimensions of preferences, as shown by the differing budget shares assigned to health and education expenditures.

The methodology used in the empirical sections of this paper is preliminary and is presented in the Appendix. In all cases, the elderly are defined in this paper as those aged 65 and more, and the prime-age is defined as those aged 35 to 59. To take into account sampling error, the paper uses statistical tests based on stochastic dominance that were developed by Davidson and Duclos (2000), Barrett and Donald (2003), Barrett, Donald and Bhattacharya (2014) and Davidson and Duclos (2013). Because of its preliminary nature, the results reported in what follows are best viewed as illustrations of possible outcomes when performing the empirical work. The empirical section of this paper suggests preliminarily that Mexico, Colombia and Chile face different intergenerational equity situations in this decade.

In Mexico in 2013, the difference in adjusted expenditure per capita equivalent at the median of the two distributions was 9.2%, against the elderly. Similar differences obtain for almost all percentiles. Stochastic dominance at first order fails only because these distributions cross at the 99th percentile. Since this position is irrelevant for social policy, it can be suggested that the elderly's distribution of standards of living is less desirable. This finding is robust to the alternative specifications of consumption tested in the Appendix. The result suggests that a further permanent expansion of non-contributory old-age pensions in Mexico, financed with a further proportional tax on the active population, might be progressive in the intergenerational sense. Of course, other factors not reviewed here should also be taken into account by actual policy, including the fiscal situation and the

degree of crowding-out of private transfers. The type of tax levied on the active population, such as a value-added tax or a tax on earnings covered by social security also makes a difference for the size of covered employment.

In contrast, the preliminary finding for Colombia is that the distributions of discretionary expenditure per capita equivalent are very similar across these two age groups. These distributions cross dozens of times at relatively small intervals. One implication os such a situation is that an expansion of non-contributory pensions, financed with a PAYG tax on the active population, is likely to drive apart the standard of living of the elderly from the one of those in prime ages, creating a cleavage that was not present. That would create inequality in the inter-generational sense.

The preliminary findings for Chile differ as well because the distributions cross. Taking into account sampling error, these distributions cross in the region between the 61th and 68th percentiles. Up to the 61th percentile, the elderly have a distribution of discretionary expenditure per capita equivalent that is slightly above the comparable distribution for prime-age individuals. For percentiles from the 69th and higher, the ordering reverses and the elderly are slightly below. This information suggests to policymakers that pension policies need to be more nuanced in order to insure a gain in intergenerational equity.

The Chilean government proposed in August 2017 to raise contributory pensions by 20%, financed with a 2% earnings tax (PAYG method). The preliminary finding of crossing distributions of consumption per capita equivalent implies that this policy would increase intergenerational inequality in the lower three-fourths of the distribution, and would reduce it at the top fourth. Thus, the proposed policy appears to be regressive in the intra-generational dimension as well. In any case, intra and intergenerational redistribution should be assessed jointly (e.g. Valdes-Prieto, 1994).

This paper contributes to several literatures on redistribution across generations through pension policies. One view searches for optimal fixed rules that provide mutual insurance between generations whose standards of living are fully unknown today because of a veil of ignorance (Ball and Mankiw 2007, Gottardi and Kubler 2006 XXX). An alternative view is that since policymakers do know the current standard of living of the old and prime-age generations, evaluation of policy changes should be conditioned on this information. This paper belongs in this second tradition. Highlights in this branch are Mesa-Lago (1978), who showed how stratification in Latin American pension policies interacted with migration from the countryside to cities, and World Bank (1994), which emphasized the link between uncovered jobs and low contributory pensions.

The economic demography literature on age-related policies is led by Lee and Mason (2011). It was applied to Colombia by Tovar and Urdinola (2014) and to Chile by Bravo and Holz (2011). Espinosa et al (2014) provide an important further development. Private transfers are endogenous, and the behavioral impact differs for the poor, as shown by

Maitra and Ray (2003). The increasing size of differential mortality by income level is documented by the NAS Committee (2015).

Section 2 presents a simple model that links the direction of desirable inter-generational redistribution to relative consumption in the cross-section and to other factors. Section 3 presents our statistical framework. Section 4 presents the results for our three countries. Section 5 offers concluding remarks. The Appendix presents the methodology used to obtain empirical results.

2. The cross-section of consumption as an indicator for inter-generational equity

This section takes a first step in the development of "tests" for the direction of redistribution between age groups created by policy changes. This test relies on cross section data sets, which are available in most economies. Panel data sets contain more information, but are not available for a large number of economies. This is one of the reasons why the test proposed in this section is preliminary.

The tests that are needed must inquire about benevolent policy. Ignoring political equilibrium topics such as the policy induced by the median voter, interest groups and rent-seeking is necessary for these tests to contribute to deliberation and debate. This purpose requires the tests to be prescriptive, appealing to normative criteria. A model that describes of the outcome of deliberation and negotiation does not inform policymaking, but predicts policymaking. Each type of model has a distinct role, and here the normative role is sought.

In this spirit, consider a standard overlapping generations model, where a representative individual for each generation has a lifetime of two periods of equal duration[9]. She supplies labor in the "young" phase of life only. A benevolent social planner uses a standard discounted utilitarian expected social welfare function, where each generation receives a weight that combines its population size and an exponentially declining discount factor:

$$(1)\quad \mathrm{E}_1\langle \mathrm{SW}^T\rangle \equiv \mathrm{N}^0 \cdot \frac{\left(U^{y0}_{old\ in\ t=1}\right)^{1-v}}{1-v} + \frac{\mathrm{N}^1}{1+\rho}\cdot \mathrm{E}_1\left\langle \frac{\left(\mathrm{U}^{y1}\right)^{1-v}}{1-v}\right\rangle + \sum_{t=2}^{t=\infty} \mathrm{E}_1\left\langle \frac{\mathrm{N}^t}{(1+\rho)^t}\cdot \frac{\left(\mathrm{U}^{yt}\right)^{1-v}}{1-v}\right\rangle$$

where $\mathrm{E}_1\langle\ \ \rangle$ is the expectations operator, for expectations are taken in period 1; N^0 is the number of covered old individuals alive in the present, who were young in the past, $t = 0$; N^t is the number of individuals in the generation born in period $t \geq 1$ and live until period $t + 1$; $\rho > 0$ is the inter-generational utility discount rate[10]; U^{yt} is the lifetime utility of

[9] Equal duration prevents this simple model from taking into account differences in longevity between generations, either in trend or not. The increasing size of differential mortality by income level documented by NAS Committee (2015) is ignored also. Despite their importance, those are side issues for this paper.

[10] As argued by Dasgupta and Heal (1979, p. 262), the probability of exogenous extinction is above zero.

covered individuals in the generation that becomes active at period $t \geq 1$; $U_{in\ t=1}^{y0}$ is the lifetime utility of the current old (in $t = 1$); and $\nu > 0$ is a coefficient of relative social aversion to intergenerational inequality, which is assumed constant (Slemrod et al, 1994). N^t is assumed not to rise too fast with t, so that the infinite sum converges.

The lifetime utility of covered individuals in the generation that becomes active at period $t \geq 1$ is standard:

(2a) $$\mathrm{U}^{yt} \equiv \mathrm{u}\left(c_{young}^{yt}, 1 - l_{young}^{yt}\right) + \beta^{yt} \cdot \mathrm{v}\left(c_{old}^{yt}, 1 - l_{old}^{yt}\right) \forall t \geq 1$$

In the young or active phase of life, utility is designated as $\mathrm{u}\left(c_{young}, 1 - l_{young}\right)$, where c_{young} is consumption when young and $l_{young} \in [0,1]$ is the fraction of time devoted to work when young. This in turn is the sum of time worked in the market in exchange for remuneration and time worked in home production, while $1 - l_{young}$ is the fraction of time not devoted to work, which is the sum of time spent in both personal and social leisure and in philanthropic or altruistic activities where production is donated; β^{yt} is the intra-generational discount factor for the generation that is young at date t.

In the old phase of life, utility is $\mathrm{v}(c_{old}, 1 - l_{old})$, where l_{old} is time worked in home production when old, after retiring from market work. Retirement means that $l_{old} < l_{young}$. The function v uses a different letter to take into account possible age-based differences in marginal utility. The lifetime utility for the initial old must take into account the full lifetime, despite the fact that the first period is already frozen in the past, to allow the test to compare lifetime utilities. The proposed definition for the initial old is:

(2b) $$U_{in\ t=1}^{y0} \equiv \mathrm{v}(c_{old}^{0}, 1 - l_{old}^{0}) + \mathrm{u}\left(c^{y0}, 1 - l_{old}^{y0}\right) \cdot \mu^{y0}$$

This expression is centered in the old period and in $t = 1$. The utility of past youth that is registered in lifetime utility is the one recollected in the present by the current old, augmented by a "memory factor" designated as μ^{y0}. If recollections were unbiased, this memory factor would be the inverse of the discount factor.

Because the expectation operator in (1) is conditional on current conditions, this model does not impose a veil of ignorance on all outcomes. Specifically, three terms or factors are known with certainty as seen from the present: $\frac{\mathrm{N}^0 \cdot \left(U_{old\ in\ t=1}^{y0}\right)^{1-\nu}}{1-\nu}$, $\frac{\mathrm{N}^1}{1+\rho}$ and $\mathrm{u}\left(c_{young}^{y1}, 1 - l_{young}^{y1}\right)$.

This social welfare function records an improvement when redistribution goes from richer to poorer generations as measured by consumption per capita, if their numbers are equal. It also registers an improvement when redistribution goes from smaller to larger generations if both have the same per capita consumption.

The test presented here focuses on the purely redistributive component of policies. Of course, in general redistribution also affects incentives to supply labor and thus production and income in each period. For example, a new tax on the formal economy (an increase in

VAT, covered earnings taxes, covered income taxes) always induces some individuals to switch to uncovered and informal jobs, to increase under-reporting of earnings and to shift towards jobs or activities with less hours of paid work per year[11].

With the aim of focusing on redistribution alone, it is assumed from now on that labor supply to the market sector is inelastic to market wages, so l_{young}^{yt} is fixed, both in the young and the old phases of life. It is also plausible to assume that the time worked in home production during old age is also inelastic to market wages, i.e. l_{old}^{yt} is fixed as well.

If a policy does not affect incentives, then under fairly general conditions (dynamic efficiency), the following fiscal policy theorem applies: when a purely redistributive policy change is permanent and provides an aggregate benefit to the initial old generation, then its resource cost must equal the present discounted value of the sum of the aggregate net resource losses for all other generations (e.g. Lindbeck and Persson 2003, p. 80-81)[12].

Dynamic efficiency requires that in the long run, the difference between the real interest rate and the growth rate of the GDP be positive, in the certainty case. For conditions for dynamic efficiency under uncertainty, see Demange (2002). Since this condition refers only to the long run, it is compatible with negative growth rates and negative real interest rates for extended periods. However, if dynamic efficiency fails, deeply implausible fiscal policies and other behaviors become Pareto superior[13]. This important point and substantial empirical evidence, justify taking dynamic efficiency as the benchmark case of interest.

