

Raising pay-as-you-go pensions: does it increase inequality? ¹

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Abstract

Since many policies create inter-generational redistributions, it is important to assess their impact on inequality. For example, expanding PAYG-financed pensions financed with a proportional tax that falls mostly on the active generation can be benevolent if the elderly have lower consumption than contemporaneous workers, but could be regressive if otherwise. This paper uses consumer expenditure surveys to compute adjusted distributions of expenditure per capita on an equivalent basis for Mexico, Colombia and Chile, for two age groups: those aged 65 and more, and those aged 35 to 59. The paper's statistical tests finds that in Mexico, expenditure by the elderly is smaller than (is stochastically dominated at first order by) adjusted expenditure by adults aged 35 to 59. In contrast, in Colombia expenditure by the elderly is similar to the adjusted expenditure by adults aged 35 to 59 (the hypothesis of stochastic dominance in both directions are rejected). Finally, in Chile expenditure by the elderly stochastically dominates the adjusted expenditure by adults aged 35 to 59, at high levels of significance. The implication is that expanding PAYG-financed pensions would be progressive in Mexico, neutral in Colombia and regressive in Chile.

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1. Introduction

An important policy issue is whether a general expansion of public pensions for the elderly is progressive, when financed with an earnings tax, or with any proportional tax that falls mostly on active-age individuals in similar deciles of the distribution of consumption. When permanent, this policy is the classic expansion of pensions financed on a pay-as-you-go basis. It is well known that such a policy creates an inter-generational redistribution in the lifetime sense, where active-age individuals lose out in net terms: the extra costs for them (more taxes when active, now) exceed the present value of extra benefits for them (more benefits when old, several decades later). The generations that follow also lose out, while the initial elderly benefits (Diamond, 1965).

Such inter-generational redistribution can be progressive or regressive, depending on the initial relative standard of living of the losing and winning generations. For example, if the current elderly are facing relative poverty, as they did in the Netherlands in 1946 after the Second World War, it would be progressive to increase or create public pensions for most of the elderly, even if financed with an earnings tax (as in the AOW pension, see Anderson 2004). It is even more progressive if the expansion of public pensions is targeted or means tested, as Denmark chose to do in 1956 (Abrahamson and Wehner, 2003).

Standards of living need to be compared in order to inform and guide the debate on this and other policies with inter-generational impact. In the absence of this disciplining information, a bias in public policy can build up, because politicians tend to increase transfers towards the age groups that vote more frequently, which are the elderly in most countries, and because most of the losers are unborn and may not be fairly represented by the voters who are alive (Browning, 1975).

This perspective is somewhat different from the insurance view, which searches for optimal mutual insurance rules between generations whose standards of living are yet unknown (Ball and Mankiw, 2007). Information on the relative standard of living of currently alive generations is available, as shown in this paper. That transforms mutual insurance into redistribution with known losers and gainers, which makes a large difference in the political area.

Measures of the standard of living of the elderly must take into account that the elderly have non-pension resources, such as spending away assets different from pension wealth (move to a smaller house, sell plot of land, etc.), as suggested by the life-cycle theory of saving. Non-pension resources also include private transfers (intracouple, intrahousehold, to and from extended family members in other households), imputed rental income from home ownership, rent from other property, labor income after age 65 and the value of public transfers different from pensions (medical services, long-term care, subsidies for transportation, recreation and housing, and age-based tax expenditures). Therefore, statistics on the amount of official pensions, on pension replacement rates, and on income

measures that omit asset consumption and private transfers, are unable to inform and guide the debate on this and other policies with inter-generational impact. Sadly, many current publications suffer from this pitfall. This is also the case of the recent Report by the Presidential Advisory Commission on Pensions (Chilean Pension Commission, 2015).

This paper approaches this challenge with data taken from consumer expenditure surveys. Current expenditure can be the best proxy of consumption. This measure includes inflows from all non-pension sources net of saving. The surveys also supply adjustments for the difference between purchase and use of the main consumer durables. Expenditure measures consumption net of saving or dissaving, a valuable feature when households have access to formal or informal credit facilities or insurance opportunities, which allow smoothing of some fluctuations in current income (Blundell and Preston, 1998).

We compare the cross-sectional distribution of expenditure per capita on an equivalent basis by the elderly (65 and more), with the distribution of similar expenditure by those aged 35 to 59 who do not reside in a household where an elderly person lives. This comparison is useful because from behind a veil of ignorance, one would be better off in the age group whose distribution dominates at first order. Social welfare is at least as large in the dominant group for a wide class of social welfare functions (Deaton, 1997).

This paper seeks to learn whether one of those distributions dominates stochastically at first-order, in Chile, Colombia and Mexico. The paper focuses in the first 7 deciles of the distributions, because this is the range of interest for non-contributory pension policy, and this is where these surveys are more reliable. To assess dominance empirically, the paper uses the non-parametric test pioneered by McFadden (1989) and clarified by Barrett and Donald (2003).

Before comparing, the distributions are subject to two types of adjustment. First, the expenditure of prime-age individuals is adjusted downward to take into account their smaller availability of time for home production of consumption goods and services. They need higher money expenditure to compensate and consume the same. This paper adapts the adjustment factor estimated by Aguiar and Hurst (2005) to these three countries. Second, some expenditure preferences differ predictably by age. This is the case of out-of-pocket expenditure in health and education. It is also the case of maintenance of owned housing, because home ownership rates differ among these age groups. To take into account the high priority of these expenditures, the distributions compared here are those for expenditure in excess of these items.

The paper finds that the relative consumption by the elderly is quite different among these three countries. In Mexico, the hypothesis that the current elderly have a distribution of expenditure per capita equivalent that is lower (in amounts, not in probabilities) than the adjusted distribution of expenditure by prime-age individuals, cannot be rejected at any confidence level. The difference at the median was 11% against

the elderly in 2013. This may be explained in a number of ways. One suggestion is that family support for the Mexican elderly may be hobbled by insufficient communications and cash-transfer facilities between the Mexican countryside (where many elderly live) and adult children who migrated to cities in Mexico, the United States and elsewhere (World Bank 1994, Chapter 2). It also suggests that non-contributory pensions such as the federal PAM program and similar programs at the state and municipal levels have not yet reached an adequate size.³ Indeed, our result suggests that expanding non-contributory old-age pensions in Mexico for this range of elderly households, financed with a tax on the active population in the same range, would be progressive in the intergenerational sense.

