The long term impact of demographic change on Chilean savings and pensions

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Abstract

Using the Chilean Expenditure Survey I measure the impact of three factors on household consumption and savings over the period 1996-2012: i) demographic change, ii) shocks to expected income and labor risk, and iii) exogenous changes of the consumption tastes. I find that demographics and expected income are the main drivers of consumption. The estimated model is used to simulate the savings rates and pensions in future years, taking into account new generations, ageing and increased longevity of retired households. The Chilean pension system is projected to deliver inadequate replacement ratios, unless policy makers increase retirement age and contribution rates.

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Keywords: Savings, labor income, income volatility.

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1 Introduction

Household savings in Chile suffered a steady decline over the last 15 years. Aggregate data from National Accounts show that the saving rate in Chile (measured by $s_t = \frac{GDP_t - C_t}{GDP_t}$, with C_t being household consumption at time t) has declined from 43.1% in the 4th quarter of 1996 to 40.5% in 2006 and 33.6% in 2011. Savings are an important source of capital for investment and a buffer against future developments such as aging, adverse health or income shocks. Therefore this decline in household saving rates could have important implications and deserves further study.

During the 2000s the demographic dividend was strong in Latin America (Bloom, Canning, Sevilla, 2003, Saad, 2009, Azevedo et al., 2013), with a strong impact in Chile and an estimated increase of 1.7% annual GDP growth (Mason, 2005). In economic theory, demographic changes such as a decline in fertility reduce the fraction of workers and savers in the population, while increasing the fraction of the elderly and dis-savers (Rios-Rull, 2001, Braun, Ikeda and Joines, 2009). Also, a significant portion of the saving rates fluctuations over time and its differences across countries is explained by age-education differences (Fry and Mason, 1982, Higgins, 1998, Attanasio and Székely, 2000), therefore demographic changes could be a strong force behind the decline in Chilean savings. Another potential factor behind the savings of households is uninsurable idiosyncratic income risk (Aiyagari, 1994). If previous generations of Chilean workers faced higher risks, such as unemployment or shocks to their labor income, then a decline in these risks could explain increased consumption rates and lower savings due to precautionary motives.

This paper explains the savings rate and consumption profile of Chilean households over the last 15 years based on three shocks: i) the demographic dividend (changes in education, fertility and ageing), ii) shocks to permanent income and income risk, and iii) changes to the consumption profile of the same households over time (after conditioning on observables). Using the Chilean Expenditure Survey (EPF) from the most recent waves (1997, 2007, 2012) I estimate the household consumption profiles conditional on their income, observable labor income risk (unemployment probability and wage risk) and demographic characteristics. The results show that the non-durable expenditure model of each EPF wave is close to the others, with the model coefficients confirming a role for the life cycle hypothesis (with older households saving more before retirement) and a strong marginal propensity to consume out of household income. The effect of precautionary behavior in relation to unemployment risk and labor income volatility is estimated to be insignificant and approximately zero in almost all waves. This finding could be due to the nature of the employed measure of unemployment risk and labor income volatility, since these rates are estimated from workers with similar observable characteristics in the Chilean Employment Survey dataset and do not represent the actual individual risk of each household.

I then simulate the counterfactual consumption profiles of these Chilean households, based on the demographic distribution, unemployment rates and wage risk observed over the period 1996-2012. The aggregate savings rate from National Accounts is not explained by the simulated consumption from the Chilean households.This could be due to several factors, such as differences in the concept of expenditure between survey data and aggregate acounts and because aggregate data includes non-profit institutions in the household accounts.

The estimated household model in the most recent EPF (2012) survey is then used to simulate the savings rates of Chilean households in future years. For this I take into account the demographic changes over time in terms of ageing, new fertility and increased longevity of retired households. I show that the Chilean pension system is projected to deliver worse replacement ratios in the future, unless policy makers increase retirement age and contribution rates. In particular, the OECD presents 70% as a minimum reference value for the replacement ratio of pension income relative to the previous labor income of the household (OECD, 2012). The baseline results show that after 2025 more than 50% of the newly retired population are expected to be below the target 70% for the replacement ratio of income. Also, after the year 2025 more than 25% of the newly retired households have replacement ratios of 50% or below, which is close to the 40% rate argued by the International Labor Organization (ILO) as a minimum living standard for retirees.

I then test how the pension replacement ratios improve with different policies: i) increasing the contribution rate from 10% to 13%, ii) a gradual increase of the retirement age to 67 years for both men and women, iii) an expansion of the college education among the new generations of workers, iv) improved incentives for female labor participation, and v) all policy alternatives implemented jointly. The results show that an increase of contribution rates implies a strong improvement in pensions. However, this measure takes a long time to take its full impact and this policy may be of limited value if government wait until after 2025 to implement it. Increasing the retirement age of households has a big immediate improvement in household pension income, but its effect systematically wears off after 2030. Improving the education of new generations only has an impact on the generations retiring 40 years into the future, but it does have a small impact on improving the pension income of all households, especially among the 10% lowest pension ratios. The recent Female Labor Subsidy program implemented in 2012, however, has a strong impact in improving the pension income of the poorest 25 percentiles of newly retired households and is estimated to increase the pension replacement income of the poorest population of retirees by 5% to 10% by the year 2055.

The main conclusion is that the Chilean pension system may fail to guarantee good savings in the absence of either voluntary savings from each household or major policy changes. Increasing contribution rates to 13% and retirement age to 67 years jointly appears to be the most adequate policy combination for improving the pension income of Chilean households. This policy combination manages to improve the pension income immediately and to make this improvement sustained over time. Implementing all the four policy alternatives in a joint scenario also insures adequate pension replacement rates, with more than 75% of the newly retired households receiving the target 70% replacement rate or more for their pensions.

This study is structured in the following way. Section 2 explains the empirical model of household consumption and shows the impact of demographic changes in the labor market over the last 20 years. Section 3 documents the consumption profiles in the Chilean Expenditure Survey and how these relate to demographics, income and labor risk. Section 4 shows how well the different models of consumption fit the distribution of households and their implications about the evolution of consumption over the period of 1996 until 2012. Section 5 explains how the household model of consumption, labor participation, savings and the birth of new generations is implemented to simulate the Chilean households from 2013 until 2055. In Section 6 I describe the baseline results for the evolution of the saving rates and pension income of Chilean households between 2013 until 2055. Section 7 modifies the baseline simulations to account for new policies and shows how effective these are in improving pensions. Finally, section 8 concludes with a summary of the results and policy implications.

2 An empirical model of expenditure

Let's assume household i at time t chooses their expenditure of non-durable goods ($c_{i,t}^{nd}$), based on their income ($P_{i,t}$), labor income volatility ($\sigma_{i,t}$), unemployment risk ($u_{i,t}$), demographic characteristics ($z_{i,t}$) and an idiosyncratic taste for consumption ($\varepsilon_{i,t}^{nd}$) with a standard-error $\sigma_{\varepsilon_{i,t}^{nd}}$: $c_{i,t}^{nd} = F(z_{i,t}, P_{i,t}, \sigma_{i,t}, u_{i,t}, \varepsilon_{i,t}^{nd})$. This simple model implicitly assumes households choose their consumption as an approximate function of their income and demographic characteristics, since it does not take into account an optimization process of a given intertemporal utility consumption with all the possible consumption choices over the agent's life. In the context of this model saving rates are the residual between current income and the observed expenditure: $s_{i,t} = Y_{i,t} - c_{i,t}^{nd}$.

Under standard conditions $F(.)$ is identified from an empirical dataset of household observations, $i = 1, ..., N$, of consumption $c_{i,t}^{nd}$ and household characteristics $(z_{i,t}, P_{i,t}, \bar{\sigma}_{i,t})$. For estimation purposes I consider $F(.)$ is given by a parametric log-linear function of the demographic characteristics ($z_{i,t}$), log-income ($\ln(P_{i,t})$) and labor income risk ($\sigma_{i,t}$):

1.1) $\ln(c_{i,t}^{nd}) = \beta_t^{nd} \left[\ln(P_{i,t}), \sigma_{i,t}, u_{i,t}, z_{i,t}, z_{i,t} \times \ln(P_{i,t})\right] + \varepsilon_{i,t}^{nd}$,

1.2) $\sigma_{\varepsilon_{i,t}^{nd}} = \exp(\lambda_t^{nd} z_{i,t})$.

The coefficients for the demographic variables $z_{i,t}$ can be interpreted mostly as representing a life-cycle hypothesis, in which younger agents consume more in the present because they expect larger income in the future and older agents consumer less since they must save to smooth the income fall associated with retirement (Attanasio and Weber, 2010). Also, demographic variables help control for other shocks to household expenditures such as marriage and the presence of children (Gourinchas and Parker, 2002). The coefficient for income is expected to be positive and it can be interpreted as the marginal propensity to consume out of current income (Campbell and Mankiw, 1989). This marginal propensity to consume out of income can be justified in two ways. One is that consumption theory predicts that agents should consume a proportion of their lifetime income or their permanent income. The permanent income of an agent is hard to measure, since it requires knowing what each agent expects to receive for all future periods and for each possible state of the world. However, current income is included in most survey data and can be used as a proxy for permanent income, since both are likely to be correlated. Also, some agents could be naive or credit constrained, therefore making consumption decisions in each period based on their current income (Campbell and Mankiw, 1989). The coefficients of labor income volatility $\sigma_{i,t}$ and unemployment risk $u_{i,t}$ are expected to be negative, since these represent a precautionary savings motive. In a world with incomplete insurance and asset markets, agents desire to accumulate some savings in order to smooth consumption during negative shocks, such as unemployment or other income falls (Gourinchas and Parker, 2002). The empirical function of households' expenditures also includes interactions between demographic variables plus income, since the marginal propensity to consume out of income may differ across different ages and other characteristics.

This function of non-durable goods expenditures is obviously a very simplified model of agents' decisions. In particular, it neglects two important aspects: i) consumption depends to a large degree on the expectations of future income growth or the probability of unexpected events such as health shocks or unavoidable expenses (Corbae et al., 2007), ii) it excludes the consumption role of non-durable goods, such as large house items, furniture, vehicles and jewelry. Household expenditures in durable goods can also be interpreted as a saving mechanism since it represents consumption for future periods (Attanasio and Weber, 2010) and for this reason it is excluded from the consumption definition used in this study.

This model can either be estimated by MLE if we assume the errors $\varepsilon_{i,t}^{nd}$ are normally distributed or by OLS in two stages. The OLS in two stages requires first a linear regression of $\ln(c_{i,t}^{nd})$ to estimate $\hat{\beta}_t^{nd}$ and the residuals $\hat{\varepsilon}_{i,t}^{nd}$, then making a second linear regression of $\ln(\left|\hat{\varepsilon}_{i,t}^{nd}\right|) = \lambda_t^{nd} z_{i,t}$ to obtain an estimate of $\hat{\sigma}_{\varepsilon_{i,t}^{nd}}$. The MLE approach has the advantage of estimating all the coefficients in a single step and is therefore a more efficient solution if the normality assumption is true, but it has the advantage of not being robust to empirical distributions of consumption that are not log-normal. In the current application, however, both approaches give similar estimates. In the sections that follow I will report only the estimates from the 2-stage OLS approach.

2.1 Measuring households' expected income and labor income volatility

Based on the quarterly Chilean Employment Survey, ENE, which covers 35,000 households, Madeira (2014) estimated the unemployment probability ($u_{k,t} = \Pr(U_{k,t} = 1 \mid t, x_k)$), of workers with characteristics x_k for all quarterly periods from 1990 to 2012. The vector x_k is composed of

540 mutually exclusive groups, given by x_k = {Santiago Metropolitan city or not, Industrial Activity (primary, secondary, terciary sectors), Gender, Age (3 brackets, ≤ 35, $35-54$, ≥ 55), Education (secondary school or less, technical degree, college), and Household Income quintile}. Madeira (2014) also computed these groups' labor income volatility even if workers did not suffer unemployment, $\sigma_{\zeta,t}(x_k) = \sqrt{E\left[(Y_{k,t} - E[Y_{k,t} \mid Y_{k,t-1}, x_k])^2 \mid t, U_{k,t} = U_{k,t-1} = 0, Y_{k,t}, x_k\right]}$.