Back with the fiscal policy theorem, note that losses to the younger generations are defined in the lifetime scale: the benefit to be received in the old phase can rise due to the policy, but for the average of those generations, the loss in their young phase of life must be larger than the present value of the benefit rise in the old phase. On a lifetime basis, it is sure that the initial old generation gains from the policy. The contemporaneous prime-age generation and the average of subsequent generations must lose from the policy. This

[11]The size of efficiency costs are an empirical matter. It should be compared with the efficiency costs of the alternative policy, one of which is to do nothing. These costs depend on features of the economy and of policies such as the personal income tax, the design and size of age-related transfers such as non-contributory pensions and health subsidies, and the design and parameters of the contributory pension schemes.

[12] Intergenerational effects were not well understood until the 1970's in the Economics profession. Indeed, at first sight contributory pensions appear to be neutral for the younger generations, because they contribute more taxes now but obtain larger benefits later. However, for the average young individual, the present expected value of the increase in future pension tends to be way below the present value of the extra earning taxes, because in a dynamically efficient economy pay-as-you-go finance yields a smaller return than capital. The difference in return, accumulated in a lifetime, is a substantial hidden tax. The masking of this tax and the losses imposed on the young and future generations can obfuscate policy-making.

[13] Examples are cutting all taxes and financing all public expenditure with unlimited amounts of new public debt, and expanding with few limits the contribution rate to pay-as-you-go pensions and public health insurance. Moreover, when the dynamic efficiency condition is not met, other infinitely-lived agents with access to revenue streams that grow with the economy, such as private monopolies and dynasties, also find it feasible and desirable to backload costs towards generations in the remote future.

allows of course that a few of the younger generations also gain, but this requires the other younger generations to lose even more, since resources are finite.

The issue in this section is whether such a policy change is progressive or not across generations. To be progressive, the social welfare value attached to the increase in benefits for the current old must be larger than the present discounted loss assigned by the policy to be borne by the current young and the unborn generations over their lifetimes.

To identify these valuations and build a test, (1) is differentiated with respect to per-capita consumption and divided through by the first term, $\mathrm{N}^0 \cdot \left(U^{y0}_{old\ in\ t=1}\right)^{-v} \cdot \mathrm{v}_c(c^0_{old}) \cdot dc^0_{old} > 0$. It follows that:

$$(3) \qquad \mathrm{sign}(\mathrm{dE}_1\langle \mathrm{SW}^T \rangle) \equiv \mathrm{sign}\left(1 + \sum_{t=1}^{t=\infty}(1+\rho)^{-t} \cdot \mathrm{E}_1 \langle \frac{\mathrm{N}^t}{\mathrm{N}^0} \cdot \left(\frac{\mathrm{U}^{yt}}{U^{y0}_{old\ in\ t=1}}\right)^{-v} \cdot \left[\frac{d\mathrm{U}^{yt}}{\mathrm{v}_c(c^0_{old})\, dc^0_{old}}\right] \rangle\right)$$

The positive first term in the RHS of (3), namely 1, reflects that the policy change is defined as raising the consumption of the current old. Since the other generations finance that resource transfer, it follows that $d\mathrm{U}^{yt} < 0$ on average for $t \geq 1$, so the second term in the RHS of (3) is negative.

The next step emphasizes again that the test being sought has a normative nature. It does not attempt to predict the political equilibrium but to provide inputs for policy deliberation. In this normative mode, equity concerns regarding unborn generations impose some criteria that discard some policies from consideration. Specifically, one of those criteria is that the policy change treats unborn generations the same as the current young. A policy that fails to do so can be easily attacked in the debate. Although such a policy may still be observed in equilibrium, it would be internally inconsistent to defend it on the basis that it enhances intergenerational equity. The test discussed here would be useless in a polity that selects policies despite flagrant violation of basic equity criteria such as this one.

Equal treatment across the losing generations requires:

$$(4) \qquad \mathrm{E}_1\langle (\mathrm{U}^{yt})^{-v} \cdot d\mathrm{U}^{yt} \rangle = \mathrm{E}_1\langle (\mathrm{U}^{y1})^{-v} \cdot d\mathrm{U}^{y1} \rangle \qquad \forall t \geq 1$$

Thus, the test here imposes the criterion that the policy imposes an expected lifetime utility change on the current young in per-capita terms with the same expected value as for members of all other unborn generations.

Separately, it is assumed that starting from the present young onwards, population varies at a constant and certain rate designated as $n > -1$, so that $\mathrm{N}^t = \mathrm{N}^1 \cdot (1+n)^{t-1}\ \forall t \geq 1$. To insure that the infinite sum in the RHS of (3) converges, it is also assumed that $n < \rho$. Note that the current young population relative to the current old population - $\mathrm{N}^1/\mathrm{N}^0$- is allowed to differ from $1+n$. This assumption can be relaxed to yield similar tests.

Using (4) and $\mathrm{N}^t = \mathrm{N}^1 \cdot (1+n)^{t-1}$ in (3), and summing the second term in the RHS of (3):

$$(5)\qquad \operatorname{sign}(\mathrm{dE}_1\langle \mathrm{SW}^T\rangle) = \operatorname{sign}\left(1 + \frac{\mathrm{N}^1}{\mathrm{N}^0}\cdot\frac{1}{\rho-n}\cdot \mathrm{E}_1\left\langle\left(\frac{\mathrm{U}^{y1}}{U^{y0}_{old\ in\ t=1}}\right)^{-v}\cdot\left[\frac{d\mathrm{U}^{y1}}{\mathrm{v}_c(c^0_{old})\,dc^0_{old}}\right]\right\rangle\right)$$

The next step is to link the change in lifetime utility for the current young to changes in their current consumption. Current prime-age individuals are assumed to be forward-looking and optimizing. In the case where the young individual is choosing an interior solution along her lifetime's consumption path and labor supply to the market is fixed to insure the absence of efficiency effects, differentiation of (2a) and the F.O.C. allows expressing $d\mathrm{U}^{y1}$ in terms of the current marginal utility of consumption:[14]

$$(6)\qquad d\mathrm{U}^{y1} = \mathrm{u}_c\left(c^{y1}_{young}\right)\cdot\left[dc^{y1}_{young} + \frac{dc^{y1}_{old}}{(1+rf)}\right]$$

where rf is the risk-free real interest rate offered by the financial market and the term in square brackets is the negative impact of the policy change on the current wealth of the young generation. This term in square brackets is designated below as $dW^{y1}_{young} < 0$. General equilibrium effects of the policy change would affect rf and wages. Thus, for the interior solution case and the previous assumptions:

$$(7)\qquad \operatorname{sign}(\mathrm{d}\langle \mathrm{SW}^T\rangle) = \operatorname{sign}\left(1 - \frac{\mathrm{u}_c\left(c^{y1}_{young}\right)}{\mathrm{v}_c\left(c^{y0}_{old}\right)}\cdot\left(\frac{U^{y0}_{old\ in\ t=1}(c^0_{old})}{E_1\langle \mathrm{U}^{y1}(c^{y1}_{young},c^{y1}_{old})\rangle}\right)^{v}\cdot\left[\frac{-dW^{y1}_{young}}{dc^0_{old}}\cdot\frac{1}{\rho-n}\right]\cdot\frac{\mathrm{N}^1}{\mathrm{N}^0}\right)$$

Expression (7) is close to the required test. Whether a given policy change is progressive between generations depends on how large is the second term in the RHS of (7), as compared to the first term in the RHS, namely 1.

The final step is to model period marginal utilities, which control the first factor in the second term of (7). The approach is to assign to each age a different CES utility function between leisure and consumption. This allows for the marginal utility of consumption to fall at older ages, as reported by Börsch-Supan and Stahl (1991), who present the hypothesis that deteriorating health constrains consumption above age 80. In the CES case, the ratio of marginal utilities that appears in (7) becomes:

$$(8)\qquad \frac{\mathrm{u}_c\left(c^{y1}_{young}\right)}{\mathrm{v}_c\left(c^{y0}_{old}\right)} = \left(\frac{c^0_{old}}{c^{y1}_{young}}\right)\cdot\frac{(1-\alpha)\cdot \mathrm{u}}{(1-\gamma)\cdot \mathrm{v}}\cdot\frac{\left(c^{y1}_{young}\right)^{\theta}\cdot\left[\alpha\cdot(1-l_{young})^{\theta}+(1-\alpha)\cdot\left(c^{y1}_{young}\right)^{\theta}\right]^{-1}}{\left(c^0_{old}\right)^{\pi}\cdot\left[\gamma\cdot(1-l_{old})^{\pi}+(1-\gamma)\cdot\left(c^0_{old}\right)^{\pi}\right]^{-1}}$$

where the elasticities of substitution between leisure and consumption at each age are $1/(1-\theta)$ and $1/(1-\pi)$ respectively, and α and γ are the distribution parameters for

[14] In general, $d\mathrm{U}^{y1} = \mathrm{u}_c\left(c^{y1}_{young}\right)\cdot dc^{y1}_{young} + \beta^{y1}\cdot \mathrm{v}_c\left(c^{y1}_{old}\right)\cdot dc^{y1}_{old}$. The FOC for an interior solution is $\mathrm{u}_c\left(c^{y1}_{young}\right) = \beta^{y1}\cdot(1+rf\,)\cdot \mathrm{v}_c\left(c^{y1}_{old}\right)$. Elimination of $\mathrm{v}_c\left(c^{y1}_{old}\right)$ yields (6) because the discount factor β^{y1} cancels. If the individual is in a corner solution, the valuation of the impact of the policy depends on the initial level of consumption when old (c^{y1}_{old}) and on whether the policy makes the young choose a new solution that is interior, not corner. In a more general case with uncertainty both, c^{y1}_{old} and U^{y1} are uncertain, so an expectation operator is needed for t = 1 also.

leisure at the respective ages[15]. Substitution between leisure and consumption appears to change with age, as suggested by related results of Dohmen et al (2017) on risk aversion. However, they find that the size of this change is relatively small, because an increase of 10 years in the median age of a society leads to a reduction in mean willingness to take risks equivalent to 2.5% less investment in equities. In the Cobb-Douglas case ($\theta = 0 = \pi$) the elasticity of substitution between leisure and consumption is unity and the third factor in the RHS of (8) collapses to one.

Summing up, under the previous assumptions and simplifying by assuming Cobb-Douglas preferences between consumption and leisure at both ages:

$$(9)\quad \mathrm{sign}(\mathrm{d}\langle \mathrm{SW}^T \rangle) = \mathrm{sign}\left(1 - \left(\frac{c^0_{old}}{c^{y1}_{young}}\right) \cdot \frac{(1-\alpha)\cdot \mathrm{u}}{(1-\gamma)\cdot \mathrm{v}} \cdot \left(\frac{U^{y0}_{old\ in\ t=1}(c^0_{old})}{E_1\langle \mathrm{U}^{y1}(c^{y1}_{young}, c^{y1}_{old})\rangle}\right)^{\nu} \cdot \left[\frac{-dW^{y1}_{young}}{dc^0_{old}} \cdot \frac{1}{\rho - n}\right] \cdot \frac{\mathrm{N}^1}{\mathrm{N}^0}\right)$$

Expression (9) is the proposed test. Whether a given policy change is progressive between generations depends on how large is the second term in the RHS of (9), as compared to the first term in the RHS, namely 1. Despite its simplicity, this test is a useful first step because it spells out the different factors that shape the second term in the RHS of (9).