In contrast, the paper finds that in Colombia the inference is that the distributions are equal. Neither of the two opposing hypothesis of stochastic dominance at first order are rejected. This finding implies that expanding old-age pensions in Colombia for this range of elderly households, financed with a tax on the active population in the same range, would not be regressive or progressive. It is revealing that Colombia, who has smaller non-contributory public pensions than Mexico, still achieves an elderly consumption that is almost equal to the one achieved by prime-age individuals. This might be explained by stronger family transfers in Colombia than in Mexico. Maybe migration of adult children in Colombia is mostly to cities within Colombia, where communications and cash-transfer facilities with the countryside could be adequate.

Finally, the paper shows that in Chile the results are the opposite from Mexico: the elderly have a distribution of expenditure per capita equivalent that stochastically dominates at first order the distribution for prime-age individuals, at any confidence level. The difference at the median was 6% in favor of the elderly in 2012. This result is not new for Chilean economists, as other evidence has pointed in the same direction for years. The concluding remarks offer a potential explanation for this result for Chile. In any case, the result implies that the creation of a general public pension in Chile, financed with a new tax on earnings that falls on the active generation (standard pay-as-you-go), would be regressive. Unfortunately, this was the policy outlined in August 9, 2016, by the Chilean authorities. Of course, a regressive outcome can be avoided by changing the financing to other taxes. A regressive outcome would also be avoided by changing benefits towards targeted increases for pensions of discriminated or unlucky groups.

The literature on the distribution of pension amounts includes Mesa-Lago (1978), who shows the importance of stratification in Latin American pensions, and World Bank (1994) which emphasizes the link between uncovered jobs and pensions. The survey of the older literature by Whitehouse (2000) argues that expenditure surveys offer more appropriate data, but he is forced to report mostly on income surveys because these were the most prevalent in poverty studies. Fox et al (2014) favor expenditure surveys, and use them to measure trends in consumption among the poor in the United States. Important recent

³ See the excellent report by Sedesol (2013) on elderly welfare and opportunities.

contributions on elderly poverty in Latin America include Holzmann and Hinz (2005) and Bosch, Melguizo and Pagés (2013). The economic demography literature on age-related policies is led by Lee and Mason (2011), was applied to Colombia by Tovar and Urdinola (2014) and to Chile by Bravo and Holz (2011). Measurement of the standard of living has been influenced by Garner and Short (2004, 2009), Aguiar and Hurst (2005), Attanasio and Weber (2010), Bee, Meyer and Sullivan (2012) and Barrett, Levell and Milligan (2013). Espinosa et al (2014) provide a new measure of economic insecurity for Chile and Mexico. The statistical tests of first-order dominance are beginning to be used widely and were developed by Barrett and Donald (2003), Barrett, Donald and Bhattacharya (2012) and by Davidson and Duclos (2013).

Section 2 presents the concept of sufficiency and the strengths and weaknesses of consumer expenditure surveys. Section 3 presents the adjustments needed for comparison among age groups. Section 4 presents the statistical tests for dominance. Section 5 presents the results, including the surveys' distributions of expenditure per capita equivalent for the elderly and for the 35 to 59 age group, without and with adjustments, for our three countries. It also applies statistical tests for stochastic dominance at first order, and applies further tests that compare the degree of inequality in consumption of the elderly, relative to inequality among the prime-age population. Section 6 offers concluding remarks.

2. Sufficiency: consumer expenditure surveys

Measures of the standard of living of the elderly must take into account non-pension resources (Meyer and Sullivan, 2013). For example, the OECD secretariat's report *Pensions at a Glance 2013* devotes a 60-page chapter to housing, financial wealth and public services for the elderly.

National accounting from the United Nations' System of National Accounts (SNA, United Nations, 1993) has been adapted to age groups by the National Transfer Accounts project (NTA).⁴ The result is that the standard of living of each individual, which is identified with consumption, must meet the following accounting identity, where non-pension resources play a prominent role in old age (Lee and Mason 2011, Chapter 3, p. 56)⁵:

⁴ See www.ntaccounts.org

⁵ As in national accounts, identity (1) has some limitations, which are important for some purposes: non-market time is not valued. One implication is that the value of services produced within the household, mostly by women, is not included these figures. Finally, it does not value degradation (or upgrades) of the environment. 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.

$$(1) \quad C(x) \equiv Y^l(x) + Y^{asset}(x) + NT(x) - S(x) \quad \forall x$$

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).⁶ 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 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.⁷ $NT(x)$ is the net transfer received, combining money and in-kind transfers, and combining private sources (intra-couple, intra-household and between households) 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)⁸. $S(x)$ is net saving (flow concept), which adds private saving to 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 for those elderly who saved for old age (in active life). However, more realistic versions take into account that the stock of desired precautionary saving rises when individuals need to cover (a portion of) medical expenses, whose incidence rises with age, and 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 that was accumulated in active life.⁹ However, in many data sets these pensions are reported as positive transfers in (1). In this case, $S(x)$ in old age is likely to be dominated by spending of assets different from pension income (move to a smaller house, sell plot of land), as modelled by the life-cycle theory of saving.

⁶ In the NTA project, estimates of consumption, labor income, and asset income are measured using basic prices; that is, income and consumption are valued prior to the assessment of taxes on production and products, also known as indirect taxes. Public transfer outflows thus include all taxes, including taxes on production and products.

⁷ “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.

⁸ For example, exemptions from health contributions (Medicare), subsidies for health insurance premia (Obamacare) and health and long-term care subsidies in kind (Medicaid).

⁹ 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.

The per-period budget constraint (1) holds for the aggregate, for the average of any population, and for 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 versus dominance

The International Labor Office (ILO) defines “sufficiency of pensions” (non contributory plus mandatory contributions) in a way that makes room for non-pension resources. Sufficiency is defined as “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 in p. 34). Because the pension replacement ratio agreed by the ILO Convention N° 102 is only 40% of labor earnings while active, and only for contribution careers of at least 30 years, it certainly allows non-pension resources to be larger than the pension.

The ILO definition of sufficiency may easily appear to collide with the “societal perspective” on elderly welfare mentioned by the OECD.¹⁰ This perspective measures the elderly’s average current consumption relative to the average consumption of contemporaneous active-age individuals. This collision occurs in societies with relative large non-pension resources among the elderly, because sufficiency according to the societal perspective can be satisfied, while pensions may be insufficient according to the ILO’s criterion.

Longitudinal replacement rates are defined as:

$$(2) \quad R_{it} \equiv \Sigma P_{it} / \bar{Y}_i^l$$

where ΣP_{it} is the sum of social security and pension income received by individual i at date t from different pension institutions and programs, and $\bar{Y}_i^l$ is average covered earnings as reported to the social security institutions, for certain averaging period with is normally longer than 10 years.

Replacement rates are easy to compute because they only require administrative data. However, they are heavily biased indicators of sufficiency for individuals, and for groups where uncovered earnings are large in the active phase, and relatedly, where non-pension resources are large in old age.