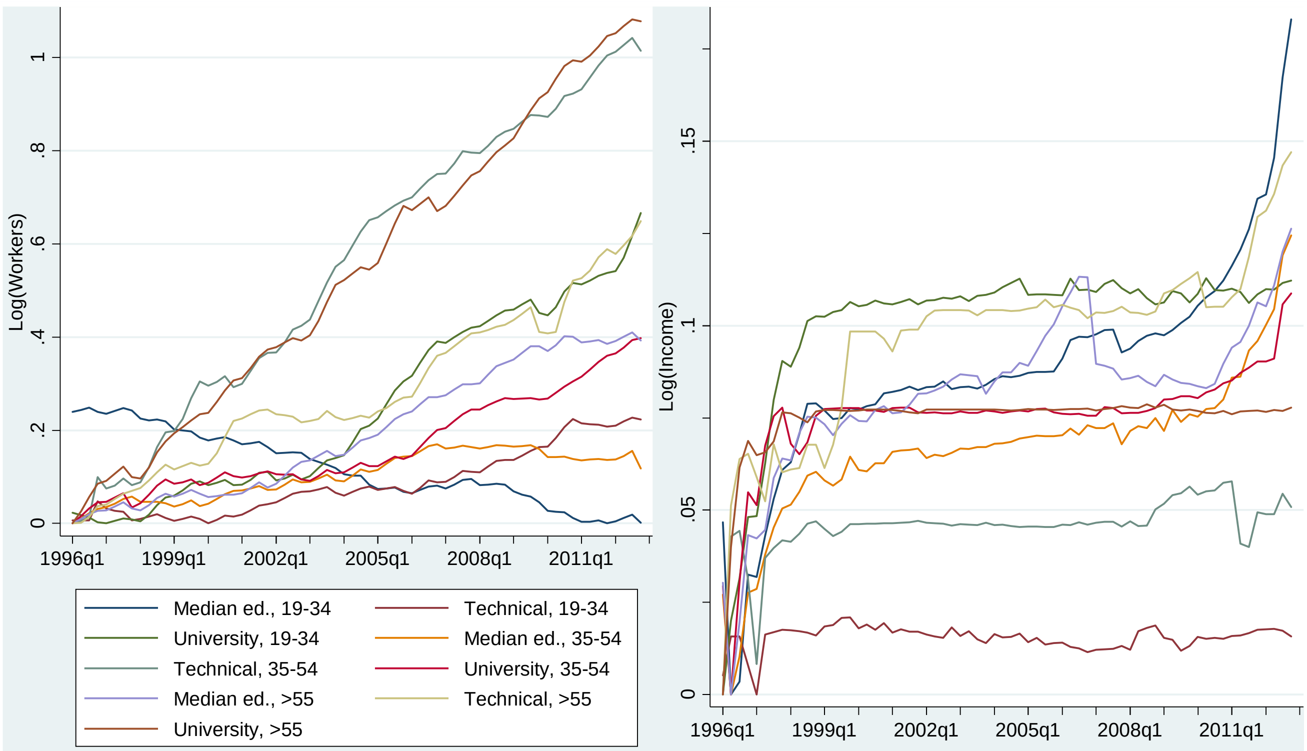
I then calculate the expected income $P_{i,t}$ of each household i as the sum of their non-labor income, a_i, and the expected labor income of each household member k: $P_{i,t} = a_i + \sum_k P_{k,t}$, where $P_{k,t} = W_{k,t}(1-u_{k,t}) + W_{k,t}R_{k,t}(u_{k,t})$ is each worker k's average labor income during the employed and unemployed states, respectively. This unemployment weighted income measure helps reflect that for some workers the current income is unusually low and not a reflection of their standard way of living. The unemployment risk and labor income volatility of each household is then given by a weighted average of the rates of each member using their labor income relative to the total household labor income: $u_{i,t} = \sum_k \frac{P_{k,t}}{\sum_h P_{h,t}} u_{k,t}$ and $\sigma_{i,t} = \sum_k \frac{P_{k,t}}{\sum_h P_{h,t}} \sigma_{\zeta,t}(x_k)$.

2.2 Demographic and labor market changes in Chile: 1996-2012

The labor population of Chile changed towards older workers (those above age 55) and also towards more educated workers. Figure 1 shows the logarithmic growth of the number of workers according to their age and education group from 1996 to 2012, as measured by the quarterly Chilean Employment Survey (ENE) dataset. For exposition reasons I standardize the number of each group h at time t in relation to their population level in the fourth quarter of 1995: $\ln(\frac{Pop_{h,t}}{Pop_{h,1995-Q4}})$. The figure depicts the role of the demographic dividend in Chile clearly. Within each age-bracket, the number of workers rose the most for the college-educated group and second for the technical educated workers. Within each education group, there has been a stronger labor force growth of older workers (those above 55), followed by the middle-aged (35 to 54). Therefore Chile is both getting older and more educated.

Figure 2 shows the real wage growth for each age and education group of workers during the same period, as measured by the ENE dataset. Again, for exposition reasons I standardize the number of each group h at time t in relation to their population level in the fourth quarter of 1995: $\ln(\frac{Wage_{h,t}}{Wage_{h,1995-Q4}})$. The figure confirms the arguments of the research who attributes a significant

Figure 1: Worker Population and Real Labor Income by age and education (1996Q1-2012Q4)



part of economic growth to the ageing and human capital of the labor force. There was a robust wage growth in Chile until 1998 for all workers, but between 1999 and 2009 real wages stagnated for most workers. A significant part of wage growth in this period can therefore be attributed to a demographic composition change, since workers are moving to higher education and higher age brackets which pay more. Since 2010 Chile experienced a new economic growth boom. Figure 2 confirms all types of workers experienced some wage growth after 2010, but that is especially true for the lower education group (workers with Middle education or less). This result confirms the findings of recent studies who show that the education wage premium has been falling for several Latin American countries (Lustig et al., 2013a, 2013b).

3 Consumption profiles from the Chilean expenditure survey

Chile implements an Expenditure Survey, the *Encuesta de Presupuestos Familiares* (EPF), at regular intervals of ten years. More recently the EPF has been implemented at intervals of five years each. Therefore the more recent Chilean Expenditure Surveys collect data for the calendar year of July to June of the years 1996-97, 2006-07 and 2011-12. The EPF survey provides a high quality measure of durable and non-durable expenditures, with interviewers visiting households multiple times during a period of one month, asking for their bills and receipts from expenditures, plus memory reports of non-receipt expenses made during the period and of infrequent expenses, similar to the best measurement procedures (Attanasio and Weber, 2010). Furthermore, participation in the EPF is compulsory by law and therefore non-response rates are low. The EPF survey waves are designed with population weights (or expansion factors), due to a higher probability of selecting poorer urban areas. For this reason all the results in this paper - whether tables, graphics or regressions - are estimated with population weights.

There are some differences between survey waves, however. One of these differences is the sample design. In 1996-97 and previous decades, the EPF sample only covered the urban population of Great Santiago, the capital of Chile and where around 40% of the national population reside. In 2006-07 and 2011-12 the EPF added a sample component of Chilean households at the national level. Another important point of difference is the detail of the classification of expenditure categories. In 1996-07 and 2006-07 expenditures were classified under a list of 491 different categories. However, in 2011-12 the EPF implemented a new list of 1570 product categories to classify household expenditures. This list of 1570 product categories does not have an exact overlap with the list used in the previous surveys and therefore it is not entirely comparable. In particular, there are strong differences in the coverage of expenditures of services, which were expanded and received more detail in 2011-12. Applying the international Classification of Individual Consumption According to Purpose (COICOP), I classify the expenditure of each of three surveys in terms of Durables, Semi-Durables, Non-durable Goods, and Services. For the purposes of this paper I consider an extended definition of Non-Durable Goods, which includes also Semi-Durables and Services.

The EPF surveys include several demographic variables for the household, including the education, age and relationship status for its members. Age in the EPF waves of 1996-97 and 2006-07 is only reported in terms of 5-year brackets, therefore I also summarize the 2011-12 wave in terms of age brackets although the actual number of years of age is reported for the households in this wave. For simplicity I will only focus the analysis on families with a household head between age 25 and 64, since this is the range of age for males who are active members of the labor force. Among the demographic variables I consider 8 dummy variables for the age of the household head with each dummy representing a 5 year age bracket, a dummy for whether the household includes a couple (either married or cohabiting as partners), a dummy for whether there are children under age 15, a dummy for whether the female spouse in the household is employed, and a dummy for whether the household includes a senior person with age above 65.

Table 1 summarizes the demographic distribution for the households in each the 3 waves, as well as their monthly log-income ($\ln(P_{i,t})$), annual labor income volatility ($\sigma_{i,t}$) and unemployment risk ($u_{i,t}$). For comparison purposes I also include the statistics obtained from a pooled cross-section of all the EPF years (1997, 2007, 2012). Since this comparison is made for surveys spanning a period of 15 years, I report the income and consumption in terms of real 2012 pesos. Table 1 shows that there was a substantial real income growth of almost 0.15 log-points between the 1997 and 2007 waves, although between 2007 and 2012 real income growth was more modest and on average below 0.02 log-points. There was also a decrease in labor income volatility between 1997 and 2007 and then again in 2012. Unemployment risk remained similar between 1997 and 2007, but it decreased substantially in 2012 with the economic expansion that followed the Chilean earthquake of 2010. As expected, all waves confirm that there is substantial heterogeneity across households in terms of income, labor income volatility and unemployment risk. In terms of demographics, more than 80% of the sample corresponds to couples (either married or cohabiting) and over two thirds of the households include at least one child. Only 8% or less of the households include a senior person with age above 65. Household heads between age 40 to 54 represent roughly 45% of the total population between age 25 to 64. Chile experienced a strong demographic change over time, with the brackets below age 44 decreasing between 1997 and 2012, while those above age 45 now represent a larger share of the population.