Specifically, (9) shows that the policy change is more likely to be progressive if:

- the current old have a lower standard of living (lower consumption) than the current young, implying that c^0_{old} is smaller than c^{y1}_{young}. This condition makes the first factor smaller than 1 and pushes the second term to be less negative. Most important for this paper, this factor depends only on the current cross section of consumption. This factor is operative even if the social aversion to intergenerational inequality is zero (if $\nu = 0$) because it reflects whether the "sum of utils" afforded by the policy change rises or falls (Dasgupta and Heal, 1979);
- preferences change with age, in such a way that the second factor in the second term of the RHS of (9) is smaller than 1. The evidence mentioned above suggests that the young assign consumption a higher share of utility than the old ($\alpha > \gamma$, so $1 - \alpha < 1 - \gamma$). However, according to the evidence of Börsch-Supan and Stahl (1991) the level of utility would be higher for the young, which goes in the opposite direction. In general, the second factor allows adjustment for age-related changes in preferences.
- the social aversion to intergenerational inequality, ν, is larger, provided that the initial condition, before the policy change applies, is that the old have a lower level of lifetime satisfaction than the young. In this case the second factor in the second term of the RHS of (9) is smaller than 1. This provides an extra push towards the

[15] For example, $\mathrm{u}_c\left(c^{y1}_{young}\right) = (1-\alpha)\cdot\left[\alpha\cdot\left(1-l_{young}\right)^{\theta} + (1-\alpha)\cdot\left(c^{y1}_{young}\right)^{\theta}\right]^{\frac{1}{\theta}-1}\cdot\left(c^{y1}_{young}\right)^{\theta-1}$ for $\theta \neq 0$ and $\mathrm{u}_c\left(c^{y1}_{young}\right) = (1-\alpha)\cdot\left(1-l_{young}\right)^{\alpha}\cdot\left(c^{y1}_{young}\right)^{-\alpha}$ for $\theta = 0$. And similarly for the elderly.

second term being less negative and towards evaluating the policy as progressive. In contrast to the first factor, the comparison here is between lifetime satisfactions. This opens the possibility that even with equality of consumption in the cross section, some intergenerational redistribution may be called for. For example, a situation that combines a projected drop in consumption by the current young in the coming decades, and a recollection of high consumption of the current old in the previous decades, would recommend redistribution towards the young;

- the per-capita wealth loss that the policy change inflicts on the current young, compared with the per-capita consumption benefit granted by the policy to the current old. Because the resource cost of the benefit for the current old is shared among many young generations, the per-capita wealth loss that the policy change inflicts on a single young generation must be quite smaller than the gain enjoyed by the single gaining generation (the old). To take into account that there is a large number of young generations that share the loss, the fourth factor introduces the utility discount rate ρ and the trend in size of the young generations, n. For example, if the utility of future generations is discounted more heavily, a policy change that burdens those generations is assessed as less damaging.
- the current population ratio $\mathrm{N}^1/\mathrm{N}^0$. This factor is present because this social welfare function values more those policy changes that improve the condition of more people. For example, if the economy has an advanced demographic transition so that population has already declined, $\mathrm{N}^1 < \mathrm{N}^0$, and also $n = 0$, then this factor provides an extra push towards the second term being less negative and towards evaluating the policy as progressive. Indeed, an increase in benefits for the elderly, financed pay-as-you-go by an earnings tax, is valued by more because the elderly are relatively numerous. However, the intertemporal budget constraint links the values of the last two factors: if the current old are more numerous, then the wealth loss to the young must be larger and the fourth factor is higher.

A major lesson from the model in (9) is that contemporaneous relative consumption of different age groups does not provide enough information for deliberation on policies that create intergenerational redistribution. Indeed, four other factors are identified in the second term of the RHS of (9) that can moderate, exacerbate or reverse the evaluation of a policy based solely on contemporaneous relative consumption of different age groups.

On the other hand, this simple model has major limitations. One is the representative agent assumption. The next section begins to face the issue of inequality within each generation.

3. Statistical tests for comparing distributions of consumption within age groups

The data provides two empirical distributions of consumption per capita: one for the elderly and the other for prime-age citizens. When two distributions are compared, two situations may arise: they may cross, or they may not. If they don't cross, it is natural to rely on stochastic dominance concepts and tests to take into account sampling error.

An important result is that provided the marginal utility of consumption is positive, all individuals would prefer the distribution of consumption that dominates at the first order. Similarly, all social welfare functions in a wide class assign higher welfare to the distribution that dominates at first order. First-order stochastic dominance implies higher order dominance, including second-order dominance.[16] Therefore, in the presence of stochastic dominance at the first order, the degree of Lorenz dominance is irrelevant for choosing between two distributions.

The recent literature on statistical tests of stochastic dominance started with McFadden (1989), who identified consistent tests for stochastic dominance at first and second order, in the Kolmogorov-Smirnov family of tests. This was extended by Barrett and Donald (2003) for different sample sizes for the two cumulative distribution functions, and also by providing consistent tests for stochastic dominance of any order, which require bootstrap and simulation procedures.

In many applications the two distributions cross, including those in this paper. In this setting, the focus changes to identify the crossing points, and to take into account the sampling error around each crossing point.

Davidson and Duclos (2000, p. 1452 and Theorem 3) were the first to identify the asymptotic standard error for a crossing point, which they also designate as a "critical poverty line". This allows the computation of both endpoints of a confidence interval around the crossing point. These authors illustrate the determination of crossing points and its standard error with data for three countries (see their Table II in p. 1455).

An important book on Indonesia by Strauss et al (2004) and material issued by the World Bank reports that these calculations can be made with a program called *Distributive Analysis/Analyse Distributive* (DAD), written by Araar, Duclos and Fortin. In this paper, we use the DAD program in version 4.6, written in 2010 (http://dad.ecn.ulaval.ca/). Our tests are calculated using household weights.

Lorenz curves and degrees of inequality

The Lorenz curve gives the cumulative proportion of total resources up to each possible cumulative proportion of the population, when the population is ordered from poorest to richest in resources. Some inequality measures such as the Gini coefficient are based on the Lorenz curve.

[16] This follows from the fact that distributions are positive and increasing functions.

Lorenz dominance refers to comparisons of the degree of inequality of two distributions regardless of the ordering of their means. [17]

Now consider stochastic dominance at second-order. It is well known that in the special case where the means of two distributions of consumption are equal, and provided that for all individuals the marginal utility of consumption is positive and falling (concave utility), then all risk-averse individuals prefer the distribution that dominates at the second order.

Second-order stochastic dominance plus equality at the means implies Lorenz dominance, but the converse is not true. Distribution A weakly Lorenz dominates Distribution B if the Lorenz curve for A is nowhere below that for$B$.

4. Comparing distributions of consumption in 3 countries

4.1 Results for Mexico

The *Encuesta Nacional de los Hogares 2013* (ENGASTO) is a survey taken by the *Instituto Nacional de Estadística y Geografía* (INEGI) of Mexico during 2013. One of its objective is to obtain estimates of annual consumption expenditure of Mexican households, and the average per household and per person. The sample size is 73,388 households at the national level, representative for a total of 118,310,830 people. Of these 8,638,447 correspond to those aged 65 or more (the elderly) and 33,859,647 correspond to the prime-age group, defined as those aged 35 to 59. The actual comparison group is the subset of prime-age individuals that do not reside in households where one or more elderly person resides. This reference group is chosen to minimize overlap between the two groups and thus to avoid inducing a correlation between the two distributions.

To take into account economies of scale in consumption, INEGI applies the equivalence scale adopted by the OECD. The index includes the composition and household size and is calculated as follows: (first member with age >18)*1 + (sum of members aged >=18 except the first member)*0.7 + (sum of members aged <18)*0.5. Owner-occupied housing brings about an imputed rent, which is estimated by three methods, as explained in detail in INEGI (2013). The imputed rent is also a use of funds included in total household expenditure in our computations.

To take into account that these age-based groups differ in the availability of hours for home production of consumption goods and services, the following pieces of information for Mexico in 2016 are used to adjust expenditure by those aged 35 to 59: (a) for those aged 35 to 59, the proportion of the group that was employed was 72.1% and the average hours of employment per week among the employed was 43.9; (b) for those aged 65 and more,

[17] Barrett, Donald and Bhattacharya developed a test for Lorenz dominance which was published in 2014 (although it circulated from 2003). It is also available in Stata through the command *ldtest*.

the average hours of employment per week among the employed was 37.4 and the proportion of the group that was employed was 27.4%; (c) full-time employment was 48 hours per week.[18] Applying equation (XXX in the Appendix) to this data for Mexico, the required adjustment in the expenditure of the group aged 35 to 59 is the following reduction:

(10) $$A_{35-59}^{Mexico} = 0.17 \cdot \left(\frac{43.9*0.721-37.4*0.274}{48-0}\right) = 0.076 \quad (7.6\%)$$

As an introduction to the results, Table 1 reports the annual per capita equivalent expenditures for percentiles 25 and 50 of the two distributions described above. It also separates the elderly by gender. All columns exclude priority out-of-pocket expenditure in health, education and housing maintenance. The adjustment for hours is applied to the group aged 35 to 59 only, as done in columns 2 and 3.

Table 1: Expenditure in Mexico by age group and gender, ENGASTO 2013

(Adjusted per capita expenditure equivalent including imputed rent of owner-occupied housing, in Mexican pesos- MXN. The second column is labeled "adjusted" to indicate the application of the adjustment factor for time availability in home production)

Expenditure, per capita equivalent (MXN/year)	**Elderly (65 and more years of age)**	***Adjusted* 35 to 59 (only households without old)**	**(Expend. 65 and more) / (*Adjusted* expend. 35-59)**	**Elderly women (65 +)**	**Elderly men (65 +)**
Median (50th percentile)	32,195	35,471	**0.908**	32,371	32,035
Vulnerable (25th percentile)	19,166	21,635	**0.886**	19,285	19,000

Source: ENGASTO 2013, taken by the *Instituto Nacional de Estadística y Geografía* (INEGI) in 2013. The figure for each percentile is the average for all households that belong in the same percentile, which is slightly different from the marginal household in the percentile. These figures can be converted into PPP USD with the exchange rate for the U.S. Dollar for 2012, which was MXN 7.86 = 1 PPP USD, obtained from http://data.worldbank.org/indicator/PA.NUS.PPP.

The result is that the standard of living of the elderly is lower than for the prime-age population, at those percentiles. The ratios in column 3 are 0.908 at the medians and 0.886 at the 25th percentiles, revealing a substantial difference in standard of living.