This paper takes a different approach to sufficiency, suitable only for large groups: compare the cross-sectional distribution of expenditure by the elderly (65 are more), with the distribution of expenditure by those aged 35 to 59 (either working in covered jobs, in uncovered or working at home). If this comparison identifies regions where the elderly’s distribution of consumption is dominated at first-order, we say that sufficiency fails in that region of the distribution.

¹⁰ The expression “societal perspective” is taken from OECD (2013) *Pensions at a Glance 2013*, p. 61.

The interpretation of dominance is as follows: from behind a veil of ignorance, where one does not know which position in the distribution one might have in each of those distributions (just before being born into a household chosen by chance), an individual would be better off if he belonged to the group whose distribution dominates in first order. If the means for the two groups are equal, one may then ask which distribution dominates in second order, and so on. Social welfare is at least as large in the dominant group for a wide class of social welfare functions (Deaton, 1997).¹¹

Advantages of consumer expenditure surveys

Expenditure survey data has advantages over administrative data, because the latter has inadequate coverage in countries with substantial self-employment, as in those studied here. Expenditure survey data also has advantages over poverty-oriented 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, a behavior facilitated by self-reporting of incomes. 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.¹² 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 repeatedly. However, realization of this potential of the Diary Method depends on a number of factors, including application of oversampling to counteract modest response rates, and strict follow-up of survey workers' performance.¹³

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 mainly for housing and vehicle purchases. Most 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

¹¹ In real time, matters are different: once an individual knows where he stands now, the appropriate distributions to compare are conditional distributions going forward. Assess the distribution of consumption paths for the remaining lifetime, given each starting position. These conditional distributions may be obtained from panel data sets.

¹² For the case of Chile, see data from Centro Políticas Públicas UC (2012).

¹³ 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.

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). Consumer expenditure data also allows subtraction of home maintenance expenditure, a measure of depreciation, while income data does not.

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.¹⁴

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), private transfers (intracouple, intrahousehold, to and from other households), and non-monetary public transfers (health, transportation, recreation, for housing, etc.).

The implications of these weaknesses of "monetary income" are substantive. For example, if home ownership in a country is more extended than in a reference foreign country, the relative "monetary income" 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 same ratio is 84%.¹⁵ However, home ownership in Chile among the elderly is 84% while in Germany is 48%.¹⁶ Thus, the relative standard of living of the elderly in Chile may be better than in Germany.

3. Adjustments needed for comparison among age groups

¹⁴ 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. The "monetary income" measure is also reported by the OECD.

¹⁵ The Chilean figure is from Chilean Pension Commission (2015), p. 60. The figure for Germany is from OECD (2003), Figure 2.3, p. 70.

¹⁶ 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-

Expenditure and consumption patterns vary by age. These variations can make invalid a comparison between the expenditure per capita equivalent 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 main adjustments are:

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 in each country that is analyzed, 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 (1). In response, this paper calculates per capita equivalent expenditure minus expenses in health, education and maintenance of housing, for each age group.

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 the issue of “excessive housing” is secondary in Latin America.

Hours in home production allow saving on money expenditure

Last but not least, 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 retirement.

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, 2005). 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, 2005).

In an influential survey, Attanasio and Weber (2010, p. 717) endorse the seminal paper by Aguiar and Hurst (2005), 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, 2005).

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 adjustment in expenditure is then:

$$(3) \quad A_{35-59} = 0.17 \cdot \left(\frac{H_{35-59}^{empl} \cdot p_{35-59}^{empl} - H_{65+}^{empl} \cdot p_{65+}^{empl}}{F - 0} \right)$$

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.¹⁷ Previewing the results in section 5, the adjustment factors for the countries studied here are 7.6% for Mexico, 7.9% for Colombia and 9.1% for Chile.

4. Statistical tests for dominance

If the marginal utility of consumption is positive, then 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. It is well-known that first-order stochastic dominance implies higher order dominance, including second-order dominance.¹⁸ Therefore, in the presence of stochastic dominance at the first order, the degree of Lorenz dominance is irrelevant for choosing between the 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 Garry Barrett and Stephen Donald (2003) for different sample sizes for the two cumulative distribution functions (CDFs), and also by providing consistent tests for stochastic dominance of any order, which require bootstrap and simulation procedures. Barrett and Donald (2003) confirm that only first-order dominance can be tested in a relatively simple manner.

The null hypothesis is that distribution F dominates distribution G at first order: $H_0: F(z) \leq G(z)$ for all $z \in [0, z^{max}]$, where z is the income or consumption variable, and the alternative hypothesis is $H_1: F(z) > G(z)$ for all $z \in [0, z^{max}]$. The Kolmogorov-Smirnov test statistic under the null is (Barrett and Donald 2003, p. 75-78):

$$(4) \quad \hat{S}_1 \equiv \sup_{z \in [0, z^{max}]} \left\{ \left(\frac{1}{N} \sum_{i=1}^N 1(X_i - z) \right) - \left(\frac{1}{M} \sum_{i=1}^M 1(Y_i - z) \right) \right\} \cdot \left(\frac{N \cdot M}{N+M} \right)^{1/2}$$

where $\{X_i\}_{i=1}^N$ and $\{Y_i\}_{i=1}^M$ are finite and independent samples from CDFs F and G respectively, and the notation $1(y)$ means that the item takes the value 1 if the argument y is positive and 0 otherwise. As in our case both samples come from a cross-section survey, not from a panel dataset or other designs that may cause dependence, we assume that the samples are independent.

¹⁷ 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.

¹⁸ This follows from the fact that distributions are positive and increasing functions.

This test statistic can be computed quite easily. A Stata program for this test for stochastic dominance at first order was made publicly available in 2009 by researcher G. Yalonetzky from Oxford University.¹⁹

The null is rejected if there is at least one income or consumption value z at which F is close enough to G , so that, given the sample sizes N and M , the test statistic is below a critical value. For this test statistic, the critical values are 1.073, 1.2239 and 1.5174 for the 10%, 5% and 1% levels of significance respectively. The p-value can be computed as $\exp(-2(\hat{S}_1)^2)$.

Another recent test for stochastic dominance is provided by Davidson and Duclos (2013) based on an empirical statistic that is similar to a likelihood ratio. They propose to test a null hypothesis of *non* dominance. They argue for this approach because if this null is rejected, the alternative can be legitimately inferred without knowing the power of the test. In this paper we do not use this test because we are not aware of a programmed version.

Degrees of inequality

Now return to 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 the marginal utility of consumption is positive and falling (concave utility), then all individuals would prefer the distribution that dominates at the second order. This type of dominance is intimately related to inequality measures. Some inequality measures such as the Gini coefficient are based on the Lorenz curve, which 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.