Tables 2.1 and 2.2 show the results of the empirical model for non-durables household expenditures. Since the model has a large number of coefficients due do the demographic interactions, I will show first the coefficients without interactions in Table 2.1 and the interactions between the demographic

Table 1: Characteristics of the EPF households in the three waves

Variables	All years	1997 **	2007	2012
$\ln(P_{i,t})$ - Mean	13.564	13.438	13.586	13.606
$\ln(P_{i,t})$ - Percentile 25	12.990	12.858	13.014	13.047
$\ln(P_{i,t})$ - Percentile 50	13.502	13.348	13.563	13.529
$\ln(P_{i,t})$ - Percentile 75	14.086	13.943	14.125	14.100
Labor income volatility $\sigma_{i,t}$ - Mean	0.138	0.145	0.140	0.133
$\sigma_{i,t}$ - Percentile 25	0.024	0.024	0.024	0.025
$\sigma_{i,t}$ - Percentile 50	0.079	0.080	0.078	0.079
$\sigma_{i,t}$ - Percentile 75	0.193	0.211	0.191	0.187
Unemployment Probability $u_{i,t}$ - Mean	0.040	0.041	0.042	0.037
$u_{i,t}$ - Percentile 25	0.006	0.004	0.007	0.005
$u_{i,t}$ - Percentile 50	0.016	0.017	0.018	0.015
$u_{i,t}$ - Percentile 75	0.054	0.058	0.058	0.048
Dummy for couple	83.8%	86.7%	83.6%	82.7%
Dummy for Children in household	70.7%	74.4%	71.3%	68.2%
Female spouse is employed	41.9%	35.0%	41.8%	45.3%
Dummy for senior (>65) in household	7.1%	6.7%	6.4%	8.0%
Head with Primary or Secondary education *	64.5%	49.6%	69.4%	67.4%
Head with Technical education *	13.5%	27.2%	8.8%	10.9%
Head with University education	22.0%	23.2%	21.8%	21.7%
Head between age 25-29	6.8%	8.2%	7.0%	6.1%
Head between age 30-34	11.1%	14.2%	11.3%	9.3%
Head between age 35-39	13.0%	15.6%	12.8%	11.9%
Head between age 40-44	14.7%	15.3%	15.5%	13.5%
Head between age 45-49	15.9%	13.9%	16.7%	16.3%
Head between age 50-54	15.4%	12.9%	14.7%	17.2%
Head between age 55-59	12.6%	10.7%	11.7%	14.4%
Head between age 60-64	10.5%	9.1%	10.4%	11.2%
Number of households	22,427	6,744	7,807	7,876

* In the 1997 wave the education classification includes individuals who did some Technical education in the same category as those who actually completed the degree. For 2007 and 2012 the education classification only considers the degrees completed. ** The 1997 wave only includes the Metropolitan Area of the capital Santiago, while the other waves are national.

variables in Table 2.2. All regressions are done in real 2012 pesos. Table 2.1 shows that the log-expenditure in non-durables increases 0.68 points with each point of log-income. Unemployment risk has a small and insignificant coefficient for all survey waves, while the coefficient of labor income volatility is only statistically significant in the 1997 wave. Overall, this shows there is little evidence for a precautionary savings motive in the decisions of Chilean households, at least in terms of the variables $u_{i,t}$ and $\sigma_{i,t}$ considered in this study. In terms of the impact of other characteristics, it appears that couples and families with senior citizens have higher consumption that others, although the coefficients are not statistically significant for some waves. The coefficients for the age brackets accurately reflect the life cycle hypothesis of consumption, since household heads between age 45-59 consume less in order to save for older age. Also, household heads between age 60 to 64 have a stronger decrease in consumption, possibly because some are already anticipating a sharp income decrease upon retirement. Households with a female spouse employed in the labor market have a lower consumption level of non-durables.

The interaction between income and demographics in Table 2.2 shows that households with Female spouses who are employed and with heads between ages 45 to 64 have a higher marginal propensity to consume out of income. This is interesting, because the coefficients in Table 2.1 show that these are the same groups which on average have a lower consumption level. Therefore while these groups on average consume less, they are also more willing to consume as income increases.

4 Explaining consumption changes between 1996 until 2012

4.1 Model Fit

I now compare how much the distribution of consumption has changed between the years 1997, 2007 and 2012, and how well do the models estimated in the previous section fit the data. Now I denote $v_{i,t,Data} = \ln(c_{i,t}^{nd})$ as the log-consumption of household i observed in the survey of time t and $x_{i,t} \equiv \{\ln(P_{i,t}), \sigma_{i,t}, u_{i,t}, z_{i,t}, z_{i,t} \times \ln(P_{i,t})\}$ as the characteristics of household i. Also I represent $v_{i,t,m} = \hat{\beta}_m^{nd} x_{i,t} + \hat{\sigma}_{\varepsilon_{i,m}^{nd}} \omega_{i,t}$ as the simulated consumption of household i at time t if we apply the coefficients $\left\{\hat{\beta}_m^{nd}, \hat{\sigma}_{\varepsilon_{i,m}^{nd}}\right\}$ of the model estimated from the survey data of time m, with $\omega_{i,t}$ being a pseudo standard normal random error. Therefore for a survey of a given date t (for

Table 2.1: Log-Consumption estimates of $\ln(c^{nd}_{i,t})$: OLS Coefficients for $\ln(P_{i,t}), \sigma_{i,t}, u_{i,t}, z_{i,t}$

Exogenous variables	All years	1996-07	2006-07	2011-12
Log-Income: $\ln(P_{i,t})$	0.683***	0.710***	0.694***	0.685***
	(0.0183)	(0.0350)	(0.0334)	(0.0329)
$\sigma_{i,t}$	-0.000	-0.210***	-0.038	-0.0273
	(0.001)	(0.042)	(0.042)	(0.0396)
$u_{i,t}$	0.001	0.099	-0.008	0.0765
	(0.001)	(0.122)	(0.005)	(0.109)
Dummy for couple	0.318*	0.330	0.833**	0.599**
	(0.173)	(0.284)	(0.342)	(0.302)
Dummy for children in household	-0.0908	-0.170	0.313	-0.344
	(0.131)	(0.242)	(0.231)	(0.234)
Female spouse is employed	-0.994***	-0.845***	-1.421***	-1.434***
	(0.117)	(0.203)	(0.213)	(0.235)
Dummy for senior (>65) in household	0.401*	0.266	1.136***	0.172
	(0.207)	(0.359)	(0.399)	(0.384)
Dummy for household head between age 30-34	0.0419	0.263	-0.806*	0.429
	(0.232)	(0.396)	(0.426)	(0.445)
Dummy for household head between age 35-39	-0.0993	-0.263	-0.539	0.114
	(0.238)	(0.414)	(0.438)	(0.445)
Dummy for household head between age 40-44	-0.357	-0.379	-0.893*	-0.463
	(0.249)	(0.422)	(0.470)	(0.441)
Dummy for household head between age 45-49	-0.826***	-0.686	-1.335***	-1.193***
	(0.240)	(0.432)	(0.428)	(0.447)
Dummy for household head between age 50-54	-0.663***	-0.705	-1.384***	-0.904**
	(0.240)	(0.429)	(0.436)	(0.437)
Dummy for household head between age 55-59	-0.893***	-0.512	-1.802***	-1.290***
	(0.253)	(0.460)	(0.448)	(0.465)
Dummy for household head between age 60-64	-1.200***	-1.120**	-1.965***	-1.426***
	(0.260)	(0.453)	(0.465)	(0.499)
Constant	3.953***	3.814***	4.100***	4.683***
	(0.242)	(0.457)	(0.442)	(0.446)
Nr of Observations	22,427	6,744	7,807	7,876
R-squared	0.652	0.674	0.618	0.663

Robust Standard-errors in (), ***,**,* denote 1%, 5% and 10% statistically significance, respectively

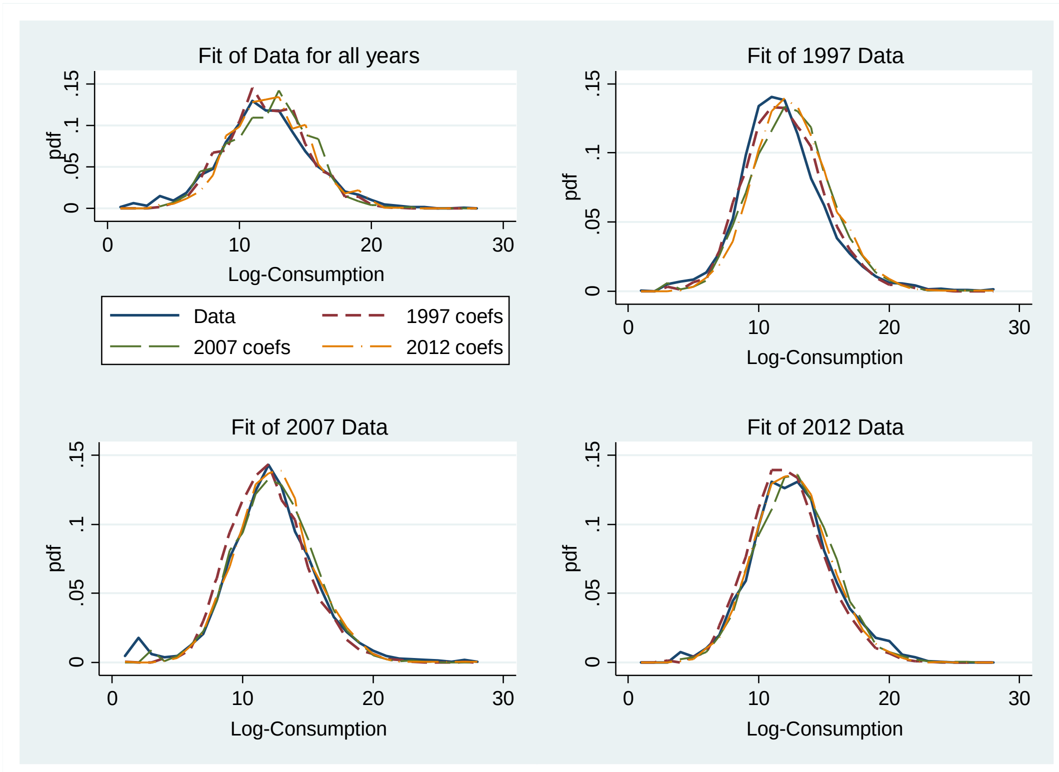
Table 2.2: Log-Consumption estimates of $\ln(c_{i,t}^{nd})$: OLS Coefficients for $\ln(P_{i,t}) \times z_{i,t}$

Exogenous variables	All years	1996-07	2006-07	2011-12
Dummy for couple	-0.0278**	-0.0158	-0.0576**	-0.0321
	(0.0139)	(0.0220)	(0.0259)	(0.0226)
Dummy for children in	0.0218**	0.0457**	-0.0171	0.0289*
household	(0.0102)	(0.0184)	(0.0169)	(0.0171)
Female spouse is employed	0.0898***	0.0603***	0.0966***	0.104***
	(0.0112)	(0.0154)	(0.0157)	(0.0173)
Dummy for senior (>65) in	-0.0618*	-0.0181	-0.0794***	-0.0118
the household	(0.0338)	(0.0275)	(0.0294)	(0.0279)
Dummy for household head	0.00582	-0.0169	0.0601*	-0.0319
between age 30-34	(0.0186)	(0.0309)	(0.0320)	(0.0329)
Dummy for household head	0.0208	0.0265	0.0407	-0.00857
between age 35-39	(0.0191)	(0.0322)	(0.0329)	(0.0328)
Dummy for household head	0.0487**	0.0365	0.0682*	0.0351
between age 40-44	(0.0198)	(0.0326)	(0.0351)	(0.0326)
Dummy for household head	0.0736***	0.0563*	0.100***	0.0893***
between age 45-49	(0.0191)	(0.0334)	(0.0321)	(0.0331)
Dummy for household head	0.0710***	0.0607*	0.105***	0.0660**
between age 50-54	(0.0190)	(0.0330)	(0.0326)	(0.0322)
Dummy for household head	0.0820***	0.0431	0.131***	0.0910***
between age 55-59	(0.0200)	(0.0353)	(0.0334)	(0.0343)
Dummy for household head	0.114***	0.0836**	0.142***	0.0996***
between age 60-64	(0.0205)	(0.0349)	(0.0347)	(0.0368)

Robust Standard-errors in (), ***,**,* denote 1%, 5% and 10% statistically significance, respectively

instance $t = 1997$) we can compare how well the empirical data is fitted by the model coefficients estimated from $m = 1997, 2007, 2012, all - years$. One important difference between the wave of 1997 and the others is that it only covered the Metropolitan area of the capital city of Santiago, therefore for purposes of comparison I took the option of making an adjusted 1997 sample for outside of the capital area. To implement this I used the same sample of households in the EPF 1997 wave, but adjusted their expansion factors for the different population found in the regions of Chile: $f_{i,1997}(a = 2) = f_{i,1997}\frac{Pop_{1997,x_i}(a=2)}{Pop_{1997,x_i}(a=1)}$, where Pop_{t,x_i} is the number of households in Chile at time t with characteristics x_i in region a, which takes the value 1 for the Metropolitan area of Santiago and 2 for the other regions of Chile. The estimates of the Chilean population Pop_{t,x_i} are obtained from the ENE dataset for all quarterly periods t between 1996 and 2012, with the vector of characteristics x_i defined as $x_i = \{$Santiago Metropolitan city or not, Income Quintile of the Household, plus Gender, Age (3 brackets, ≤ 35, $35 - 54$, ≥ 55),and Education (secondary school or less, technical degree, college) of the household head$\}$. In the remaining analysis of this section I use this EPF 1997 wave adjusted for the national area to compare with the other waves.