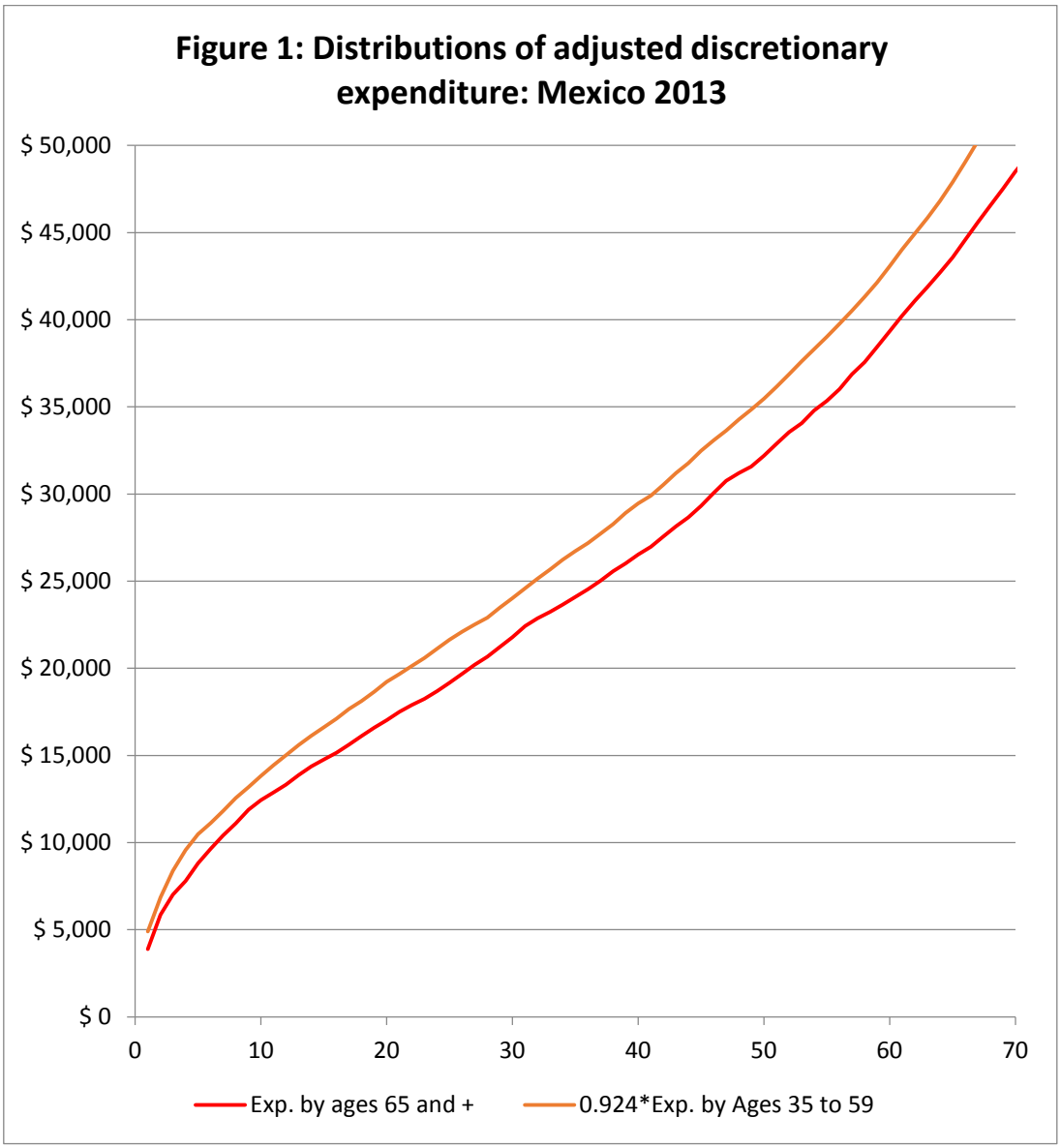
Disaggregation by gender of the standard of living of the elderly reveals much smaller differences between elderly men and elderly women: 1% at the medians and 1.5% at the 25th percentiles. Note that differences between single-gender households are captured by

[18] Source: *Encuesta Nacional de Ocupación y Empleo* (ENOE) of Mexico, run by the *Instituto Nacional de Estadística y Geografía* (INEGI).

this data, so this finding is not explained solely by the standard assumption that household resources are divided equally among all adult members.

Next, figure 1 presents the distributions of per capita equivalent discretionary expenditures, only up to the 70th percentile to keep the scale of the abscissas within bounds. One distribution is for the elderly, and the other for the prime-age population that does not reside with the elderly. They exclude priority expenditure in items whose budget share varies ostensibly with age, and the data for prime-aged individuals is multiplied by 0.924 to take into account the time not devoted to home production.

Figure 1: Distributions of adjusted discretionary expenditure: Mexico 2013



Source: ENGASTO 2013 survey, taken by the *Instituto Nacional de Estadística y Geografía* (INEGI) in 2013. The horizontal axis is the percentile in the distribution of discretionary expenditure per capita equivalent. The vertical axis is in thousands of MXN per year. The distributions in this figure incorporate expansion factors and the adjustments explained in the text.

A visual examination of Figure 1 suggests that the distribution of expenditure for the Mexican elderly is dominated at first order by the distribution for prime-age individuals. However, an examination of the empirical distributions finds that they do cross, although this happens at the 99.06th percentile for the first time. The curves cross again several times for even higher percentiles. Strictly, these crossings imply that from behind a veil of ignorance, an individual choosing age group has a slightly positive probability of getting a higher standard of living when choosing the elderly's distribution.

Table 2 presents the first crossing point and applies the Davidson and Duclos (2000) estimate of the standard error as explained in section 4. The lower bound for the first crossing point is calculated as the point estimate minus 2 times the standard error.

Table 2: Statistical test for the first crossing point: Mexico

D. expenditure at the First Crossing Point, (MXN/month)	Percentile at the first crossing point	Standard Error for the first crossing point (MXN/mo.)	Percentiles at the lower bound for expenditure
298,924	99.06	10,409	98.85 for the elderly 98.91 for those aged 35-59

Note: The test is for adjusted discretionary expenditure per-capita equivalent. For smaller expenditures than the first crossing point, the distribution for those aged 35-59 dominates.

The first crossing occurs at an expenditure level that is more than 8 times the medians reported in Table 1. If one conditions the probability of getting a higher standard of living when choosing the distribution for the elderly on an initial position near the medians, and assumes that the degree of mobility is finite, then it is intuitive that for most policy purposes the elderly do worse than the active or younger population in Mexico.

For policy purposes, the conclusion for Mexico is strong: the current elderly have a distribution of discretionary expenditure per capita equivalent that is almost dominated by the analogous and adjusted distribution for prime-age individuals. The same result holds for total expenditure per capita equivalent (not shown). This result suggests that non-contributory old-age pensions in Mexico such as the federal PAM program and similar programs at the state and municipal levels, may have not reached an adequate size, and a further expansion financed with a proportional tax on the active population, might be progressive in the intergenerational sense.[19]

It may be objected that other authors' evidence on recent expansions of non-contributory pensions reveal that those expansions triggered crowding-out of private transfers from family residing in Mexico, at a rate close to 30% (Amuedo-Dorantes and Juárez, 2015). They

[19] See the excellent report by Sedesol (2013) on elderly welfare and opportunities.

also find that crowding-out of private transfers is zero for transfers coming from family members that reside abroad, who presumably have higher incomes.

In this connection, it is important to note that our results take into account private transfers to and from different age groups in two ways. First, those transfers that occur within the households where persons aged 65 or more reside, are assumed by reporting per capita equivalent expenditure. Second, transfers between households of different age groups are taken into account insofar as they influence expenditure.

4.2 Results for Colombia

The *Encuesta Nacional de Ingresos y Gastos de los Hogares 2006-2007* (ENIG) is a survey taken by the *Departamento Administrativo Nacional de Estadística* (DANE) of Colombia. Its objective is to obtain consumption expenditures and incomes of Colombian households. The sample size is 42,733 households at the national level, representative of 42,439,326 people. The elderly group, defined as those aged 65 or more, represents 2,881,207 people. As before, the comparison group is the subset of individuals aged 35-59 that do not reside in households where one or more elderly person resides.

DANE imputes a rent to owner-occupied housing, which allows the inclusion of this important use of funds among expenditures. In our knowledge, DANE does not apply an official equivalence scale. In replacement, we apply the scale yield used by Chile, because it is simpler than the Mexican scale (see below).

To take into account that age groups differ in the availability of hours for home production of consumption goods and services, the following pieces of information for Colombia in 2008 are used: (a) for those aged 35 to 59, the average hours of employment per week among the employed was 44.2, and the proportion of the age group that was employed was 74.1%; (b) for those aged 65 and more, the average hours of employment per week among the employed was 36.8 and the proportion of the age group that was employed was 28.2%; (c) full-time employment was 48 hours per week.[20] Applying equation (3) to the Colombian data, the required adjustment in expenditure made by those aged 35 to 59 is the following reduction:

(11) $$A_{35-59}^{Colombia} = 0.17 \cdot \left(\frac{44.2*0.741-36.8*0.282}{48-0}\right) = 0.079 \quad (7.9\%)$$

The size of this reduction is similar to the one in Mexico.

Table 3 presents the monthly per capita equivalent expenditure for percentiles 25 and 50 of the two age groups described above. This table includes expenditure on health,

[20] Source: another survey, called the *Gran Encuesta de Hogares*, also run by DANE.

education and housing maintenance. The second column adjusts the expenditures of prime-age individuals by their smaller availability of hours for home production.

Table 3: Expenditure in Colombia by age group and gender, ENIG 2006-07

(Adjusted per capita expenditure equivalent including imputed rent of owner-occupied housing, in Colombian pesos – COP. The second column is labeled "adjusted" to indicate the application of the adjustment factor for time availability for in home production)