Lorenz dominance refers to comparisons of the degree of inequality of two distributions regardless of the ordering of their means. 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 . The distribution or resources corresponding to the dominant Lorenz curve is more egalitarian (Atkinson, 1970), or equivalently, it is less risky from behind a veil of ignorance.

Barrett, Donald and Bhattacharya developed a test for Lorenz dominance which was published in 2014 (although it circulated from 2003), and is available in Stata through the command *ldtest*. The hypothesis of weak Lorenz dominance of A over B is:

$$(5) \quad \begin{aligned} H_0^1: L_B(p) &\leq L_A(p) \text{ for all } p \in [0,1] \\ H_1^1: L_B(p) &> L_A(p) \text{ for some } p \in [0,1] \end{aligned}$$

¹⁹ See program in <http://www.ophi.org.uk/statistical-tests-for-unidimensional-dominance/>

Since the roles of A and B can be reversed to test similar hypotheses, labeled H_0^2 and H_1^2 , then the hypotheses H_0^1 and H_1^2 together imply the strong dominance of A over B . In it is possible to test the hypothesis that the Lorenz curves are identical.

5. Sufficiency of consumption for the elderly in 3 countries

This section presents results for stochastic dominance at first order for Mexico, Colombia and Chile. The final subsection presents the results of tests for inequality among the elderly, relative to inequality among the prime-age population, in these three countries.

5.1 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. Its objective is to obtain estimates of annual consumption expenditure of Mexican households, and the average expenditure 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 elderly and 33,859,647 correspond to the prime-age group. The elderly are defined as those aged 65 years or more. Prime-age individuals are defined as those aged 35 to 59, to minimize the impact of special pension system rules for women aged 60 to 64.

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 follow: (first member with age > 18)*1 + (sum of members with age >= 18 except the first member)*0.7 + (sum of member 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). This imputed rent is also a use of funds included in total household expenditure.

The 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 avoid mixing the distribution of the standard of living for the elderly with the distribution for the reference group.

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: (a) for those aged 35 to 59, the proportion of the age 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, the average hours of employment per week among the employed was 37.4 and the proportion of the age group

that was employed was 27.4%; (c) full-time employment was 48 hours per week. The source of this information is the *Encuesta Nacional de Ocupación y Empleo* (ENOE) of Mexico, run by *Nacional de Estadística y Geografía* (INEGI). Applying equation (3) to this data, the required adjustment in the expenditure of the group aged 35 to 59 is the following reduction:

$$(6) \quad A_{35-59}^{Mexico} = 0.17 \cdot \left(\frac{43.9 \cdot 0.721 - 37.4 \cdot 0.274}{48 - 0} \right) = 0.076 \quad (7.6\%)$$

As an introduction to the results, Table 1 reports the annual per capita equivalent expenditures for percentiles 25 and 50 of the two populations described above. It also separates the elderly by gender. The first column does not include the adjustment for hours of employment per week to the expenditures of prime-age individuals, nor excludes priority out-of-pocket expenditure in health, education and housing repairs. Table 1 shows that before the adjustment for hours, the money expenditure of the elderly is below the one of prime-age individuals, in both the 25th and the 50th percentiles, by 19 and 22%. This is a substantial amount.

When the adjustment for hours is applied, as done in column 3, the standard of living of the elderly remains lower than for the prime-age population. The ratio rises to 0.886 at the medians and to 0.908 at the 25th percentiles. The difference is still substantial.

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

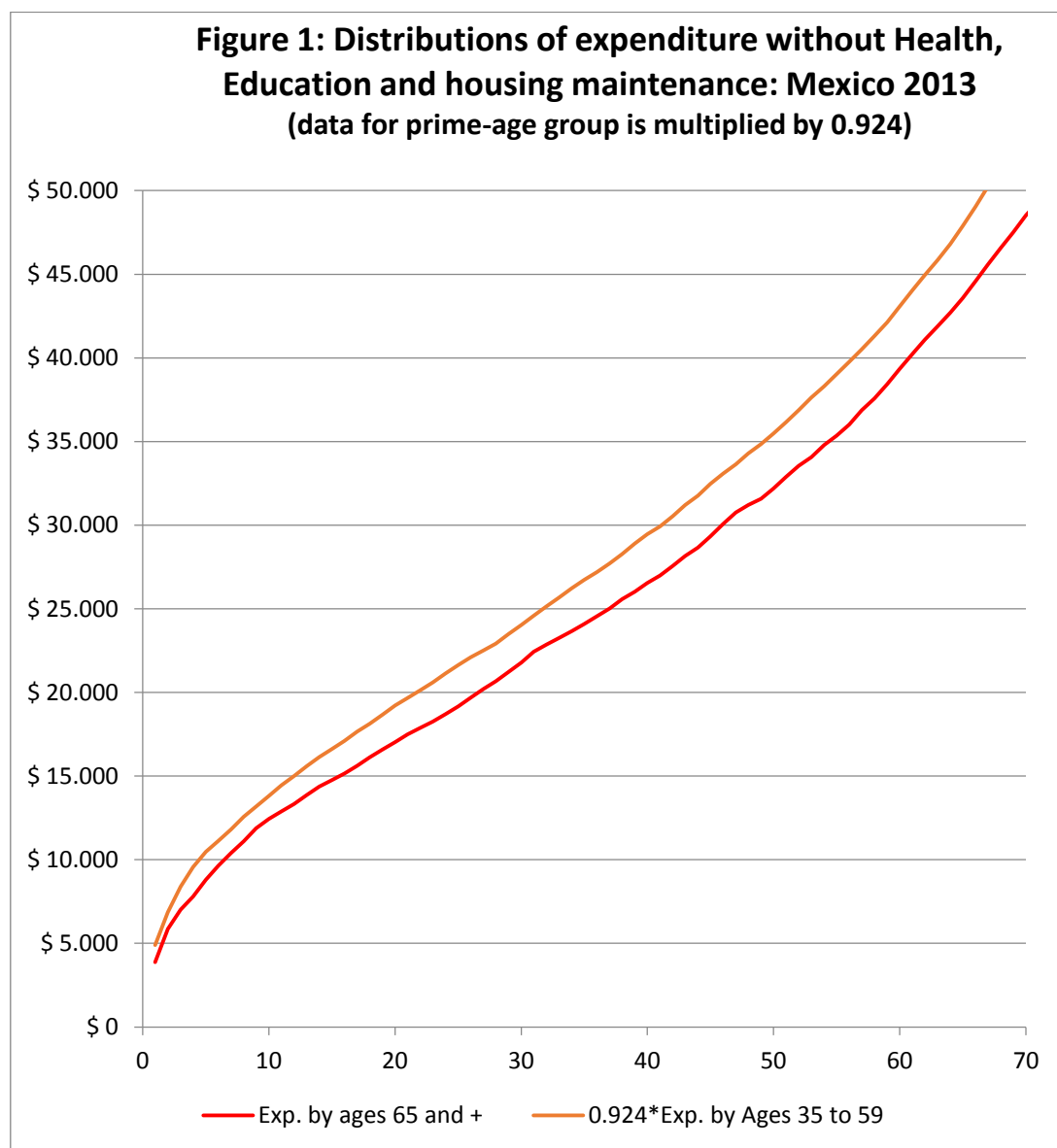
(Total per capita expenditure equivalent including imputed rent of owner-occupied housing, in Mexican pesos- MXN)