Figure 2: Fit of each OLS model in relation to each data sample



After producing the predictions from these distinct models, I compute the probability density functions for each model m using a non-parametric kernel estimator, $\hat{p}_{t,m}(x) = \frac{1}{h\sum_{i=1}^{N_t} f_{i,t}} \sum_{i=1}^{N_t} f_{i,t} K(\frac{v_{i,t,m} - x}{h})$, where $f_{i,t}$ is the population expansion factor, $K()$ is the Epanechnikov function and the bandwidth $h = \frac{0.9IQR(v_{i,t,m})}{N_t^{0.2}}$ (which is an asymptotically consistent option and minimizes the sample mean square error, Pagan and Ullah, 1999). Also, I compute the Kullback-Leibner distance measure between each model m and the distribution of the data, $KB_{Data,m,t} = \int_x \hat{p}_{t,Data}(x) \ln(\frac{\hat{p}_{t,Data}(x)}{\hat{p}_{t,m}(x)}) \partial x$. The Kullback-Leibner is a measure of the expected log-distance between two different density functions, therefore the bigger it is the worse is the fit between the model and the data.

Figure 3 shows the pdf distribution of the actual household consumption in each period versus the distribution predicted by the OLS model coefficients estimated from the data of the waves of all years plus the individual waves of 1997, 2007 and 2012. It is easy to confirm that all models give a similar distribution for the households' non-durable consumption, except for a level constant. In particular, the 1997 model always gives a lower level of consumption than the 2007 and 2012

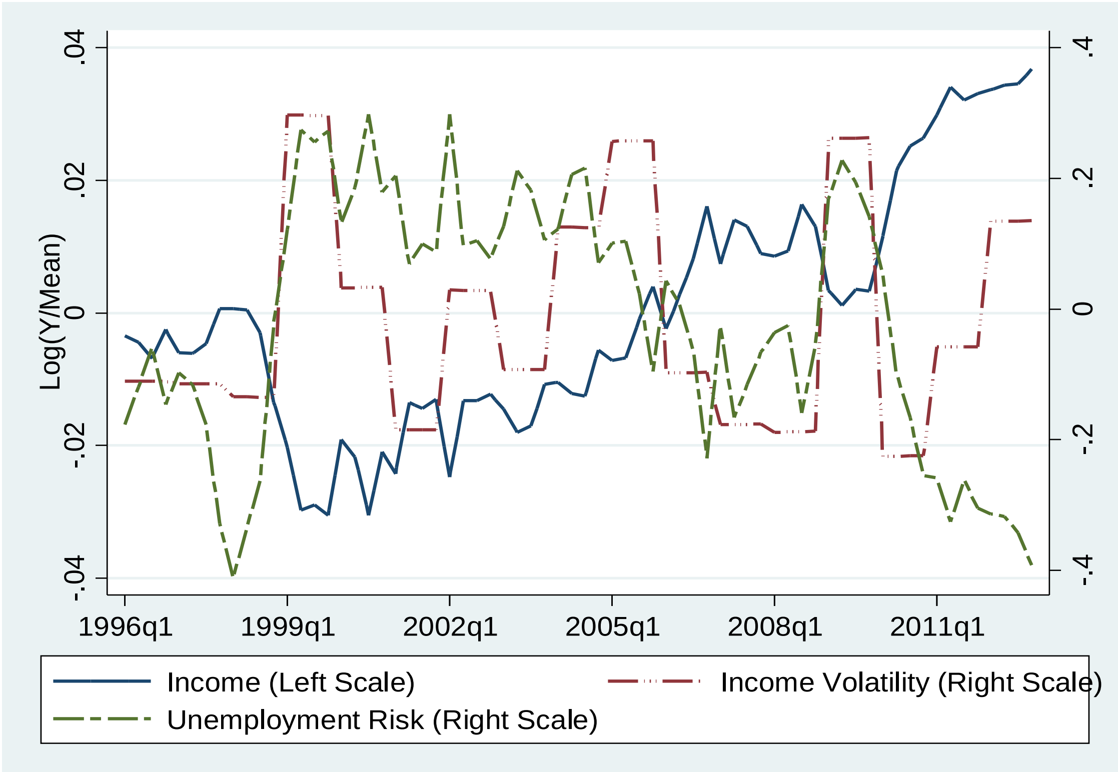
Table 3: Kullback-Leibner Distances of empirical data distributions relative to OLS models and among the OLS models based on the same exogenous variables of each data sample

Baseline distribution / Counterfactual model	All years OLS	1997 OLS	2007 OLS	2012 OLS
All years: Data	0.0603	0.0629	0.0635	0.0626
1997: Data	0.1024	0.0963	0.0986	0.1062
2007: Data	0.0935	0.0925	0.0862	0.0956
2012: Data	0.1271	0.1184	0.1197	0.1124
All years: OLS model	0	0.0629	0.0642	0.0621
1997: OLS model	0.1194	0	0.1244	0.1213
2007: OLS model	0.1018	0.1050	0	0.1125
2012: OLS model	0.1236	0.1303	0.1302	0

models. The models of 2007 and 2012 give very similar distributions of consumption, although the 2012 has a slightly higher level. This indicates that all the models are similar in terms of the shape of the consumption distribution, but perhaps a model failure is that it cannot keep track of an exogenous increase in consumption over time. Figure 3 confirms this, since it shows that a researcher using the 1997 model to predict the consumption of households in 2007 and 2012 would predict lower consumption levels than the data actually shows. Possibly this implies that the model of equation 1.1) is missing key variables, such as the expectations of increases in future income or the current interest rates. If the real interest rate is positive, then consumers should have a trend in their consumption growth over time. Also, equation 1.1) implicitly treats a household with income x and expecting 0% annual income growth in the same way as a household with the same income x and expecting an annual income growth of 2%. However, the economic theory of intertemporal utility maximization would expect that households with positive expected income growth would consume more today. The only covariates in the model that can proxy for future income growth are the age dummies, since younger households expect income increases as they become more experienced.

Table 3 shows the Kullback-Leibner Distances between each data distribution and the corresponding models and also between the models themselves. The Kullback-Leibner distance between the data distribution and each OLS model is similar. Also, each OLS model has a similar distance relative to the other OLS models. This results confirm that the models estimated from each EPF wave are not too different among themselves, therefore there should not be a big difference in using one model, except for the level difference observed in Figure 3. Table 2.1 also confirms that almost all the coefficients are similar across waves, except for the constant which is substantially bigger in 2012 relative to 2007 and 1997 (although these differences are not statistically significant).

Figure 3: Evolution of income, labor income volatility and unemployment risk (all EPF samples)



4.2 Comparing the simulations of saving models to the aggregate data

Now I compare the fit between the time series of the total micro simulated expenditures and the National Accounts series of non-durable consumption to check if the model can explain the aggregate consumption changes over time. To implement this I simulate each of the 1997, 2007, 2012 samples, for all the quarters of 1996 to 2012, by applying two changes:

i) demographic changes, which is done by adjusting the population weights of wave m over time t as $f_{i,m,t} = f_{i,m}\frac{Pop_{t,x_i}}{Pop_{m,x_i}}$, where Pop_{t,x_i} is the number of households in Chile at time t with characteristics x_i obtained from the ENE data, with $x_i = \{$Santiago Metropolitan city or not, Income Quintile of the Household, plus Gender, Age (3 brackets, ≤ 35, $35-54$, ≥ 55), and Education (secondary school or less, technical degree, college) of the household head$\}$;

ii) both demographic changes and changes to the labor income volatility, unemployment risk and expected monthly income $(P_{i,t}, \sigma_{i,t}, u_{i,t})$ of each household i in the survey wave m over time t.

Figure 4 shows the evolution of the labor market variables for the average household in the

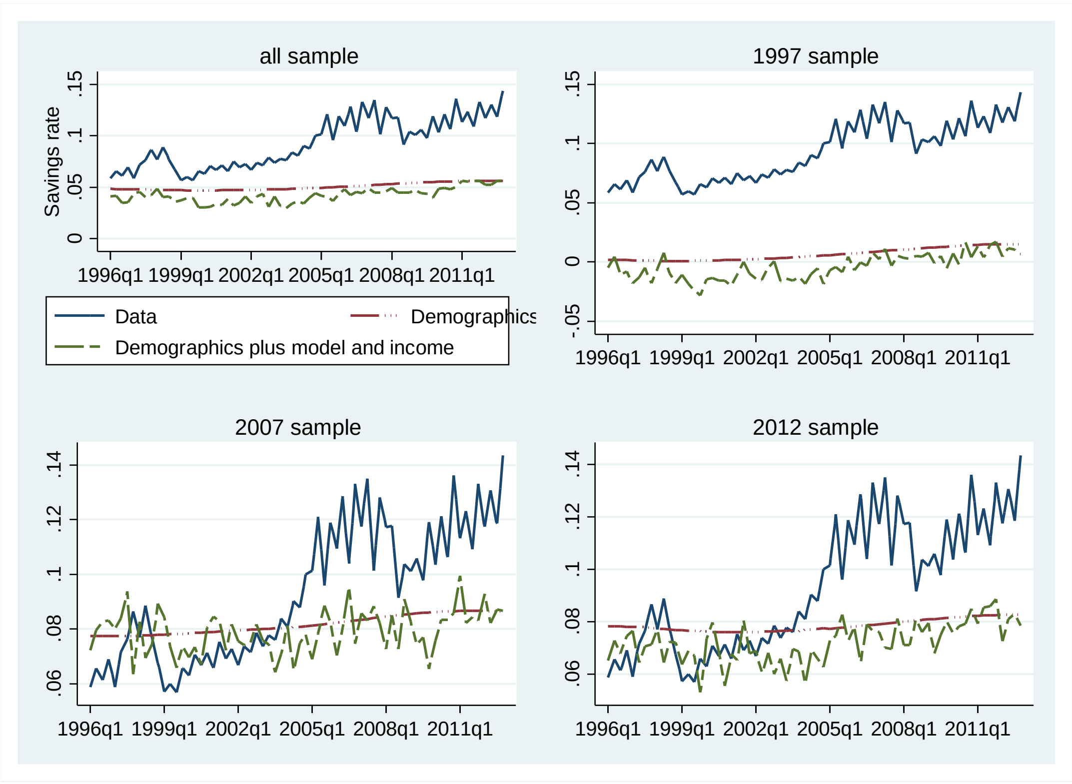
EPF from 1996 to 2012. Since these variables have different scales, I summarize them in terms of log-deviations from the average $\ln(\frac{Y_t}{E[Y_t]})$ for the whole period. Household income dropped sharply with the crisis of 1998 and income growth only recovered after 2003. There was a significant income fall in 2009, but its duration was much shorter than the crisis of the late 90s. Unemployment risk increased substantially during the 1998 to 2002 crisis and in the brief 2009 recession, but it has dropped significantly after 2010. Idiosyncratic labor income volatility, however, has brief surges during both economic booms and recessions, having increased in the crisis of 1998 and 2009, but also during the booms of 2003 to 2005 and 2011 to 2012. This figure is similar for each one of the EPF samples, therefore I only report the values for the complete pooled EPF sample.