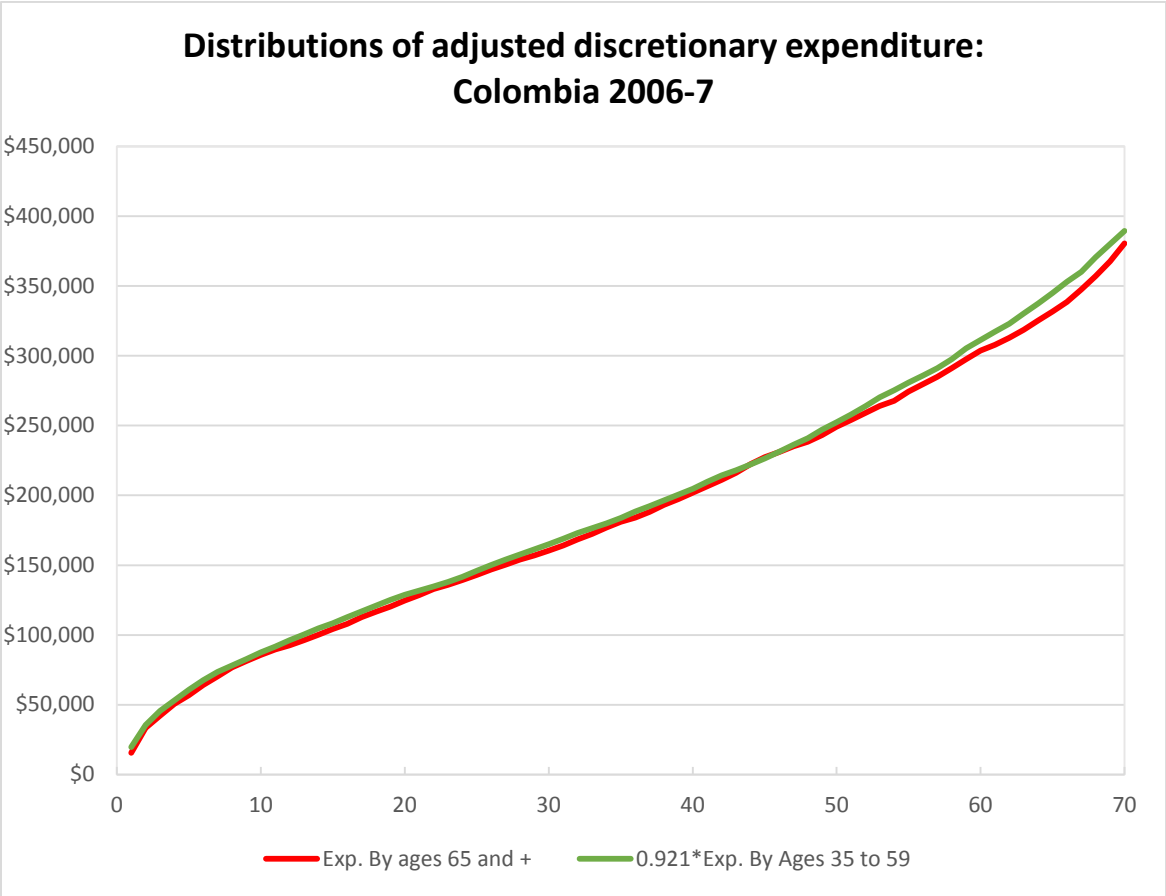
Expenditure, per capita equivalent (COP/month)	**Elderly (65 and more years of age)**	***Adjusted* 35 to 59 (only households without old)**	**(Expend. 65 and more) / (*Adjusted* expend. 35-59)**	**Elderly women (65 +)**	**Elderly men (65 +)**
Median (50th percentile)	249,118	252,261	**0.988**	259,733	236,524
Vulnerable (25th percentile)	142,960	145,908	**0.980**	150,023	137,839

Source: ENIG 2006-2007 survey, taken by DANE. The figure for each percentile is the average for all households in the same percentile, which is different from the marginal household. Figures can be converted into PPP USD with the exchange rate for 2006, which was COP 977.71 = 1 PPP USD, from http://data.worldbank.org/indicator/PA.NUS.PPP.

The results in Table 3 are different from what is found for Mexico (Table 1): column 3 reveals that after adjustment, the standard of living of the Colombian elderly is almost equal to those for prime-aged individuals, in both the 25th and the 50th percentiles.

In contrast, disaggregation by gender in Colombia reveals substantial differences between the standard of living of elderly men and elderly women that favor women by 9% at the median and by 8% at the 25th percentile. This result should be a topic for future research.

Figure 2 presents the two distributions of discretionary per capita equivalent expenditures, up to the 70th percentile for graphical reasons. As in figure 2, both exclude expenditure in the priority items that vary with age, and include the adjustment for hours.



Source: ENIG 2006-07 survey, taken by DANE in 2006. The horizontal axis is the percentile in the distribution of expenditure per capita equivalent, excluding priority expenditures in health, education and housing maintenance. The vertical axis is in thousands of COP per month. The distributions in this figure incorporate expansion factors.

A visual examination of Figure 2 suggests that the distribution for the Colombian elderly is quite similar to the distribution for prime-age individuals. When analyzed in more detail, these distributions cross dozens of times throughout the whole range of expenditure values. Neither of the distributions dominates at first or second order. The same result holds for total expenditure per capita equivalent (not shown).

The conclusion for Colombia is that expanding PAYG-financed pensions might create inequality between generations, since the relative consumption level of the elderly and the prime-age group is already equal in the absence of that policy.

Note that an expansion of payroll taxes in Colombia has further intra-generational effects driven by the fact that about 60% of Colombian workers do not pay the payroll tax (they are either exempt, as happens for the self-employed, or evade). In addition, new private transfers may be triggered by the expansion of benefits and the expansion of payroll taxes. As noted in the introduction, a pay-as-you-go financed expansion of pensions is also different depending on whether non-contributory pensions are raised, targeting the lower

percentiles of the distribution of consumption, or contributory pensions are raised by a given percentage, because the latter are positively correlated to the covered earnings reported in the past, as in U.S. Social Security in 1940-65.

4.3 Results for Chile

The *Encuesta de Presupuestos Familiares 2013* (EPF 2013) is a survey taken by the *Instituto Nacional de Estadísticas* (INE) in 2012. The sample size is 10,527 households at the national level. Again we define the elderly as those aged 65 and more, who are compared to prime-age individuals (aged between 35 and 59) who do not reside in households where one or more elderly person resides. In the sample, the elderly reside in 2,003 households and the prime-age group resides in 5,860 different households.

The EPF's methodology to determine expenditure uses the Diary Method with 4 follow-up visits within a two-week period. Owner-occupied housing triggers the imputation of a rent by INE, which combines three estimation methods as explained in INE (2013).

This paper applies the official equivalence scale adopted by the Ministry of Social Development to define the poverty line. This scale computes the per-capita equivalent of household variables by dividing by $h^{0.7}$, where h is the number of household members, regardless of age.

To take into account that age groups differ in the availability of hours for home production, the following pieces of information for Chile in the second half of 2013 are taken into account: (a) for those aged 35 to 59, the average hours of employment per week among the employed was 43.23, and the proportion of the age group that was employed was 75%; (b) for those aged 65 and more, the average hours of employment per week among the employed was 36.31 and the proportion of the age group that was employed was 23%; (c) full-time employment was 45 hours per week. The source of this information is the employment Survey (NENE) run by INE. Applying equation (XXX in the Appendix) to this data, the required adjustment in expenditure made by the group aged 35 to 59 is the following reduction:

(12) $$A_{35-59}^{Chile} = 0.17 \cdot \left(\frac{43.23*0.75-36.31*0.23}{45-0}\right) = 0.091 \quad (9.1\%)$$

The reduction for Chile, 0.909, is somewhat larger than for Colombia and Mexico. This is mainly because the Chilean elderly participate less in the labor market: 23% in Chile, compared to 27.4% in Mexico and 28.2% in Colombia.

Table 4 reports the per capita equivalent expenditures for percentiles 25 and 50 of these two expenditure distributions. As in tables 1 and 3, these include expenditure in health, education and housing maintenance. It also reports per capita equivalent expenditures for the same percentiles for the distributions of elderly women and elderly men.

Table 4: Expenditure in Chile by age group and gender, 2012 (EPF 2013)

(Adjusted per capita expenditure equivalent including imputed rent of owner-occupied housing, in Chilean pesos – CLP. The second column is labeled "adjusted" to indicate the application of the adjustment factor for time availability for in home production)

Expenditure, per capita equivalent (CLP/month)	**Elderly (65 and more years of age)**	***Adjusted* 35 to 59 (only households without old)**	**(Expend. 65 and more) / (*Adjusted* expend. 35-59)**	**Elderly women (65 +)**	**Elderly men (65 +)**
Median (50th percentile)	243,377	226,260	**1.076**	243,522	243,132
Vulnerable (25th percentile)	160,464	142,176	**1.129**	160,535	160,376

Source: EPF 2013 survey, taken by the National Statistical Institute (INE) in 2012. The figure for each percentile is the average for all households that belong in the same percentile, different from the marginal household. These numbers can be converted into PPP USD per month with the exchange rate for the U.S. Dollar for 2012, which is CLP 350.29 = 1 PPP USD, obtained from http://data.worldbank.org/indicator/PA.NUS.PPP.

The results of column 3 in Table 4 differ markedly from those for Mexico and Colombia, because the elderly are better off in Chile relative to prime-age individuals, in those percentiles. For a household of three members (the median size), the associated total expenditure level for the elderly at the median is CLP 525,127 per month.[21]

This result is not new for Chilean economists. It was demonstrated before by Bravo and Holz (2011), who used the EPF 1997 survey and found that the Chilean elderly had access to an average consumption (median not reported) above the average for the contemporary prime-aged population, even before adjusting the expenditure of the latter by the 0.909 factor as done here. Similarly, the National Transfer Accounts project publishes online an age-assigned average consumption for 2006 in Chile, based on expenditure data from the EPF 2007. When comparing these two age groups for 2007, Valdes-Prieto (2015b) obtains also the result that the elderly are better off at percentiles 25 and 50.[22] Thus, this result has been present for at least 16 years (1996 to 2012).

Moreover, a separate set of surveys, the CASEN, consistently found the following result in each of the 9 waves taken from 1987 to 2015: the proportion of elderly below the poverty

[21] Given the Chilean equivalence scale, the associated household expenditure is $(3)^{0.7}$ x $243,377.

[22] The results of Table 4 here are more reliable than those in the papers by Bravo and Holz (2011) and Valdes-Prieto (2016) for at least two reasons: Table 4 adjusts with the equivalence scale, and includes the imputed rent on owner-occupied housing.

line is notoriously lower than among individuals of active ages.[23] Of course, this outcome is influenced by long-standing non-contributory pensions, first introduced in 1952. This outcome confirms Table 4's result for the 25th percentile.[24]

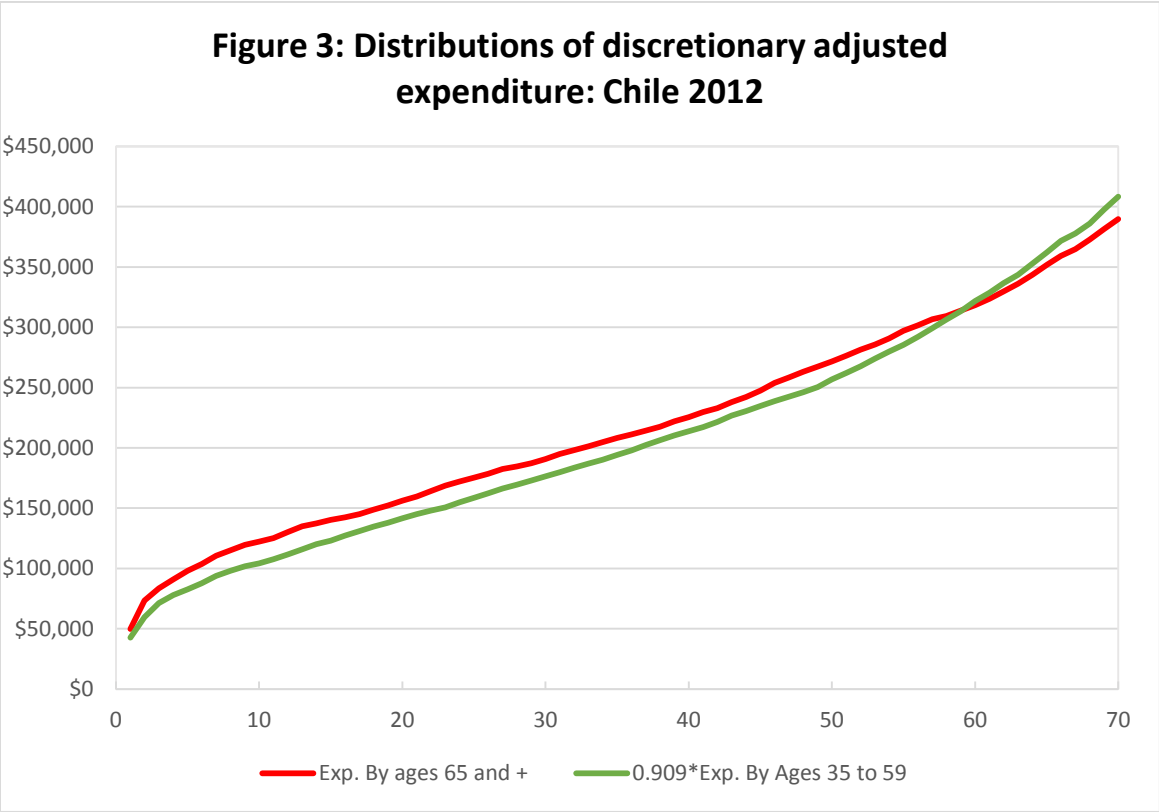
Disaggregation by gender in Chile reveals very similar values for the standard of living of elderly men and elderly women. Understanding this is a matter for future research.[25]