<i>Expenditure, per capita equivalent (MXN/year)</i>	Ages 35 to 59 (only households without old)	All Elderly (65 and more years of age)	Expend. 65 + / Adjusted 35-59 expenditure	Elderly women (65 +)	Elderly men (65 +)
Median (50th percentile)	38,389	32,195	0.886	32,371	32,035
Vulnerable (25th percentile)	23,414	19,166	0.908	19,285	18,999.8

Source: ENGASTO 2013 survey, 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 different from the marginal household in the percentile. These numbers can be converted into PPP USD per month with the exchange rate for the U.S. Dollar for 2012, which is MXN 7.86 = 1 PPP USD, obtained from <http://data.worldbank.org/indicator/PA.NUS.PPP>.

Disaggregation by gender of the standard of living of the elderly reveals smaller differences between elderly men and elderly women. The size of the difference is 1% at the medians and 1.5% at the 25th percentiles. Note that differences between single-gender households are captured by our data, so this finding is not explained solely by the standard assumption that household resources are divided equally among all adult members.

Figure 1 presents the full distributions of per capita equivalent expenditures up to the 70th percentile: one is for the elderly, and the other for the prime-age population. For robustness, both exclude out-of-pocket expenditure in priority items that vary with age, specifically health and education. They also exclude expenditure in housing maintenance. The data for prime-aged individuals are multiplied by 0.924 to take into account the lower availability of hours for the prime-age population, as in the third column of Table 1.



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 expenditure per capita equivalent, excluding health and education expenditures. The vertical axis is in thousands of MXN per year.

A visual examination of Figure 1 suggests that the distribution of expenditure per capita equivalent for the Mexican elderly is dominated at first order by the distribution of the adjusted expenditure per capita equivalent for prime-age individuals.

To test this intuition, we apply the Kolmogorov-Smirnov test statistic for stochastic dominance at first order presented in section 4, studied by McFadden and Barrett-Donald. We test separately the hypothesis that the CDF for the population aged 65 and more dominates the CDF for those aged 35-59, and the opposite hypothesis. The results are in Table 2.

Table 2: KS statistics for Stochastic Dominance at first order: Mexico

Test	K- statistic	p- value	Result
CDF for those 35-59 vs CDF for 65+*	0.124	0.9697	Not reject
CDF for those 65+ vs CDF for 35-59	4.425	0.0000	Reject

*The null hypothesis for the first row (labeled "CDF for those 35-59 vs CDF for 65+") is that the CDF for those aged 35-59 years old presents a probability that is *less than or equal* to the probability presented by the CDF for those aged 65 and more. The analogous interpretation holds for the second row.

Note: the critical value for 1% confidence is 1.5174

The null that the CDF for those 35-59 years old is less than or equal to the CDF for those of 65 years and more (i.e. that the amounts for the active group are larger) is not rejected at 1% significance. That may imply that either the CDF of those 35-59 years old stochastically dominates (at first order) the CFD of those aged 65 years and more, or that the CFDs are equal. The result of the test in the second row favors the former interpretation.

The conclusion for Mexico is strong: the current elderly have a distribution of expenditure per capita equivalent that is significantly dominated, at almost any confidence level, by the analogous and adjusted distribution for prime-age individuals.

5.2 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 for a total of 42,439,326 people. The elderly group, defined as those aged 65 or more, represents 2,881,207 people. The comparison group is the subset of prime-age individuals that do not reside in households where one or more elderly person resides. As before, prime-age individuals are defined as those aged 35 to 59. DANE imputes a rent to owner-occupied housing, which allows the inclusion of this important use of funds among expenditures.

To 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. The source of this information is the *Gran Encuesta de Hogares* run by DANE. Applying equation (3) to this data, the required adjustment in expenditure made by those aged 35 to 59 is the following reduction:

$$(7) \quad A_{35-59}^{Colombia} = 0.17 \cdot \left(\frac{44.2 \cdot 0.741 - 36.8 \cdot 0.282}{48 - 0} \right) = 0.079 \quad (7.9\%)$$

The size of the adjustment 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. The results for the elderly are also separated by gender. The first column does not adjust the expenditures of prime-age individuals by availability of hours for home production.

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

(Total per capita expenditure equivalent including imputed rent of owner-occupied housing, in Colombian pesos -COP)