Figure 5 show the average household savings in the EPF ($E_t\left[\frac{P_{i,t}-C_{i,t}^{nd}}{P_{i,t}}\right]$) adjusted over time and compares it with the National Accounts savings rate defined as $s_t = \frac{DY_t - C_t^{nd}}{DY_t} - 0.10$ (with DY_t being household disposable income and C_t^{nd} the consumption of non-durables plus services). The National Accounts consumption and savings definitions, however, differ from household surveys' concepts in several aspects: i) statistics are income-weighted for the economy and not for the average household, ii) National Accounts includes the consumption of non-profit institutions, such as religious centers, schools and health clinics. Overall, none of the EPF models can replicate well the aggregate savings in household, although perhaps that could be due to differences in definition between aggregate data and the mean variables of the households. In particular, the aggregate data shows a steady increase in savings for the whole period, but the simulations of the micro data show only a moderate increase in household savings. The 2007 model appears to be the one that can replicate better the aggregate savings rate for the 1996 to 2014 period. The model with both demographics plus changes in labor market variables appears to be more realistic, since it follows some of the business cycle changes in savings such as its drop in 1999 and 2009.

5 Simulating households consumption and savings until 2055

Now I use the EPF 2012 sample and the estimated consumption model to project the consumption and savings rates of Chilean households for each year in the future until 2055, which corresponds roughly to the complete working life for a young individual of 25 entering the labor market in 2013.

Figure 4: Comparison of aggregate savings rates with simulated savings from the EPF models



In this simulation I calibrate the following factors: i) the aging of cohorts and new generations of households, ii) the labor force participation decisions and wage growth of the workers in each household, iii) marriage of single households and new children, iv) the computing of the new household income, labor income risk and consumption of non-durables, v) the updating of the population weights and life expectancy, and vi) the accumulation of funds in the official Chilean pension system and voluntary savings for retirement. The same simulation of income and savings is done both for the future until 2055 and for the past (to obtain an estimate of the accumulated savings of households since age 25 until now).

The projections for the future include random simulations of the labor force participation, consumption and income of each household, therefore the results are subject to simulation error. The simulation error can be particularly serious, because the goal is to project each age-cohort in the future and the average age-cohort has only 197 household observations in the EPF 2012 sample. The lowest number of observations in the EPF corresponds to the cohort of age 25, which has just 81 households in the sample, while the maximum number of observations is 287 households and corresponds to the cohort of age 52. To reduce the simulation error I sample households with replacement from each age-cohort of the original EPF 2012 data until I obtain a larger sample of 102,388 observations. This larger sample of households built by sampling repeatedly from the original dataset has at least one thousand observations of each age-cohort, which therefore reduces the simulation error induced by a few households receiving random shocks in each period. However, there is still statistical error in the results due to the finite sample of the original dataset and its imperfect measurement of the actual characteristics of each cohort. This statistical error induces some random fluctuations and discontinuities in the simulations for different age-cohorts, therefore the results are not entirely smooth over time which is natural in small samples (Attanasio and Banks, 1998).

5.1 Aging cohorts and new households

Each year, all the members of a household (adults and children, included) are aged by an extra year and it is assumed children leave the household by age 24, which gives a deterministic rule for updating both the household head age dummies and the dummies for the presence of children.

Table 4: Characteristics of the EPF 2012 households by years of age of its head

Variables	25	26-34	35-54	55-63	64
$\ln(P_{i,t})$ - Mean	13.210	13.546	13.638	13.641	13.461
$\ln(P_{i,t})$ - Percentile 25	12.560	12.959	13.082	13.100	12.907
$\ln(P_{i,t})$ - Percentile 50	13.207	13.509	13.538	13.588	13.339
$\ln(P_{i,t})$ - Percentile 75	13.918	14.062	14.130	14.106	13.926
Labor income volatility $\sigma_{i,t}$ - Mean	0.217	0.171	0.111	0.177	0.205
$\sigma_{i,t}$ - Percentile 25	0.104	0.055	0.016	0.051	0.058
$\sigma_{i,t}$ - Percentile 50	0.163	0.134	0.049	0.115	0.122
$\sigma_{i,t}$ - Percentile 75	0.257	0.227	0.141	0.219	0.268
Unemployment Probability $u_{i,t}$ - Mean	0.086	0.079	0.037	0.023	0.019
$u_{i,t}$ - Percentile 25	0.004	0.006	0.005	0.003	0.004
$u_{i,t}$ - Percentile 50	0.026	0.045	0.015	0.009	0.010
$u_{i,t}$ - Percentile 75	0.080	0.096	0.045	0.023	0.028
Head with Secondary or less	0.520	0.538	0.672	0.762	0.881
Head with Technical education	0.197	0.136	0.123	0.063	0.006
Head with University education	0.284	0.326	0.205	0.175	0.112
Dummy for couple	0.803	0.783	0.836	0.837	0.810
Dummy for Children in household	0.659	0.741	0.781	0.436	0.290
Dummy for senior (>65) in household	0.000	0.025	0.077	0.118	0.207
Number of households	81	1450	4431	1777	137

Also, each year I add a new generation of households with a household head of age 25 and this new generation is always equivalent to the sample of age 25 households in the EPF 2012. Table 4 shows the characteristics of the household heads of age 25 in the EPF 2012 and compares them with the older families. Households with heads of age 25 and 64 have the lowest income and also the highest income volatility. Young households (those with age 25 and 25-34) tend to have higher education (technical and college education), but as young workers are also subject to the highest unemployment risk. Even young household heads are already likely to be married or with a partner and to have young children. Senior adults (those above age 65) tend to live with older household heads.

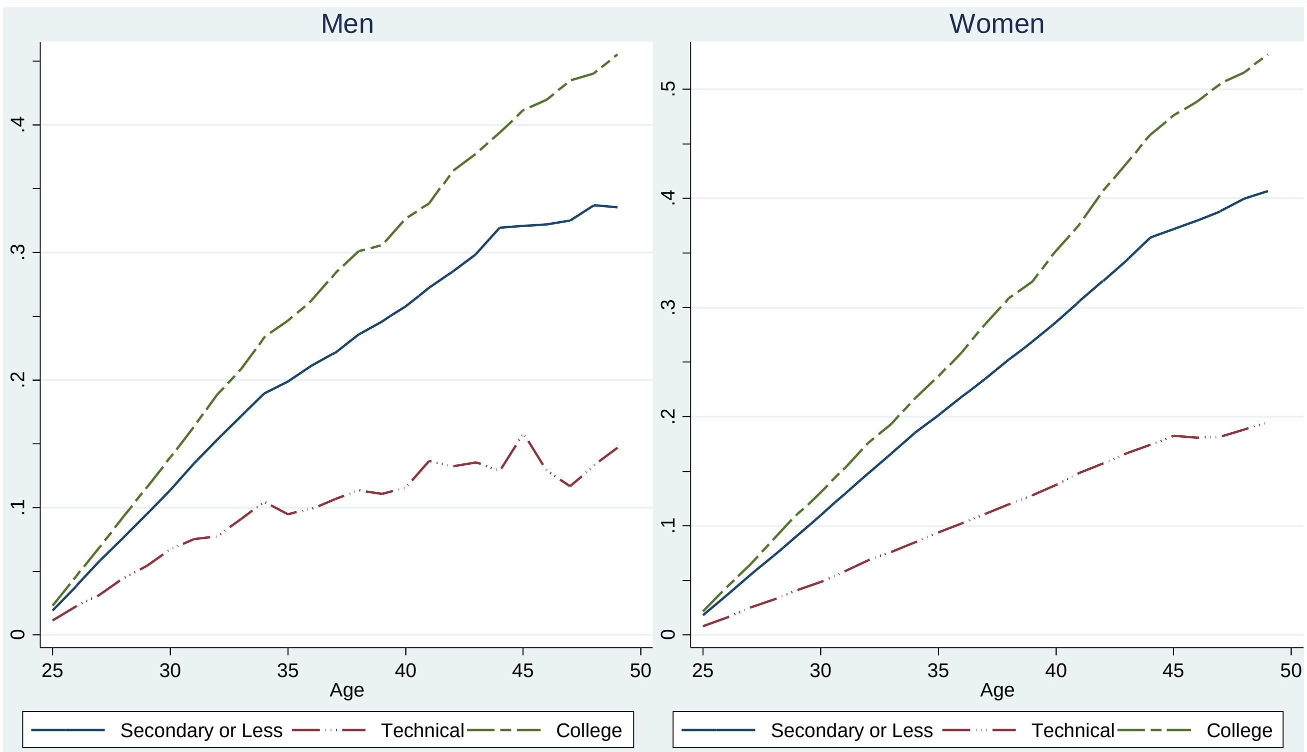
5.2 Labor Force Participation and Wage Growth

Every year I simulate the Labor Force Participation decision for male and female workers, which is conditional on the participation decision of the previous period ($LFP_{i,t} = 1 \mid LFP_{i,t-1}$): $LFP_{i,t} = 1$ if $l_{i,t} \leq \Pr[LFP_{i,t} = 1 \mid LFP_{i,t-1}, x_{i,t}]$ and 0 otherwise, with $l_{i,t}$ being a pseudo-uniform random number and $x_{i,t}$ being observable characteristics of the worker and its household. The model of labor force participation $\Pr[LFP_{i,t} = 1 \mid LFP_{i,t-1}, x_{i,t}]$ is estimated from a rotating sample of workers in the 4th quarter of the Chilean Employment survey (ENE). The ENE survey is a rotating sample, therefore it is possible to match the same households and workers over time based on their home address and whether the respondents have compatible characteristics in terms of sex and age (Madeira, 2014). Since each matched worker is only observed for two consecutive years before being replaced in the sample, I estimate the model using the pooled observations of workers over the period of 1990 to 2012. The estimates of the Probit model of Labor Force Participation decision conditional on workers being either on or off the labor market in the previous year is shown in Table 5. Men have a higher constant that women whether they were in or out of the labor force in the previous year, therefore male labor participation rates are much higher. For both men and women, the labor participation decision is positively associated with higher wages and negatively associated with larger households and with workers above 55 years of age. Indeed, there is even a strong decline in labor force attachment after age 60 for both men and women.

After simulating the labor force participation decision $LFP_{i,t}$, each worker receives a wage equivalent to the last wage when he was in the labor force plus a real wage increase $dw_{i,t} = E\left[\ln(\frac{W_{i,t}}{W_{i,t-1}}) \mid x_{i,t}\right]$. Workers receive real wage increases every year until age 50, therefore their wage evolves as $w_{i,t} = w_{i,t-1} + dw_{i,t}1(LFP_{i,t-1} = 1)$. Since wage increases are conditional on being in the labor force ($LFP_{i,t-1} = 1$), workers outside of the labor force for long periods will be penalized with worse earnings. Using the same pooled sample of ENE workers which are observed in two consecutive years, I estimate the labor earnings growth of male and female workers according to their characteristics. The OLS estimates of this model are shown in Table 6, which shows that both men and women have positive real wage growth. Wage growth is significantly higher for women with college education and men in the Santiago capital. Figure 6 shows the accumulated log-wage growth after age 25 for both men and women. It is clear that the accumulated wage increases until age 50 are substantial, especially for college educated workers.

Since both the labor force participation decision ($LFP_{i,t}$) and real wage growth ($dw_{i,t}$) models have year dummies, the simulations for the future years apply the dummy for the last year observed which is 2012. For simplicity all the income growth in the simulations comes from the higher education levels of each new generation and from the ageing process, therefore future generations earn more due to their workers being more educated and more experienced. Recent studies have attempted to estimate a long-term productivity growth for advanced economies such as the United States, finding values as low as 0.2 to 0.5% once the effects of human capital and ageing are

Figure 5: Cumulative log-wage growth by gender and education after age 25



discarded (Gordon, 2012, 2014). For the purposes of this study, assuming an exogenous growth rate would actually hurt the estimates of the ratio of pension wealth relative to current income (since current income will be higher relative to the pension payments based on past wages). However, the exogenous growth could imply an improvement in the ability of the government to pay for additional welfare benefits that are unrelated to pension savings. The impact of exogenous technological growth is an issue left out of this study.