Figure 3 extends the comparison to the full distribution of discretionary per capita equivalent expenditures: one for the elderly, and the other for prime-age individuals. The latter is multiplied by the factor 0.909 to adjust for the availability of hours. As in the other countries, both distributions exclude out-of-pocket expenditures in health, education and housing maintenance.

[23] The CASEN surveys are oriented to the evaluation of poverty programs and are independent form INE's expenditure surveys.

[24] The result that the elderly in the lower half of the distribution are better off in Chile is also confirmed by two additional sources: (1) the Adimark Gfk survey *Vivir hasta los 100* (Living up to age 100) taken in 2014, reveals that seniors reported an *increase* in their satisfaction with their financial and income situation; and (2) the "Happiness" module in the 2011 CASEN survey reveals that self-reported "life satisfaction" is slightly higher among the elderly than among active workers.

[25] Recall that that differences between single-gender households are captured by our data, so this finding is not explained solely by the assumption that household resources are divided equally among adult members.



Source: EPF 2013 survey, taken by the *Instituto Nacional de Estadística* (INE) in 2013. The horizontal axis is the percentile in the distribution of expenditure per capita equivalent, excluding health, education and housing maintenance expenditures. The vertical axis is in thousands of CLP per month. The distributions in this figure incorporate expansion factors.

Examination of Figure 3 shows that these distributions cross in a region between the 60th and 70th percentile. Outside of this region, the ranking is clear: the elderly do better for the lower two-thirds and this reverses at the top. The same result holds for total expenditure per capita equivalent (not shown).

A more detailed examination shows that the distributions in figure 3 cross several times in that middle region. Table 5 reports the first and last crossing points in this region and computes the standard deviation of the crossing points.

Table 5: Statistical test for Stochastic Dominance at first order: Chile

D. expenditure at the first and the last Crossing Points in the region (CLP/month)	Percentile at each crossing point	Standard error at each crossing point	Percentiles at the lower bound for expenditure	Percentiles at the upper bound for expenditure
$310,139	64.60	$11,587	60.9 for the elderly;	

			60.6 for those aged 35-59	
$310,288	64.65	$11,603		67.2 for the elderly 68.7 for those aged 35-59

Note: For discretionary expenditures below the lower bound of the first crossing point in this region, the distribution for the elderly dominates. For discretionary expenditures above the upper bound of the last crossing point in this region, the distribution for those aged 35-59 dominates.

The lower bound for the first crossing point is calculated as the point estimate minus 2 times the standard error taken from Table 5. According to this criterion, the crossing region starts at an adjusted per capita expenditure of CLP 286,964 per month and extends to an upper bound where adjusted per capita equivalent expenditure is CLP 333,491 per month. Therefore, the crossing region covers 8.1 percentiles. Passing to the household level, the standard of living of the elderly is lower than those of prime age only for households whose discretionary expenditure is above CLP 719,563/mo., a substantial figure in Chile.[26]

Figure 4 reports results for Lorenz dominance in Chile. It turns out that the Lorenz curves for these two age groups cross where the cumulative population percentage is about 72%, and cross again where the cumulative discretionary expenditure percentage is about 92%.

Figure 4: Lorenz curves for the two age groups: Chile 2012

[26] Given the Chilean equivalence scale, and 3-member households, the associated household expenditure is $(3)^{0.7}$*333,491.

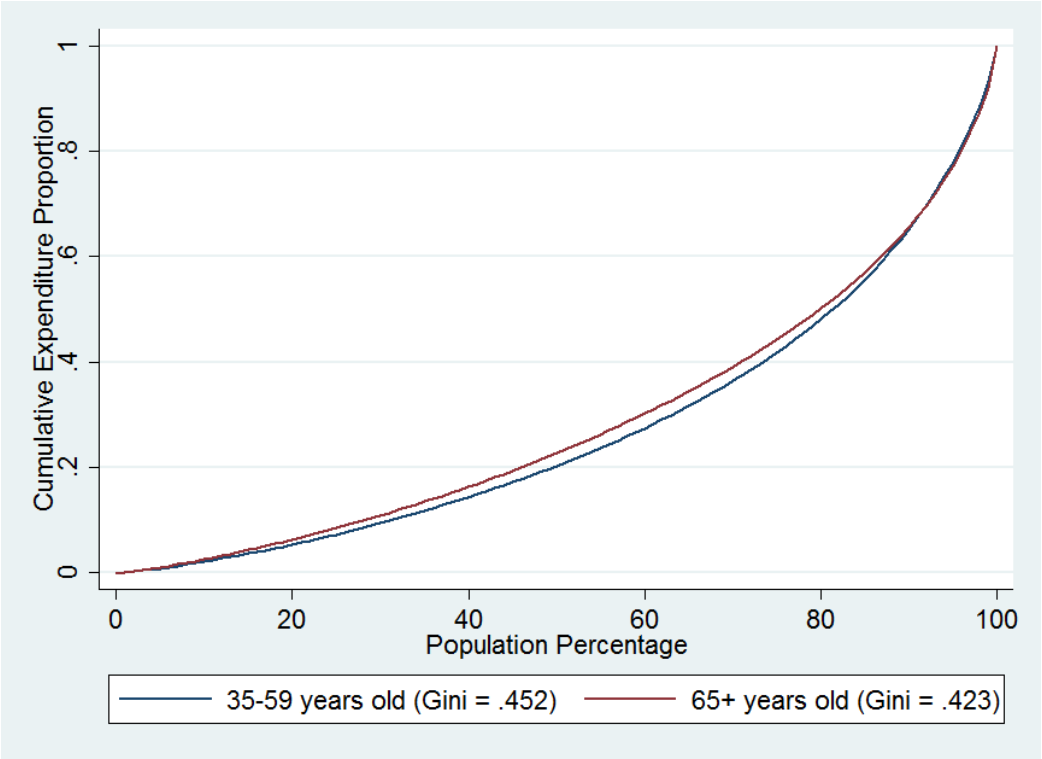


Figure 4 indicates that the degree of inequality is slightly smaller among the elderly than among those aged 35-59 who have lower adjusted discretionary expenditure. The opposite holds above the crossing point: the degree of inequality is slightly higher among the elderly than among those aged 35-59 who have higher expenditure. This result may be due to the influence of the non-contributory pensions (their fiscal cost is 1.1-1.2% of GDP).

Evaluation of a recent policy proposal

Recently, the Chilean government proposed to expand all pensions proportionately by 20%, financed with a new earnings tax at a rate of 2% on jobs with social security.[27] What is the impact of this policy on inequality between generations?

In the benefit side, the 20% increase would apply to contributory pensions, not to non-contributory ones. Therefore, the extra benefits would be positively correlated with the covered earnings reported in the past (which determine contributory pensions). As the U.S. experience with Social Security in 1940-65 confirms, that correlation has a regressive impact in the intra-generational dimension, because higher contributions to the mandatory contributory pensions are positively correlated with higher lifetime earnings.

In the taxation side, about 40% of all Chilean jobs do not contribute to social security (they are either exempt or evade). Since current earnings are also correlated positively with having social security, the 2% tax would be progressive in the intra-generational dimension.

[27] Presidential address of April 12, 2017, https://prensa.presidencia.cl/comunicado.aspx?id=51799

The net impact is ambiguous, and is further complicated by the private transfers triggered by the new taxes and benefits.

In addition, the distributions of expenditure per capita equivalent cross in Chile. To assess the impact of this crossing, the following exercise was tried: levy a new tax on the consumption of the active population (35-59 years old), at a rate equivalent to 2% of each individual's consumption. After computing the revenue, it was distributed immediately (no accumulation) as a proportional subsidy to the consumption of the elderly. One result is that this subsidy would have a rate of 4.78%. A more important result is that the new expenditure curves cross again, but the smallest crossing point shifts upwards to an adjusted discretionary expenditure per capita of CLP$ 473,369 per month, which is 52% larger than the upper crossing point in the initial distributions reported in Table 5. For a household of three members (the median size), the discretionary expenditure at the new smallest crossing point is CLP 1.02 million per month, a large figure.[28] Subtracting two standard errors to produce a lower bound for expenditure at the new crossing point, the result is CLP$ 414,918, a figure in the 76th and 78th percentile of the new distributions.[29]

Thus, the proposed policy change enlarges the range where the elderly do better by 15 percentiles (from the 61th to the 76th percentile). Thus, the policy appears to increase inter generational inequality in three fourths of the distribution and reduce it only among the elderly at the top 24%.[30]

A related issue is the impact on inequality of a proposal by a recent Presidential Advisory Commission for Chile (2015, p. 186). Among other policies, Global Proposal A, supported by a slight majority of members, proposed to transform the current non-contributory pension, which tries to target the lower half of the distribution, into an "almost universal" flat subsidy that would exclude only the ninth and tenth deciles of the distribution of contributory pensions. The results here suggest that this policy would also be regressive in the inter-generational dimension, for the lower two-thirds of the distribution.[31]

5. Concluding remarks

[28] Given the Chilean equivalence scale, the associated household expenditure is $(3)^{0.7}$*473,369.

[29] The new crossing point has a standard error of CLP$ 29,225.

[30] This conclusion does not take into account other factors that influence the desirability of expanding pay-as-you-go finance now. The massive drop in fertility occurred in the last 20 years in Chile is expected to continue, and estimates show that the burden of any pension increase that preserves its size relative to average earnings and is financed by pay-as-you-go will increase by a factor of 2.7 over the next 50 years.

[31] In the intra-generational dimension, the proposed incremental program's expenditure would be targeted from the fourth to the eighth decile. Therefore, that reform would also be regressive in this dimension when comparing with the poorest deciles, who would get a very small increment or nothing.