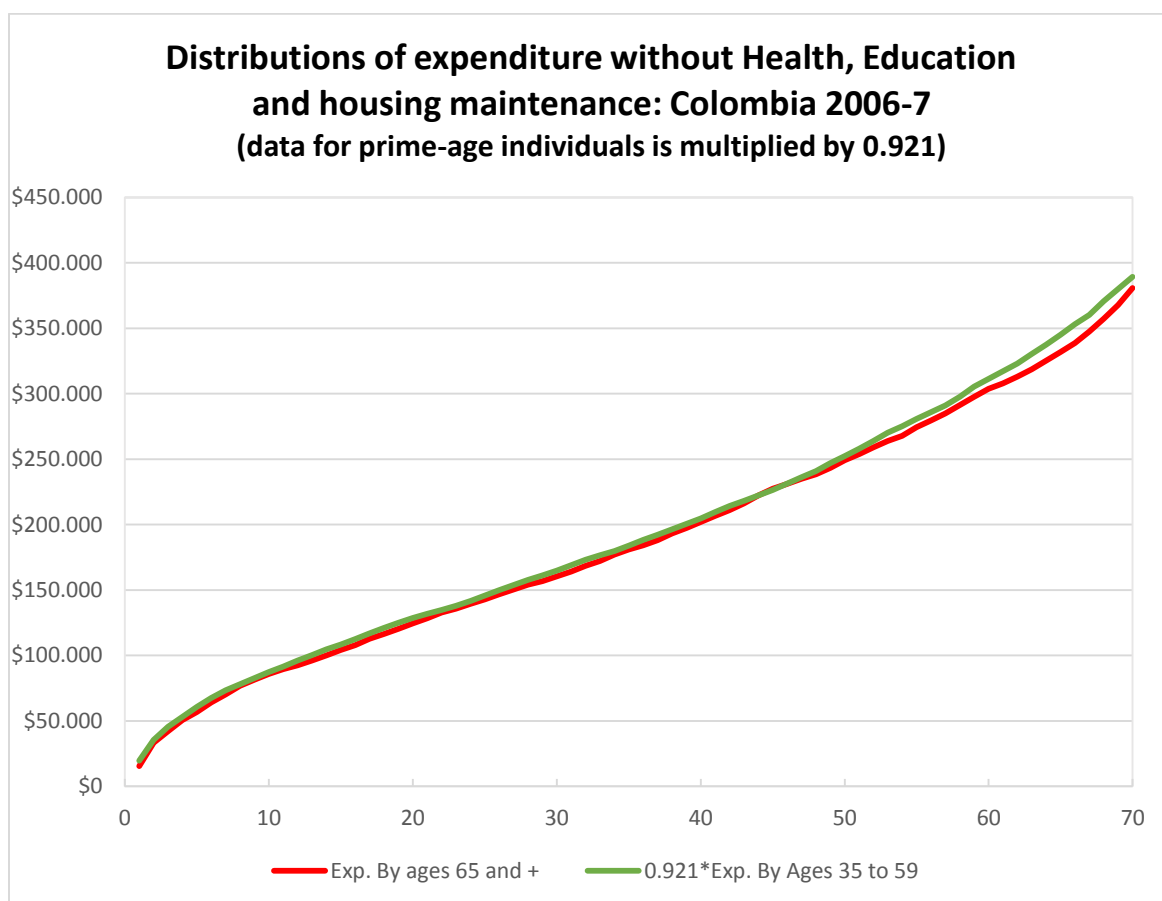
<i>Expenditure, per capita equivalent (COP/year)</i>	Ages 35 to 59 (only households without old)	All Elderly (65 and more years of age)	Expend. 65 +/ Adjusted 35-59 expenditure	Elderly women (65 +)	Elderly men (65 +)
Median (50th percentile)	273,900	249,118	0.980	259,733	236,524
Vulnerable (25th percentile)	158,424	142,960	0.988	150,023	137,839

Source: ENIG 2006-2007 survey, taken by the *Departamento Administrativo Nacional de Estadística* (DANE). The figure for each percentile is the average for all households that belong in the same percentile, which is 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 2006, which is COP 977.71 = 1 PPP USD, obtained 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 for the availability of hours, the standard of living of the Colombian elderly (measured by total expenditure per capita equivalent) is very slightly below the one for Colombian prime-aged individuals, in both the 25th and the 50th percentiles. The ratio rises to 0.980 at the medians and to 0.988 at the 25th percentiles.

Disaggregation by gender in Colombia reveals differences between the standard of living of elderly men and elderly women that favor women by a substantial 9% at the median and 8% at the 25th percentile. Understanding this result is a matter for future research.

Figure 2 presents two distributions of per capita equivalent expenditures up to the 70th percentile: one for the elderly, and the other for prime-aged individuals. For robustness, both exclude expenditure in the two priority items that vary with age, health and education. All the data for prime-aged individuals are multiplied by 0.921 in this figure, as in the third column of Table 2, to take into account that prime-age individuals tend to produce less consumption per dollar of expenditure.



Source: ENIG 2006-07 survey, taken by the *Departamento Administrativo Nacional de Estadística* (DANE) in 2006. The horizontal axis is the percentile in the distribution of expenditure per capita equivalent, excluding health and education expenditures. The vertical axis is in thousands of COP per month.

A visual examination of Figure 2 suggests that the distribution of expenditure per capita equivalent for the Colombian elderly is quite similar at first order to the distribution of the adjusted expenditure per capita equivalent for prime-age individuals.

To test this intuition, we apply the Kolmogorov-Smirnov test statistic for stochastic dominance at first order presented in section 4, by McFadden and Barrett-Donald. We test separately the hypothesis that the CDF for the population aged 35 to 59 dominates the CDF for those aged 65 and more, and the opposite hypothesis. The results are in Table 4.

Table 4: KS statistics for Stochastic Dominance at first order: Colombia

Hypothesis	K- statistic	p- value	Result
CDF for those 35-59 vs CDF for 65+*	0.048	0.9954	Not reject
CDF for those 65+ vs CDF for 35-59	0.578	0.5126	Not reject

**The null hypothesis for the first row (labeled "CDF for those 35-59 vs CDF for 65+") is that the CDF for those aged 35-59 years is *less than or equal* to the CDF for those aged 65 years and more. The analogous interpretation holds for the second row.

Note: the critical value for 10% confidence is 1.073

The null that the CDF for those 35-59 years old is less than or equal to the CDF for those of 65 years and more (i.e. that the amounts for the elderly are larger) is not rejected at conventional levels of significance 5% and 1%. That implies that either the CDF of those 35-59 years old stochastically dominates (at first order) the CDF of those aged 65 years and more or that the CDFs are equal. The test in the second row, which has the opposite hypothesis (i.e. that the amounts for the active group are larger), is also rejected. The conclusion is that these two distributions for Colombia are equal. Therefore, neither of the distributions of expenditure per capita equivalent for these two age groups dominates in the range tested here. This confirms the intuition.

5.3 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. As for the other countries, the elderly is defined as those aged 65 and more, and the comparison group is defined as the subset of prime-age individuals (aged between 35 and 59) that do not reside in households where one or more elderly person resides. The elderly reside in 2,003 households in the sample 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 brings about a rent imputed by INE, which is estimated by three 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 yields the per-capita equivalent of any household variable by dividing it 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 (3) to this data, the required adjustment in expenditure made by the group aged 35 to 59 is the following reduction:

$$(8) \quad A_{35-59}^{Chile} = 0.17 \cdot \left(\frac{43.23 \cdot 0.75 - 36.31 \cdot 0.23}{45 - 0} \right) = 0.091 \quad (9.1\%)$$

The adjustment factor for Chile, 0.909, is somewhat smaller than in Colombia and Mexico. This is mainly because the Chilean elderly participate less in the labor market than in those two other countries: 23% in Chile, compared to 27.4% in Mexico and 28.2% in Colombia.

Table 5 reports the per capita equivalent expenditures for percentiles 25 and 50 of these two expenditure distributions. It also reports per capita equivalent expenditures for the same percentiles for the distributions of elderly women and elderly men. The third column in Table 5 presents the ratio of expenditure for the elderly, divided by the product of the adjustment factor 0.909 and expenditure by prime-aged individuals, at each of those two percentiles.