5.3 Marriage of single households and new born children

Since several young households are single or childless, I simulate for each of them an outcome of whether each household will have a child or not (probit model of $\Pr(no-fertility_i = 1 \mid x_i)$), and at what age of the household head this will happen ($age-when-first-child_i = \beta_{fc}x_i + \sigma_{fc}\varepsilon_i$, with ε_i being a pseudo-random $N(0,1)$ term and $\sigma_{fc} = \exp(\alpha_{fc}x_i)$ is the heterogeneous standard-error estimated from a second-stage regression of the OLS residuals). If the household is currently a

Table 5: Labor Force Participation in the panel of the Chilean Employment Survey (Probit)

Exogenous variables	$LFP_{i,t} = 1 \mid LFP_{i,t-1} = 1$		$LFP_{i,t} = 1 \mid LFP_{i,t-1} = 0$	
	Women	Men	Women	Men
$\ln(W_{i,t-1})$	0.386***	0.317***		
	(0.0259)	(0.0307)		
2 household members	-0.336***	-0.100	-0.226***	-0.0622
	(0.0809)	(0.0908)	(0.0560)	(0.0965)
3 household members	-0.357***	-0.175**	-0.216***	-0.0708
	(0.0819)	(0.0884)	(0.0562)	(0.0970)
4 household members	-0.483***	-0.147	-0.253***	0.148
	(0.0854)	(0.0902)	(0.0561)	(0.0963)
5 household members	-0.430***	-0.236**	-0.251***	0.0911
	(0.0841)	(0.0917)	(0.0578)	(0.101)
6 household members	-0.370***	-0.286***	-0.307***	0.164
	(0.102)	(0.102)	(0.0619)	(0.115)
7 household members	-0.331***	-0.316***	-0.288***	0.132
	(0.0980)	(0.107)	(0.0650)	(0.122)
Santiago Metro Area	-0.00888	0.0415	0.193***	0.134**
	(0.0295)	(0.0399)	(0.0199)	(0.0522)
Technical education	0.150**	-0.231***	0.158***	0.129
	(0.0655)	(0.0866)	(0.0565)	(0.127)
College education	0.277***	-0.301***	0.278***	-0.0997
	(0.0514)	(0.0693)	(0.0392)	(0.0752)
Age 30-34 dummy	-0.0433	0.282***	-0.113***	0.123
	(0.0466)	(0.0675)	(0.0297)	(0.0937)
Age 35-39 dummy	0.0661	0.219***	-0.0893***	-0.00113
	(0.0455)	(0.0703)	(0.0303)	(0.0997)
Age 40-44 dummy	0.0572	0.238***	-0.144***	-0.130
	(0.0499)	(0.0674)	(0.0316)	(0.0978)
Age 45-49 dummy	0.131***	0.0558	-0.206***	-0.287***
	(0.0502)	(0.0649)	(0.0334)	(0.0948)
Age 50-54 dummy	0.0939*	-0.0689	-0.291***	-0.349***
	(0.0532)	(0.0686)	(0.0347)	(0.0878)
Age 55-59 dummy	-0.177*	-0.309***	-0.455***	-0.501***
	(0.102)	(0.0676)	(0.0373)	(0.0899)
Age 60-64 dummy	-0.561***	-0.639***	-0.695***	-0.705***
	(0.0730)	(0.0673)	(0.0394)	(0.0762)
Constant	-2.714***	-1.067***	-0.883***	-0.477***
	(0.298)	(0.331)	(0.0625)	(0.139)
Other Controls	year dummies	year dummies	year dummies	year dummies
Observations	36,616	79,070	86,615	8,920

Robust Standard-errors in (), ***,**,* denote 1%, 5% and 10% statistically significance, respectively

Table 6: Real log-wage growth $\ln(\frac{W_{i,t}}{W_{i,t-1}})$ in the panel sample of the ENE survey (OLS)

Exogenous Variables	Women	Men
Santiago Metro area	0.00765	0.0137***
	(0.00564)	(0.00381)
Technical education	-0.00336	-0.00482
	(0.00905)	(0.00889)
College education	0.0107*	0.00352
	(0.00626)	(0.00546)
Age 30-34 dummy	-0.00587	0.00228
	(0.00902)	(0.00561)
Age 35-39 dummy	0.00172	-0.00786
	(0.00890)	(0.00541)
Age 40-44 dummy	0.000864	-0.00259
	(0.00892)	(0.00572)
Age 45-50 dummy	-0.0107	-0.0153***
	(0.00901)	(0.00581)
Constant	0.0887***	0.0865***
	(0.00999)	(0.00588)
Other Controls	year dummies	year dummies
Observations	15,755	34,639
R-squared	0.019	0.024

Robust Standard-errors in (), ***,**,* denote 1%, 5% and 10% statistically significance, respectively

single member, then I assume it will become a couple in the same year when the child is born. For simplification purposes I always assume that the new spouse is the opposite gender of the household head. If the new spouse if female, then I simulate whether she is employed or not (probit model of $\Pr(female - employment_i = 1 \mid x_i)$). In the case of a new male spouse, then it is assumed he is employed. I then simulate the first income of the new spouses ($\ln(W_i^{sex} = \beta_{sex} x_i + \sigma_{sex}\varepsilon_{i,sex}$, with sex representing a different income model for a male or female spouse, $\varepsilon_{i,sex}$ being a pseudo-random $N(0,1)$ term and $\sigma_{sex} = \exp(\alpha_{sex} x_i)$ is the heterogeneous standard-error estimated from a second-stage regression of the OLS residuals. These models of fertility and the income of a new spouse were estimated using the EPF 2012 survey and are summarized in Tables 7 and 8.

5.4 Total Household Earnings, Income Volatility and Consumption

In each year I compute the household income as $P_{i,t} = a_i + \sum_k LFP_{k,t} P_{k,t}$, where $LFP_{k,t}$ is the labor force decision of each worker k and $P_{k,t} = W_{k,t}(1 - u_{k,t}) + W_{k,t} R_{k,t}(u_{k,t})$ is its average labor income during the employed and unemployed states, respectively. This calculation includes a

Table 7: Model of whether a new household will be fertile (Probit model) and the household head's age at which it happens (OLS)

	No-fertility at age 45 to 50=1	Head's age when child is born
Years of education	0.0679***	-0.143***
	(0.0147)	(0.0363)
Log-Household Income	-0.295***	0.815***
	(0.0536)	(0.133)
Constant	2.110***	21.91***
	(0.647)	(1.610)
Observations	2,041	4,162
R-squared		0.009

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Model of the new spouse's employment (Probit model) and income (OLS)

	Female spouse employed	Log-Income of female	Log-Income of male
Years of education	0.0188***	0.136***	0.137***
	(0.00546)	(0.00798)	(0.00386)
Log-Income of male spouse	0.155***	0.306***	
	(0.0173)	(0.0265)	
Constant	-2.336***	6.642***	10.12***
	(0.200)	(0.303)	(0.104)
Log-Income of female spouse			0.0970***
			(0.00919)
Observations	8,037	3,645	6,024
R-squared		0.212	0.244

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

weight for the unemployment probability $u_{k,t}$ and replacement ratio of income $R_{k,t}$ of each worker during the unemployment spell. $u_{k,t} = \Pr(U_{k,t} = 1 \mid t, x_k)$ and $R_{k,t} = R(t, x_k)$ are functions of workers' age, therefore the expected income over time is changing not only due to wage increases but also due to lower unemployment risk of older workers. Also, I compute a new estimate for the household i's income weighted unemployment risk and idiosyncratic labor income volatility of the household, which changes each year due to the ageing of their workers: $u_{i,t} = \sum_k \frac{P_{k,t}}{\sum_h P_{h,t}} u_{k,t}$ and $\sigma_{i,t} = \sum_k \frac{P_{k,t}}{\sum_h P_{h,t}} \sigma_{\zeta,t}(x_k)$. The statistics of unemployment probability and labor income volatility for each worker's type x_k are estimated from the Chilean Employment survey (ENE) of the 4th quarter of 2012, which was a period of low unemployment relative to most of the last 25 years.

After obtaining the new vector $x_{i,t} \equiv \{\ln(P_{i,t}), \sigma_{i,t}, u_{i,t}, z_{i,t}, z_{i,t} \times \ln(P_{i,t})\}$, I simulate $c_{i,t}^{nd} = \exp(\hat{\beta}_{2012}^{nd} x_{i,t} + \hat{\sigma}_{\varepsilon_{i,2012}^{nd}} \omega_{i,t})$ as the simulated consumption of household i at time t by applying the coefficients estimated in the most recent Chilean expenditure survey (EPF). $\omega_{i,t}$ is a pseudo $N(0,1)$ random term, which is independent across workers and time periods. Since there is no panel data on the consumption of Chilean households, the idiosyncratic term $\omega_{i,t}$ is simply interpreted as an independent shock to expenditures.

5.5 Population numbers and Life expectancy

Finally, in each year t I adjust the population weights for the changing demographics, $f_{i,2012,t} = f_{i,2012} \dfrac{Pop_{t,sex,age}}{Pop_{2012,sex,age}}$, with $Pop_{t,sex,age}$ being the official projection of the number of people in urban areas by sex and age (5 year dummies) from the United Nations (ECLAC, 2013). I also assume that households live a number of years after retirement equivalent to $life_{h,t} = 60 + life_{60,t} - h$, where h is the retirement age (which is currently age 65 in Chile) and $life_{60,t}$ is the projected life expectancy of Chilean people who reached age 60 from the United Nations (ECLAC, 2013). Table 9 shows the United Nations estimates of life expectancy for men, women and their average for a selected number of years. According to these estimates, the average men of age 65 will live an extra year by 2030 and two extra and a half years by 2050, while women's life expectancy will increase by three years until 2055.

Table 9: Projections of years of Life expectancy in Chile (ECLAC, 2013)

Sex / Year	2015	2020	2025	2030	2035	2040	2045	2050	2055
Men - after age 65	16.3	16.6	17.0	17.2	17.5	17.8	18.1	18.4	18.7
Women - after age 65	20.4	20.9	21.2	21.6	22.0	22.3	22.6	23.0	23.3
Both sexes - after age 65	18.6	18.9	19.3	19.6	20.0	20.3	20.6	20.9	21.2
Women - after age 60	25.4	25.9	26.2	26.6	27.0	27.3	27.6	28.0	28.3

5.6 Pension Funds and Voluntary Savings

In each period households accumulate savings in the Chilean pension system of private funds (AFP) at the compulsory contribution rate of 10% of the labor income of the household members, up to a ceiling on monthly taxable earnings of te_t. I consider te_t to be equal to 1,606,543 Chilean pesos, which was its value in 2013, the first year of the simulation, plus an annual growth rate of 1.2%. The accumulated pension savings stock $PA_{i,t}$ earns a 4% real interest rate of return that is constant over time. This is a benevolent assumption for the future simulation, since across most developed countries the real rate of return of the pension assets was close to 0 or negative in the last 10 years (OECD, 2012). While the recent international returns are low partially due to the influence of the global financial crisis of 2007, in the last decade only 5 of the OECD member countries had real returns on their pension funds above 3.5% (OECD, 2012), therefore a 4% risk free interest rate represents an optimistic scenario for the future decades.

The households' non-compulsory savings are added to the households' net wealth, $W_{i,t} = P_{i,t} - c^{nd}_{i,t}$. For simplification purposes it is assumed that both assets and debts pay a 4% constant interest rate. This is obviously a very strong assumption for several reasons, since it does not account that households have consumption of durable goods (which last for several periods, but differ from an asset that has no-depreciation and actually earns a positive interest rate), that households may be investing in liquid assets with small or no interest rate return, or that debts have a substantially higher interest rate than deposits. Therefore this assumption is benevolent in terms of representing wealthier households than these should be.