This paper shows that to inform debate on policies with inter-generational impact, current standards of living of different age groups need to be compared in the cross–section. In the absence of this disciplining information, a bias in public policy may build up if politicians have an incentive to increase transfers towards the age groups that vote more frequently, which in most democracies are the elderly. In expansions of PAYG finance, most of the losers would be yet unborn and may not be fairly represented by the voters who are alive, who have an opposing personal interest (Browning 1975, Casamatta et al 2000, Gonzales-Eiras and Niepelt 2008), although Chen, K. and Z. Song (2014) outline other forces.

Relative standards of living by age groups should be measured regularly. This paper shows that the required indicators can be built from information from the surveys taken to update the weights of the Consumer Price Index, which are available in most countries. However, the average of actual net private transfers for the elderly, intracouple and intrahousehold, may hide considerable ex-ante uncertainty. Those transfers are subject to negotiations, so they may be seen by potential beneficiaries as less reliable than a pension paid by a national pension system. This is not captured by these surveys, yet.

The inter and intra generational distributions are intertwined. The first link, mentioned in the introduction, is that the choice between a “contributory” and a “non-contributory” design of the pension increase makes a large difference for the intra-generational equity impact in the initially old beneficiaries. This choice also affects the equity impact for the young and subsequent generations.

A second link, left for future research, may be important in societies with substantial private transfers, and is related to the initial equilibrium distribution of consumption within family networks. A private transfer equilibrium may be interior or in a corner. In a proportion of the family networks, the initial equilibrium may have elderly members in a higher region of the distribution of consumption than younger members. The issue is how many of the corner equilibria will be modified by a marginal increase in subsidies for the old members. Of course, in other family networks the equilibrium must include young members in a higher region of the distribution of consumption than elderly members. Again, this equilibrium be modified by a marginal increase in subsidies for the old members. A crossing of the distributions of consumption by age may tell us something about the share of the private transfer equilibria that are in corners. Dominance may tell us something different. This a topic for future research.

The differences found here between apparently similar countries also opens questions for future research in social policy. One hypothesis is that differences between countries in the relative standard of living of the elderly is significantly influenced by differences in the size of fiscal resources devoted to non-contributory pensions. However, this is not clear. Although the Mexican government spent about 5 times more than the Colombian government as a share of GDP until recently, our data shows that the relative position of

the Mexican elderly is worse than the relative position of the Colombian elderly.[32] This "fiscal" hypothesis would be favored only in Chile, whose government spent more on non-contributory pensions than the other countries, as a share of GDP.[33]

The issues and methods discussed in this paper may also have an impact on other public policies who also redistribute wealth between generations. This is the case of many housing, education, environmental, health, infrastructure and energy policies.

Santiago de Chile, January 2018

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[32] Non-contributory pension expenditures were until recently 0.1% of GDP in Mexico and 0.02% of GDP in Colombia (Bosch et al, 2013). The proportion of the elderly that collect a pension of any type (adding non-contributory and contributory pensions) was 13% in Colombia, according to the consumer expenditure survey used in this paper. The figure for Mexico provided by Bosch et al (2013) is 50%, but it contradicts some figures in Sedesol (2013).

[33] According to Bosch et al (2013), Chile spends about ten times more in non-contributory pensions than Mexico. Our estimate is that the Chilean government spends about 1.1-1.2% of GDP in non-contributory pensions. However, Chile still spends much less than several high- income countries, who spend more than 4% of GDP in non-contributory pensions. The figure for Chile is the sum of fiscal expenditure on the Basic Pension and the Pension Complement (APS) (these two added 0.70% of GDP in 2014), and expenditure on the Minimum Pension subsidy, both for members of the old PAYG-financed plans (0.35-0.45% of GDP for 2014, according to Van Rysselberghe, 2006), and for members of the funded plan (0.05% of GDP in 2014, according to Budget Office 2015, p. 58). The proportion of the elderly that collect a pension of any type (adding non-contributory and contributory pensions) was 70% in Chile, according to the consumer expenditure survey used in this paper.

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APPENDICES: Empirical Methods

Comparison of the relative standard of living across age groups faces many challenges. For example, the elderly differ from younger age groups in several dimensions of preferences. In addition, all data sources have limitations. The methodology used to obtain the empirical results presented by this paper is preliminary and is presented in this Appendix.

Appendix A.1: Sufficiency of consumption

The Appendix presents the concept of sufficiency in consumption and some of the strengths and weaknesses of consumer expenditure surveys.

Measurement of the standard of living owes much to Garner and Short (2004, 2009), Aguiar and Hurst (2007), Attanasio and Weber (2010), Bee, Meyer and Sullivan (2012) and Barrett, Levell and Milligan (2013). In the applied empirical literature, the survey by Whitehouse (2000) argued that expenditure surveys offer more appropriate data, but he is forced to

report mostly on income surveys because these were the most prevalent by far in the 1990's. Fox et al (2014) also favor expenditure surveys over income surveys, and use the former to measure trends in consumption among the poor in the United States. Recent contributions on elderly poverty in Latin America include Holzmann and Hinz (2005) and Bosch, Melguizo and Pagés (2013).

The methodology used in those section adopts as guiding principle that the elderly have access to a wide variety of resources apart from pensions. They can spend away voluntary wealth, including housing and obtain an adequate standard of living. Non-pension flow resources include net private transfers, intracouple, intrahousehold, and inter-household. Apart from contributory pensions and official non-contributory pensions, other age-based public transfers also provide resources (medical services at lower prices, subsidies for long-term care, subsidies for transport, recreation and housing of the elderly), together with as age-based tax expenditures (usually for taxes on housing). The elderly also have capital income, mostly in the form of imputed rental income from home ownership.

All these non-pension resources are omitted from statistics on the amount of official pensions and on pension replacement rates (Lee and Mason, 2011). In our view, these omissions imply that pension replacement rates are fundamentally unreliable guides to the standard of living of the elderly. A similar drawback affects also income-based measures of elderly well-being.[34] Fortunately, acceptable proxies of consumption can be obtained from expenditure surveys. Since expenditure surveys are needed to update the weights of the Consumer Price Index, they are available in most economies.

The literature identifies four practical factors that also recommend the use of expenditure data rather than income data to measure the standard of living[35]. First, expenditure may be more stable over time than current income for households who have access to formal or informal credit facilities and insurance, which allow smoothing of some fluctuations in income (Blundell and Preston, 1998). Second, when expenditure is measured with certain survey methods, such as the Diary Method, it can be less vulnerable to under-reporting than income obtained from surveys taken at a single point in time. This is a major concern in societies where conditional transfer programs have taught the population that hiding income allows access to larger transfers.

Third, regarding durable goods, modern consumer expenditure surveys include an estimate of the consumption of the services of those goods. Fourth, the consumption basket varies with age, especially in the budget shares of health, education and housing maintenance.

[34] See Beegle et al (2012). Many current official publications suffer from this. It is also the case of the recent Report by the Chilean Presidential Advisory Commission on Pensions (Chilean Pension Commission, 2015).

[35] The data from both income and consumer expenditure surveys are rich enough to allow adjustments that take into account economies of scale at the household level.

Therefore the "standard of living" needs to recognize age-based priorities. One way to do so is to subtract out-of-pocket expenditure in health, education and housing maintenance, so only discretionary expenditure remains. The data required by this approach can only be obtained from expenditure surveys.

Separately, the use of time changes with age. A growing literature supports the theory that consumption (the standard of living) is an output produced at home from two inputs: time and expenditure on goods and services purchased in the market. Retirees supply more time towards home production. Thus, the expenditure of prime-age individuals needs to be adjusted downward to take into account the shorter time they devote to home production of consumption. The evidence provided by Aguiar and Hurst (2007), Luengo-Prado and Sevilla (2013) and Velarde and Herrmann (2014) for the U.S., Spain and Germany respectively, confirm the importance of this adjustment.

Appendix A.2: Measurement of sufficiency of pensions and consumption

According to the accounting framework of the United Nations' System of National Accounts (SNA, United Nations, 1993), the standard of living of each individual of age x, which is identified with consumption, must meet the following accounting identity (Lee and Mason 2011, p. 56)[36]:

(XXX) $$C(x) \equiv Y^{l}(x) + Y^{asset}(x) + NT(x) - S(x) \qquad \forall x$$

where $C(x)$ is consumption at age x, and $Y^{l}(x)$ is labor income at age x, which combines the incomes obtained from dependent and independent work (self-employment).[37] Of course, labor income after age 65 falls because ageing causes partial or total retirement. $Y^{asset}(x)$ is asset income net of depreciation, counting as positive the imputed rent from owner-occupied housing minus maintenance expenditures, the rent from plots of land, an allocation of the operating surplus of businesses and the total realized return from financial

[36] This is the extension to diverse age groups developed by the National Transfer Accounts project (NTA). In NTA, labor income plus asset income – that is, primary income, summed over all ages – is equivalent to net national income in SNA. Income on foreign investment or from temporary employment abroad is included in the primary income of residents. Income on assets owned by non-residents and labor income of non- residents is excluded from net national income. As in national accounts, identity (8) has limitations which are important in some applications. First, non-market time is not valued. One implication is that the value of services produced within the household, mostly by women, is not included. Second, it does not value degradation or upgrades of the environment.

[37] In the NTA project, estimates of consumption, labor income and asset income are measured using prices prior to the assessment of taxes on production and products, also known as indirect taxes. Public transfer outflows include all taxes, including taxes on production and products.

assets, and counting as negative the interest paid in consumer and mortgage loans and in loans to corporations. For consistency, net asset income includes an allocation to individuals of public asset net income, which is the difference between the rent of state-owned enterprises and the return earned in government loans and sovereign funds, minus interest paid on the public debt.[38] $NT(x)$ is the net transfer received, combining money and in-kind transfers. NT combines private sources (intra-couple, intra-household and between households) including use of housing provided for free, and public sources: the subsidy component of health and education services received, housing subsidies, non-contributory pensions and transportation and other subsidies, minus taxes net of tax exemptions and tax expenditures[39]. $S(x)$ is net saving (flow concept), which adds private net saving with an allocation of net public saving, net of depreciation.

According to the simpler versions of the life-cycle theory of consumption, saving would be negative in old age, as the stock of savings built up in the active life is spent. More realistic versions take into account that the stock of desired precautionary saving rises when individuals need to cover (a significant portion of) medical expenses whose incidence rises with age, and that this requires an increase in flow saving (De Nardi et al, 2010).

Contributory pensions received in old age can be classified as dissaving because a pensioner eats away the stock of pension rights accumulated in active life.[40] However, in many data sets these pensions are reported as positive transfers in (8). In this case, $S(x)$ in old age is likely to be dominated by spending of assets different from pension wealth (move to a smaller house, sell plot of land).

The per-period budget constraint (8) holds for the aggregate, for the average of any population, and for each individual, including the median individual. In open economies, several of the sums across resident households in a period are equal to an account for the rest of the world in SNA.

Sufficiency encompasses replacement rates provided by formal pensions

A major lesson from equation XXX is that non-pension resources play a prominent role in old age. The International Labor Office (ILO) defines "sufficiency of pensions" in a way that makes room for such non-pension resources: it is "the pension amount that allows an individual to sustain in old age, a standard of living that is minimally acceptable in relation to the one of the working life, and above the poverty line" (ILO 2011, paragraphs 99 and 100, p. 34).