Table 5: Expenditure in Chile by age group and gender, 2012 (EPF 2013)

(Total per capita expenditure equivalent including imputed rent of owner-occupied housing, in Chilean pesos - CLP)

<i>Expenditure, per capita equivalent (CLP/month)</i>	Ages 35 to 59 (only households without old)	All Elderly (65 and more years of age)	Expend. 65 + /Adjusted 35-59 expenditure	Elderly women (65 +)	Elderly men (65 +)
Median (50th percentile)	282,427	271,748	1.06	265,815	276,758
Vulnerable (25th percentile)	174,393	175,296	1.11	162,118	149,692

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 5 differ markedly from those for Mexico and Colombia. In Chile the elderly appear to be better off relative to prime-age individuals. With

adjustment, the size of the expenditure discrepancy in favor of the elderly is 6% at the medians and 11% at the 25th percentiles.

A higher consumption level for the elderly is not an unusual result across countries. A number of OECD countries exhibit a similar asymmetry, as in Canada, France, Italy, Poland and Spain.²⁰ The opposite outcome applies to another subset of OECD countries.

This result is not new for Chilean economists. It was demonstrated before by Bravo and Holz (2011), who used the 1997 EPF survey and found that the Chilean elderly had access to an average consumption (median not reported) slightly 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. Using expenditure data from the EPF 2007, the National Transfer Accounts project published online an age-assigned average consumption and the same result emerges when comparing these two age groups.²¹

Moreover, the CASEN surveys (oriented to the evaluation of poverty programs) have consistently found the same result in each of the 8 waves taken from 1987 to 2013: each of the CASEN surveys finds that the proportion of the relative number of elderly below the poverty line is notoriously lower than among individuals of active ages.²² Table 3's result for the 25th percentile confirms this long-established result for Chile, and extends it to the median.²³

Disaggregation by gender in Chile reveals opposing differences between the standard of living of elderly men and elderly women in different percentiles. The difference favors men by 4% at the median, but it favors women by 8% at the 25th percentile. Understanding this result is a matter for future research.²⁴

Figure 3 extends the comparison for the full distribution of 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. Again, both

²⁰ As reported by *Pensions at Glance 2013* (OECD, 2013), Chapter 5.

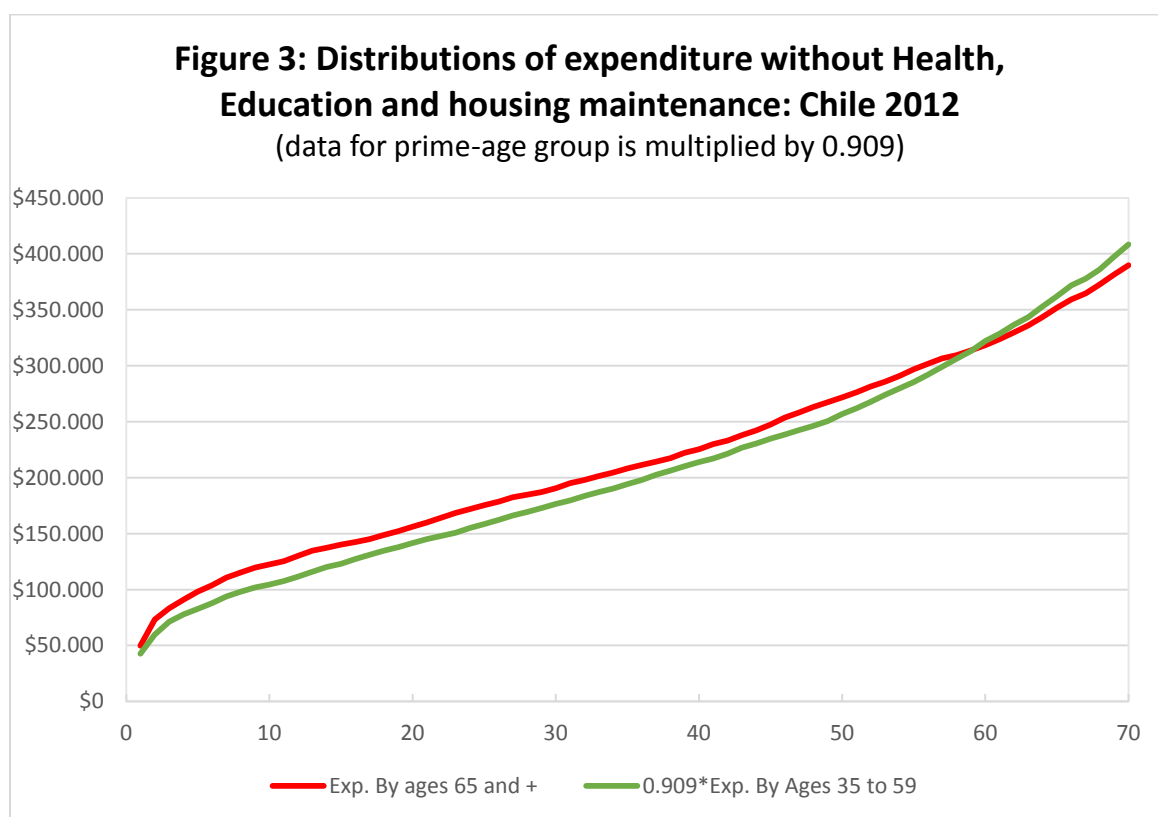
²¹ The results of Table 3 are more reliable than those in the papers quoted in this paragraph for at least two reasons: Table 3 adjusts with the equivalence scale, and Table 3 includes the imputed rent on owner-occupied housing.

²² The CASEN surveys are oriented to the evaluation of poverty programs and are completely independent from INE's surveys.

²³ This result 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.

²⁴ 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.

distributions exclude out-of-pocket expenditures in health and education, and expenditure in housing maintenance, because their incidence varies noticeably with age.



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 and education expenditures. The vertical axis is in thousands of CLP per month.

A visual examination of Figure 3 suggests that the distribution of expenditure per capita equivalent for the Chilean elderly dominates at first order the distribution of the adjusted expenditure per capita equivalent for prime-age individuals, in the range that goes up to the 60th percentile.

The Kolmogorov-Smirnov test statistic for stochastic dominance at first order allows us to test separately the hypothesis that the CDF for the population aged 35 to 59 dominates the CDF for those aged 65 and more, and the opposite. The results are in Table 6.

Table 6: KS statistics for Stochastic Dominance at first order: Chile

Hypothesis	Test statistic	p - value	Result
CDF for those 35-59 vs CDF for 65+*	2.506	0.0000	Reject
CDF for those 65+ vs CDF for 35-59	0.892	0.2037	Not reject

** The null hypothesis for the first row (labeled "CDF for those 35-59 vs CDF for 65+") is that the CDF for those aged 35-59 years old is *less than or equal to* the CDF for those of 65 years and more. The analogous interpretation holds for the second row.