When each member k from the household i retires at age h (for example, age 65) in year t, its accumulated pension savings are transformed into a monthly annuity for their remaining life, $\tilde{pa}_{k,t}(h) = \dfrac{rPA_{k,t}}{1-(1+r)^{-12\times life_{h,t}}}$. Different members of the household may retire at different ages. In Chile the current official age of retirement is 65 years for men, while women can opt to retire at age 60 or later. I assume each female worker retires after age 60 if she has been out of the labor force for the previous three consecutive years. This assumption implies that some women will retire at age 60, while others will opt to retire later at age 61, 62, 63, 64 or 65. Each member is also entitled to receive exogenous welfare benefits $B(\tilde{p}a_{k,t}(h))$ from the government as a complement for low pensions. The Chilean system of Solidarity Pensions gives extra benefits to poor families, which are entitled to receive them ($e_{k,t}$ is 1) if the person k is at least age 65 and belongs to poorest 60% of households. It is important to note that while women can only receive solidarity pension benefits at age 65 even if they opt for early retirement after age 60. The Solidarity System gives one basic pension BP which is the lowest value for all pensions and then reduces this payment at the rate of $\frac{BP}{MP}$ for each monetary unit until it reaches a maximum pension equal to MP. Therefore the actual pension income of each member k is $pa_{k,t}(h) = \tilde{p}a_{k,t}(h) + e_{k,t}B(\tilde{p}a_{k,t}(h))$, with $B(\tilde{p}a_{k,t}(h)) = BP \times 1(\tilde{p}a_{k,t}(h) \leq BP) + (BP - \frac{BP}{MP}\tilde{p}a_{k,t}(h)) \times 1(MP > \tilde{p}a_{k,t}(h) > BP)$. For the calibration of this exercise I consider BP and MP to be equal to 82,058 and 266,731 pesos respectively, which are the official values of the Chilean pension system for first year of the simulation which is 2013. Since the simulation model does not consider inflation and it is fixed in 2012 Chilean pesos, I do not calibrate any growth component in the exogenous solidarity pension benefits.

The household's pension income is then given by the sum of the pensions of its members, $pa_{i,t} = \sum_k pa_{k,t}(h)$. I then compute the replacement ratio of pension income relative to the last labor income of each household, $Rpa_{i,t} = \frac{pa_{i,t}}{\sum_k P_{k,t}}$. To take voluntary savings into account I also estimate the total replacement ratio of savings relative to the last labor income as $Rt_{i,t} = (pa_{i,t} + \dfrac{rW_{i,t}}{1-(1+r)^{-12\times life_{h,t}}})\frac{1}{\sum_k P_{k,t}}$. Since some households have accumulated debts (i.e., negative savings) then I consider a lower value of the implicit total pension to be zero.

6 Baseline Simulations

6.1 Model simulations of the saving rates

Figure 6 shows the simulated household income, labor income volatility and unemployment risk for the households with a head of age 25-64 until the year 2055. Since these variables have different scales, I summarize them in terms of log-deviations from the average $\ln(\frac{Y_t}{E[Y_t]})$ for the whole period. The model simulates a positive trend for the mean household income, which increases about 0.35 in log-points between 2015 and 2040. 0.35 log-points corresponds to a 1.4% annual rate of increase in labor income. Therefore even if we exclude technological growth, Chile can expect a steady and robust growth in the next 25 years. The model simulates that the average unemployment risk increases slightly until 2030 and then drops consistently after that. This result makes sense, because the new cohorts have more female workers and these have higher unemployment risk than males. Therefore the initial impact of more female workers increases the unemployment rate. However, older workers have lower unemployment rates, therefore as both men and women age there is a negative trend towards less unemployment. Although educated and experienced workers suffer less unemployment, these do suffer from higher wage volatility, therefore wage volatility has an increasing trend and could increase up until 0.40 log-points until 2050.

The second panel in Figure 6 shows the simulated savings rate of households with a head of age 25 to 64 over time. This represents the voluntary savings accumulation of the households and does not include the compulsory pension contribution rate of 10% out of labor income. Both the median and mean savings rate of Chilean households are projected to increase over time as an effect of the demographic projections. The mean savings rate is projected to increase from 0% to 10% of income between 2015 and 2030, while the median savings rate is projected to increase from 13% to 20% in the same period. In Figure 7 I show the percentiles 5, 10, 25, 50, 75, 90, and 95 of the simulated savings rate. The main conclusion is that all percentiles have a positive trend. But perhaps more worrisome is that the percentile 25 of the savings rate is always negative, which implies that more than 25% of the households accumulate debts instead of assets for complementary pension income.

6.2 Replacement Rates: Compulsory Savings

What do these projections of Chilean households imply for the living standards of retired households? Figure 8 shows the estimated percentiles 5, 10, 25, 50, 75, 90 and 95 of the replacement ratios of pensions for the new retired cohorts (those with heads of age 65) and how it is projected to evolve until 2055. The results do not seem to bode well for the current Chilean pension system even with all the benevolent assumptions included in the model simulations. In particular, let us take as a

Figure 6: Household Income, Volatility, Unemployment risk and Savings rates for future years

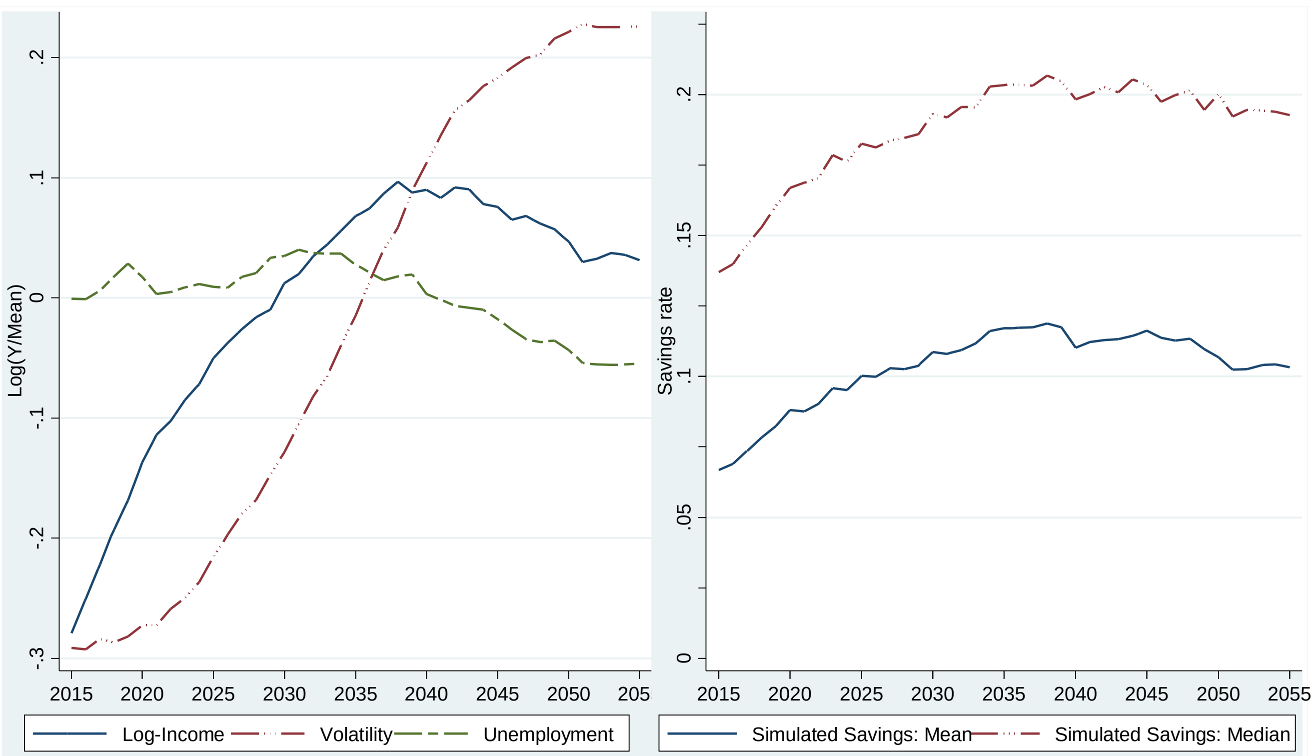


Figure 7: Percentiles of the simulated savings rate across the working age (25-64) population

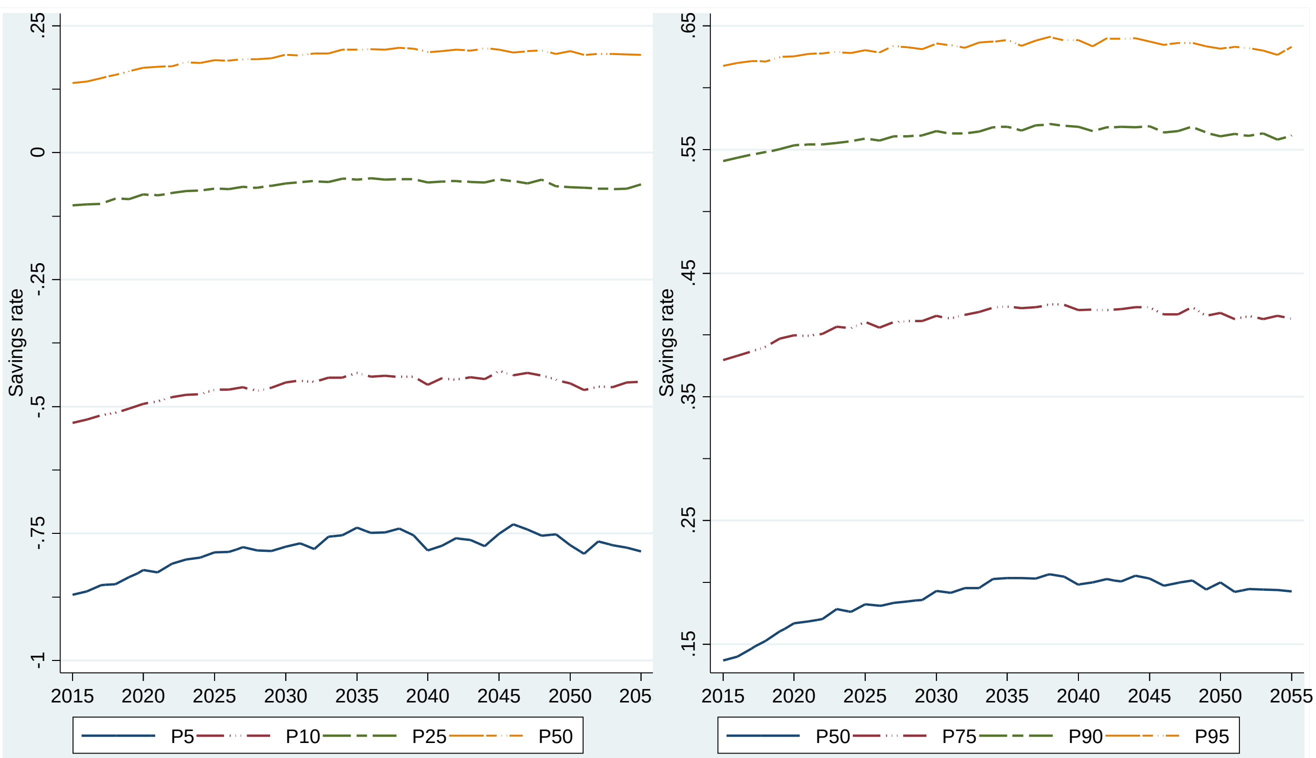
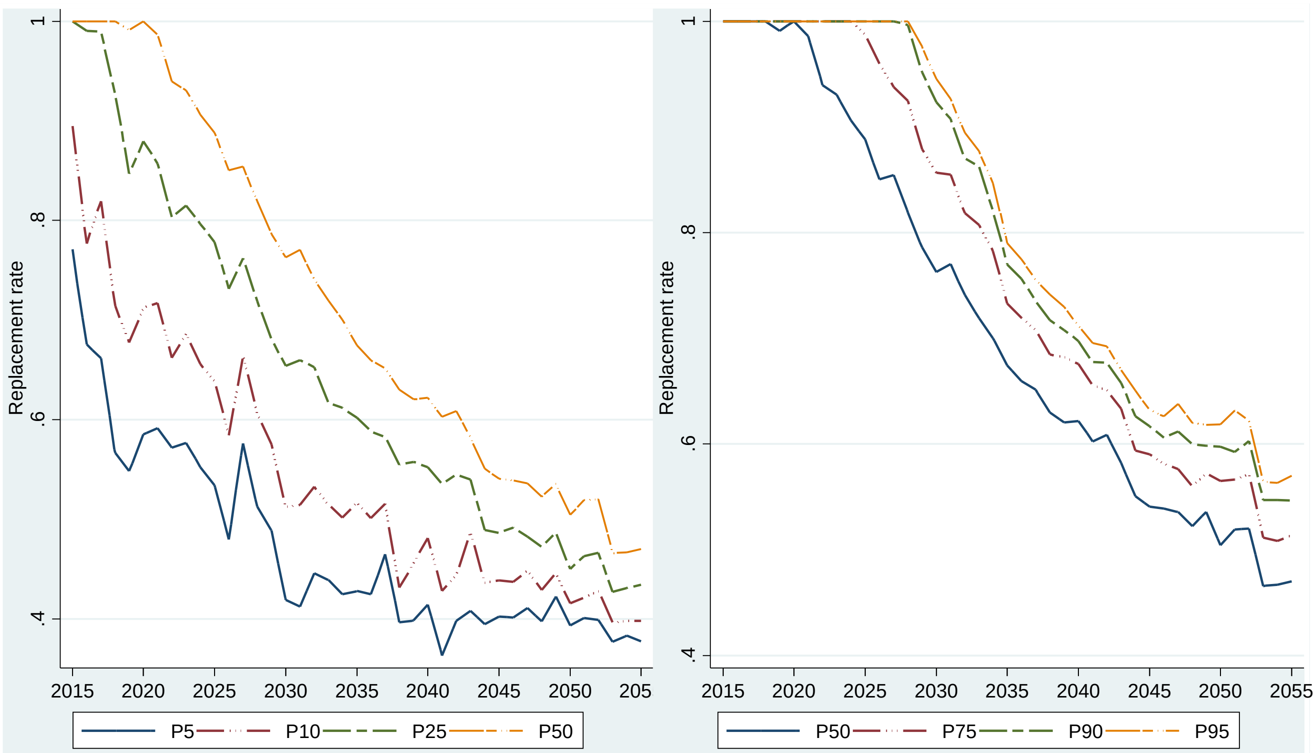