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[38] "Public" refers to "general government" in the UN's System of National Accounts. "Private" is the sum of household, corporate and non-profit institutions in the UN's System of National Accounts.

[39] For example, exemptions from health contributions (Medicare), subsidies for health insurance premia (Obamacare) and health and long-term care subsidies in kind (Medicaid).

[40] This point applies regardless of the financing method of the contributory pension (funding or pas-as-you-go), and regardless of whether the institution that provides administrative services public or private.

This concept is expressed by longitudinal replacement rates, defined as:

(XXX) $$R_{it} \equiv \sum_j P_{itj} / \bar{Y}_i^l$$

where $P_{itj}$is the social security and pension income received by individual i at date t from pension institutions and programs indexed by j (including widow and widower pensions), and $\bar{Y}_i^l$ is the average covered earnings that individual i reported to the social security institutions in the past, for certain period with is normally longer than 10 years.

Replacement rates are easy to compute because they only require administrative data. The minimally acceptable longitudinal pension replacement rate agreed by the ILO Convention N° 102 is 40% of labor earnings while active, provided that the contribution career lasted at least 30 years, a proportionally smaller rate if the contribution career was shorter, and nothing if the contribution career was below 10 years.[41]

This standard allows non-pension resources to finance up to 60% of the standard of living. This allows them be larger than the pension. Thus, longitudinal replacement rates can be heavily biased indicators of sufficiency for individuals, because they ignore all non-pension resources in old age. These non-pension resources are likely to be larger in societies where uncovered earnings are large in the active phase. In addition, the administrative data that underlies pension replacement rates have inadequate coverage in countries with substantial self-employment, as in those studied here.

This is why the literature has found that reliable measures of the standard of living of the elderly must take into account non-pension resources and must use surveys (Meyer and Sullivan, 2013). It also explains why the OECD secretariat's report *Pensions at a Glance 2013* devotes a 60-page chapter to housing, financial wealth and public services given out free to the elderly.

Some advantages of consumer expenditure surveys over income surveys

In countries where conditional transfer programs have operated for decades, some of those programs' conditions have taught many interviewees to under-report earnings and other resources. This behavior facilitated by self-reporting of income, the standard practice of income surveys designed to measure the effectiveness of poverty-relief programs. Labor taxes and regulations have also taught workers to seek agreements with employers to underreport formal earnings, because this enables the worker to draw more benefits from more social programs.[42]

In contrast, consumer expenditure surveys that use the Diary Method visit each responding household repeatedly over a substantial period, allowing survey workers to check the diary and contrast with items observed in the visit. However, realization of this potential of the

[41] A later ILO convention raised the minimum standard to 45%, but this convention has very few signatories.
[42] For the case of Chile, see data from Centro de Políticas Públicas UC (2012).

Diary Method depends on a number of factors, including application of oversampling to counteract modest response rates, strict follow-up of survey workers' performance, and other survey design features discussed in the literature.[43]

Certainly expenditure differs from consumption because the timing of purchases of durable consumer goods differs from the timing of consumption of the flow of their services. These effects are important for housing and vehicle purchases. This is why most expenditure surveys make special corrections for these two types of goods. The remaining bias associated to durables washes away when large groups of households are compared, as done in this paper.

In Latin America – as in East Asia - the family is an important resource for the elderly. Specifically, many elderly women rely on the man´s pension while he is alive and on a widow's pension after he dies, just as they relied on the man's salary in active life while she was a homemaker. Therefore, taking into account intracouple transfers is essential to obtain appropriate measures of the standard of living. The expenditure approach captures intra–couple and other intra-household transfers by assuming that household expenditure is evenly distributed among members. Expenditure data also captures support to the elderly from adult children living separately, and cash and noncash government transfers different from pensions.

An emerging major advantage of consumer expenditure surveys is that some of them include an estimate of the rental equivalent of owner-occupied housing, following the pioneering work of Garner and Short (2004, 2009). For example, if home ownership in a country is more extended than in a reference foreign country, a relative income measure that excludes this rental equivalent will be lower than in the reference foreign country, even if the standard of living of the old is the same. For example, the "monetary income" of the elderly in Chile is 70% of the monetary income of the active population's, while in Germany the comparable ratio is 84%.[44] However, home ownership in Chile among the elderly is 84% while in Germany is 48%.[45]. Consumer expenditure data also allows subtraction of home maintenance expenditure, a measure of depreciation, while income data does not.

[43] Consumer expenditure surveys have performed well in some countries, but have deteriorated in others. For instance, in the U.S.A. the performance of the Diary Method has fallen recently (Bee, Meyer and Sullivan, 2012). However, in other countries the Diary Method performs well (Chile applies oversampling rigorously). Barrett, Levell and Milligan (2013) look at number of international surveys and find that there is no clear pattern of failure by data collection method. Beegle et al (2012) present a thorough comparison of variants of consumption expenditure surveys.

[44] The Chilean figure is from Chilean Pension Commission (2015), p. 60. The figure for Germany is from OECD (2003), Figure 2.3, p. 70.

[45] Source: Federal Statistical Office of Germany (2011), p. 23. The variation in home ownership across countries is large, as shown in OECD (2013) p. 77.

In contrast, measures of the standard of living produced by poverty-oriented surveys lack many of these advantages, especially for the elderly. For example, the "monetary income" obtained from these surveys relies only on self-reported income, with no follow-up or checks. In addition, "monetary income" excludes three resources that are substantial among the elderly: spending of assets different from pension rights (move to a smaller house, sell plot of land)[46], private transfers (intracouple, intrahousehold, other households), and non-monetary public transfers (health, transportation, heating, etc.).

The implications of these weaknesses of income surveys are substantive for intergenerational redistribution. This paper takes the following approach to measure sufficiency, suitable for large groups: compare the cross-sectional distribution of adjusted expenditure by the elderly (65 are more), with the distribution by those aged 35 to 59.

Appendix A.4. Adjustments o consumption needed for comparisons among age groups

Expenditure and consumption patterns vary by age. These variations can make invalid a comparison between the expenditure per capita for an active-age group, with the similar figure for the elderly. Comparability can be restored by adjustments that take into account the main differences by age. The adjustments used in this report were:

First, the average number of members per household varies by age, and there are economies of scale at the household level. In response, this paper uses the official equivalent scale that each country has adopted, to build the "equivalent" per capita expenditure. All figures reported in this paper are adjusted in this way.

Second, the relative size of certain "priority" expenditures vary with age. It is the case of health expenditure, which rises with age. There is empirical evidence that supports the priority given to health expenditures. The estimated elasticity of substitution between health expenditure and other expenditure has a very low value, near 0.1 (Scholz and Seshadri 2010). The same happens with expenditure in the education of young family members.

Third, those age groups with higher rates of home ownership must spend more in maintenance and repairs of their homes. Depreciation must be subtracted from consumption according to (8). In response, this paper calculates per capita equivalent expenditure minus expenses in health, education and maintenance of housing, for each age group.

[46] Spending of assets is classified as "negative income" by the Haig-Simons definition of income. This confirms that for the elderly, who spend assets, consumption is a better measure of well-being than income.

Owner-occupied housing may become “excessive” as age advances, because adjustment of housing size and quality to varying needs is subject to large transaction and switching costs. However, the margins for adjustment are not limited to those offered by the housing market. Exchange of in-kind services within the family and even with others, is also an alternative. An example is when an elderly owner invites relatives to live in and promises to bequest the house, in exchange for expense sharing and long-term care. We calculated the proportion of elderly whose household expenditure in housing is above a third of total expenditure, and finds that this proportion is 4.4% in Chile, the country with the coldest winter. This suggests that “excessive housing” is secondary in Latin America, which is not surprising given the modest level of the absolute standard of living.

Hours in home production allow saving on money expenditure

The observed drop in money expenditure at retirement requires careful treatment. The “retirement consumption puzzle” raised by Banks, Blundell and Tanner (1998) and the subsequent literature asks whether this fall in money expenditure is compatible with equalization of the marginal utility of consumption over time, at the retirement date.

Retirement, and thus availability of time for home production, varies substantially by age. The theory defines consumption as the output of “home production”, which uses as inputs both expenditure in market goods and time spent on home production (Becker, 1965). This theory has substantial empirical evidence in its favor (Aguiar and Hurst 2007, Luengo-Prado and Sevilla 2013, Velarde and Herrmann 2014). Individuals who participate in the labor market have a higher implicit price of time for home production than individuals in retirement, and this change in price induces labor market participants to spend more money to substitute for time, which implies obtaining less consumption per dollar spent. In the United States, the amount of the time spent in the production of meals rises by 53% at the time of total retirement from full-time formal jobs. This extra input of hours is enough to preserve food consumption constant over time despite a 17% drop in money expenditure after retirement (Aguiar and Hurst 2007).

In an influential survey, Attanasio and Weber (2010, p. 717) endorse the seminal paper by Aguiar and Hurst (2007), who argue that the observed drop in expenditure at retirement fits the lifecycle model well, after home production of consumption is taken into account, preferences are correctly modeled, and attention is focused on those who retire at the planned age.

The implication for this paper is that expenditure data for prime-age individuals needs to be adjusted to take into account that they supply a smaller input of time into home production of consumption goods and services, as compared to the elderly. This smaller time input reduce prime-age individuals’ true consumption for any given money expenditure.

Since our microdata does not include hours of work, we make this adjustment by combining the following aggregate data for each country: (a) for those aged 35 to 59, we find the average hours of employment per week, designated as H_{35-59}^{empl}, and the proportion of the age group that was employed, labeled p_{35-59}^{empl}; (b) for those aged 65 and more, the analogous average data are collected: H_{65+}^{empl} and p_{65+}^{empl}; (c) the number of hours per week that is officially designated as full-time employment in the country, labeled F.

Finally, we use the finding that true consumption is the same for fully retired and full-time participants in the labor market, when expenditure by retirees is about 83% of expenditure by active workers, according to United States data (Aguiar and Hurst, 2007).

It follows that a higher number of average hours of employment in prime age ($H_{35-59}^{empl} \cdot p_{35-59}^{empl} > H_{65+}^{empl} \cdot p_{65+}^{empl}$) means that any given expenditure at those age is less effective in creating consumption. The proposed adjustment in expenditure is then:

(XXX) $$A_{35-59} = 0.17 \cdot \left(\frac{H_{35-59}^{empl} \cdot p_{35-59}^{empl} - H_{65+}^{empl} \cdot p_{65+}^{empl}}{F-0} \right)$$

where A_{35-59} is the percentage that must be subtracted from expenditure made by the group aged 35 to 59 to achieve comparability with the one of those aged 65 or more.[47] According to the results in section 4, the adjustment factors for the countries studied here are 7.6% for Mexico, 7.9% for Colombia and 9.1% for Chile.

[47] Of course, this approach offers only a first approximation to the exact adjustment. One should also control for difference in the size of households across age groups, and in the labor force participation and hours of those additional household members, who share expenditure. Ideally, microdata should be used.