Note: the critical value for 1% confidence is 1.5174, and for 10% confidence is 1.073.

The null that the CDF for those 35-59 years old provides probabilities that are less than or equal to the probabilities provided by the CDF for those of 65 years and more (i.e. that the amounts for the active group are larger), is rejected at conventional levels of significance 5% and 1%. The opposite hypothesis, however, is not rejected. This means that the CDF of those aged 65 and more stochastically dominates (at first order) the CDF of those 35-59 years old.

The conclusion for Chile is clear: the current elderly have a distribution of expenditure per capita equivalent that significantly dominates, at almost any confidence level, the analogous and adjusted distribution for prime-age individuals.

5.4 Results for Lorenz dominance

Recall from section 4 that Lorenz dominance compares the degree of inequality between two distributions, without reference to the means of the distributions. This section reports the result of the tests proposed by Barrett, Donald and Bhattacharya (2014) for each pair of distributions of consumption for Chile, Colombia and Mexico, in excess of out-of pocket expenses for health, education and housing maintenance, with expenditure by prime-age individuals adjusted for hours available for home production, and for the first seven deciles of the distributions.

The notation used here is as follows: hypothesis H_0^1 means that the Lorenz curve mentioned first dominates weakly, hypothesis H_0^2 means that the Lorenz curve mentioned first dominates weakly, and H_0^{eq} means that the two Lorenz curves cannot be distinguished statistically.

Table 7: P-values for Lorenz Dominance Tests^a
(the range tested is the first seven deciles of the distributions)

p-values	Lorenz Curve A	Lorenz Curve B	H_0^1 (A dominates weakly)	H_0^2 (B dominates weakly)	H_0^{eq}
Mexico	<i>Ages 35 – 59</i>	<i>Ages 65 +</i>	0.90	0.10	0.10
Colombia	<i>Ages 35 – 59</i>	<i>Ages 65 +</i>	0.50	0.50	0.80
Chile	<i>Ages 35 – 59</i>	<i>Ages 65 +</i>	0.00	0.60	0.00

Note a: To calculate these p-values, 10 bootstrap repetitions were used. The distributions considered are for per capita expenditure on an equivalent basis, in excess of out-of pocket expenses for health, education and housing maintenance, with expenditure by prime-age individuals adjusted for hours available for home production.

These results show that in Chile there is strong Lorenz dominance of the elderly's consumption distribution, over the adjusted expenditure distribution for the prime-age population, at the 5% significance level. This implies that in Chile there is a higher degree

of material equality among the elderly, than among the prime-age population, at least for the first seven deciles.

In contrast, in Mexico and Colombia dominance in any direction can be rejected at the 5% confidence level, and equality of the Lorenz Curves cannot be rejected. Therefore, the degree of inequality among the elderly is the same as among the prime-age population, at least for the first seven deciles, in Mexico and Colombia.

The difference between countries may be due to the larger relative size of the non-contributory pension in Chile (about 1.1-1.2% of GDP), combined with the targeted design of Chilean non-contributory pensions, which in a reform in 2008 copied the Finnish design.

6. Concluding remarks

This paper shows that the relative standard of living of the current elderly can be measured and assessed precisely with readily available surveys. In addition, it can be compared with the standard of living of the active-age population, after appropriate adjustments, using statistical tests.

This paper finds that in Mexico, the current elderly have a distribution of expenditure per capita equivalent whose amounts are below the adjusted distribution of expenditure by prime-age individuals. Stochastic dominance at first order by prime-age individuals is statistically significant. In contrast, in Colombia the elderly have a distribution of expenditure per capita equivalent whose amounts are quite similar to the adjusted expenditure of prime-age individuals. Our tests reject stochastic dominance at first order in both directions for Colombia. Finally, in Chile the situation is the opposite of Mexico's: the elderly have a distribution of expenditure per capita equivalent whose amounts stochastically dominate at first order the distribution of adjusted expenditure of prime-age individuals, with high statistical significance.

This large difference between countries opens new questions for future research. One explanation to be investigated is whether family support for the elderly, which depends in part on communications and cash-transfer facilities between the countryside (where many elderly linger) with adult children who migrated to cities, faces more difficulties in Mexico. This may be due in part to the much longer distance travelled by migrants in the case of Mexico.

A potential explanation for the result for Chile is that these elderly have been unable to share enough of their resources with their children, maybe because they own resources that are illiquid or lumpy, such as owned housing. Indeed, about 84% of the elderly in Chile own their housing or live in housing supplied by relatives. Money pensions have advantages such as divisibility, low risk (assuming indexation to inflation), that they

embed longevity insurance, no management required (no maintenance, no negotiations with tenants), and can replace precautionary saving if they are allowed to support emergency consumer loans provided by the administrator that pays the pension (as is the case in Chile). This opens the possibility that the Chilean elderly may suffer from an inefficiently low share of income coming from pensions.

The plausibility of this can be checked directly in the EPF 2013 by looking at the share of “non-pension resources” in household expenditure. Define non-pension resources as household expenditure minus pension payments received by the household, and restrict attention to household who have not delayed the start of their pension (this delay is likely when the individual continues to have labor earnings). The EPF 2013 shows that the share of non-pension resources in total expenditure is large: 48% for the second lowest decile of expenditure per capita equivalent. This share rises gradually to reach 70% at the seventh decile, which is a very high share, maybe inefficient. This is compatible with the hypothesis that the share of pensions is too low for the Chilean elderly. If this were correct, an attractive policy would be to supply more liquidity to housing for low-income segments, rather than increasing pensions financed by a tax on active ages, which would be regressive given the initial condition.

A complementary explanation for the differences between countries is that the volume of fiscal resources devoted to non-contributory pensions was much larger in Chile than in the other countries, relative to GDP, in the survey periods.^{25, 26} However, the high share of non-pension resources in total expenditure suggests the opposite: pensions may still be too low, and other resources may be insufficiently transferrable to the other contemporaneous generations of the family.

Santiago de Chile, September 2016

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²⁵ According to Bosch et al (2013), Chile spends about ten times more in non-contributory pensions than Mexico. However, Chile still spends much less than several high-income countries, who spend more than 4% of GDP in non-contributory pensions. 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 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 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 overall sum is then 1.1-1.2% of GDP for Chile.

²⁶ The proportion of the elderly that collect a pension of any type (adding non-contributory and contributory pensions, subtracting pensions delayed by those who continue working in the labor market, but will be higher when started) was 70% in Chile and 13% in Colombia. The figure for Mexico provided by Bosch et al (2013) is 50%, but it contradicts some figures in Sedesol (2013). The figures for Colombia and Chile are from the consumer expenditure surveys used in this paper.

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