Figure 8: Percentiles of the Replacement Ratio of Pension relative to labor income for the new retired cohorts (age 65)



reference that the OECD represents 70% as a minimum reference value for this replacement ratio of pension income, while the International Organization of Labor argues that 40% should be the lowest value a pension system should target (OECD, 2012). The main result is that the estimated replacement ratios of pension income are projected to fall substantially across the whole population and this reduction worsens steadily until 2055. The median retired household is expected to fall below the target 70% replacement rate after the year 2022, implying that the Chilean system may fail to insure adequate pensions for more than 50% of the retired households in less than 10 years. After 2045, more than 95% of the newly retired population is expected to be below the target 70% for the replacement ratio of income. The main conclusion is that the Chilean pension system may fail to guarantee good pensions for almost all the Chilean households in the absence of either voluntary savings from each household or major policy changes.

Table 10: Percentiles of the Replacement Ratio of Total Savings relative to labor income for the new retired cohorts (age 65)

Population percentiles / Year	2015	2020	2025	2030	2035	2040	2045	2050	2055
Percentile 10	0	0	0	0	0	0	0	0	0
Percentile 20	0	0	0	0	0	0.34	0	0.328	0
Percentile 25	0	0	0.197	0	0	0.579	0.213	0.481	0.1
Percentile 30	0	0	0.418	0	0.154	0.772	0.456	0.612	0.304
Percentile 35	0.059	0.083	0.631	0.227	0.372	0.949	0.671	0.741	0.424
Percentile 40	0.4	0.298	0.834	0.431	0.546	1	0.879	0.899	0.568
Percentile 45	0.715	0.527	1	0.658	0.74	1	1	1	0.742
Percentile 50	1	0.718	1	0.892	0.951	1	1	1	0.94

6.3 Replacement Rates: Total Savings

How do voluntary savings of each household compensate for this deficiency of the compulsory Chilean pension system? This estimation improves a lot the retirement income for the households in the top 50% of the savings rate, but it does not help the households with the worst pensions since the voluntary wealth $W_{i,t}$ can be negative. Table 10 shows the percentile distribution of the replacement ratio of total savings, $Rt_{i,t}$, for the new retired workers over time. Voluntary savings may guarantee a replacement ratio of retirement income close to 1 for the median retiree and above. However, for the 40% poorest retirees the voluntary savings are not enough to guarantee the target replacement ratio of income of at least 70%. It is also worth mentioning that these simulations assume that durable goods are part of the voluntary savings of households and that these durable goods plus voluntary savings earn a risk-free interest rate of 4%. Therefore these results could be regarded as an upper bound of the effect of voluntary savings on households' welfare.

7 Policy Implications

7.1 Increasing the compulsory pension discount rate

Now I analyze the effect of policy measures that could revert the negative performance of the Chilean pension system. Such a measure could be increasing the contribution rate from 10% to 13% of labor income. This measure has a substantial lagged-effect since the new households of age 25 start accumulating 13% of their income at the very start of their lives, but the oldest households are increasing their savings in the middle. Since this measure has such a long time to take effect, I show how Chilean pensions would differ if the contribution rate is increased in a legislation in the current year of 2015 versus a government that waits until 2025 to implement the new policy. Figure 9 shows the percentiles of the replacement ratios of income given by the pension system in both scenarios. The main conclusion is that a contribution rate of 13% in 2015 should guarantee a pension replacement ratio of 70% for the median retired household for the whole period of 2015 until 2055. Also, the percentile 25 of the worst pension ratios will be very close to the target 70% after the year 2042, implying that 75% of the new retired household population will be above or close to a healthy income level. This is a great improvement relative to the baseline scenario in Figure 8. However, a great deal of these positive benefits of increasing the contribution rate are lost if policy makers choose to delay. A policy maker implementing a contribution rate increase in 2025 would not reach a healthy 70% pension replacement ratio for more than 50% of the households in any year after 2025.

7.2 Delaying the retirement age

Now I simulate what should happen if the official retirement age is set to be age 67. This policy could have a strong impact, especially on households with female workers. In the baseline policy simulation I assume that women retire after age 60 if they have been out of the labor force for three consecutive years or more. Table 11 shows the simulated percentage of women selecting early retirement in a few selected years. In the initial years (2015 to 2025) of the simulation there are around 34% to 47% of women choosing to retire at age 60, while less than 46% of the female workers retire at the standard age of 65. Due to the higher education and labor participation among younger female workers, this early retirement option can be expected to decrease in future years. After 2040 more than 60% of the women can be expected to retire at age 65, while less than 20% would retire at age 60. Since a large proportion of women retire at a younger age than men and since women have a larger life expectancy, then it is expected that a future policy that increases female retirement ages will have a strong impact on the pension replacement ratios of households.

In Table 12 I consider a new policy which gradually increases both male and female official retirement ages between the years 2015 and 2022. Figure 10 shows the results of assuming the new retirement age of 67 and keeping the same contribution rate of 10% of labor income. This measure

Figure 9: Pension Replacement Ratio for the new cohorts (age 65): 13% contribution rate

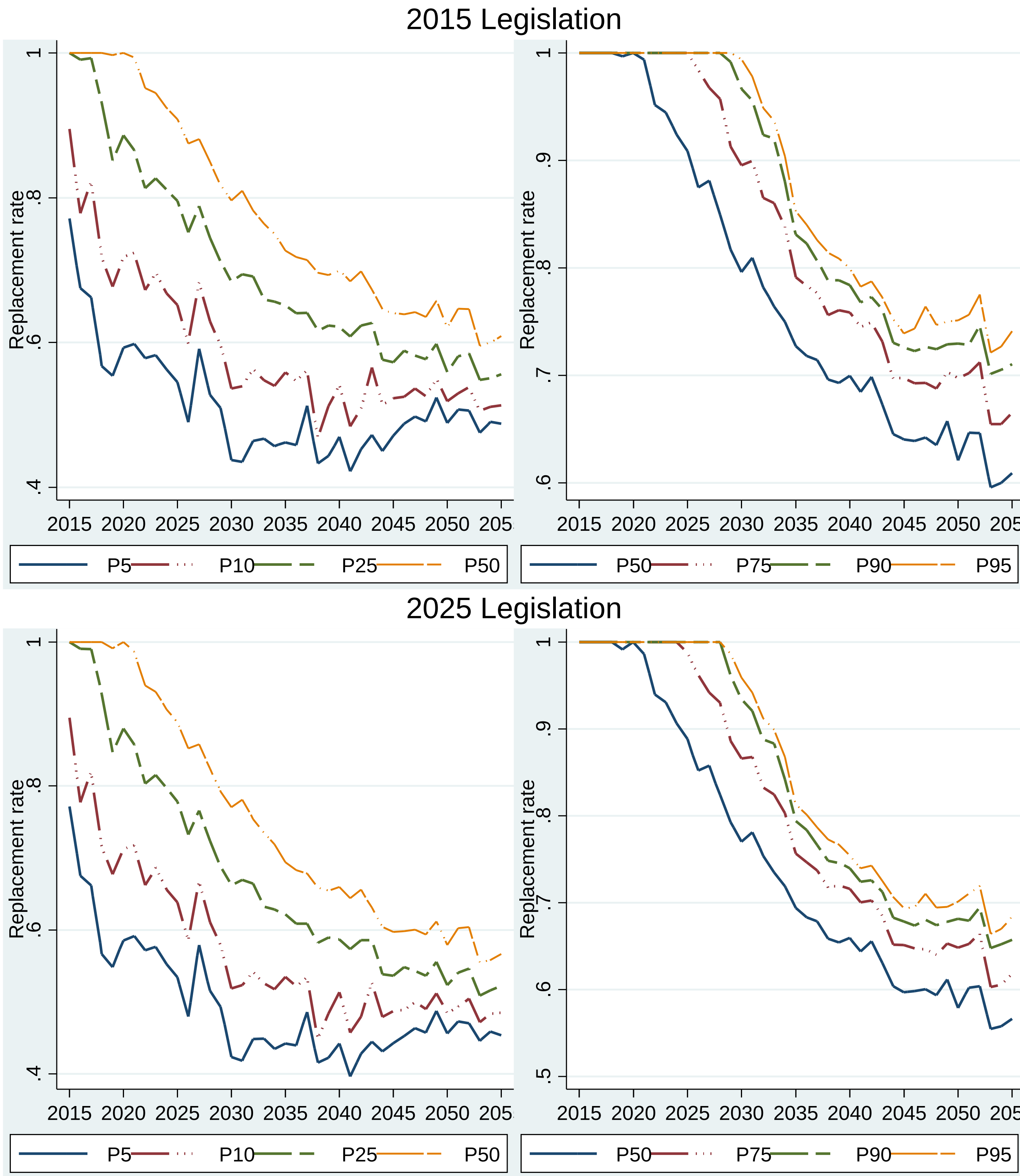


Table 11: Percentage of female workers retiring between age 60 and 65 (baseline)

Retirement Age	2015	2020	2025	2030	2035	2040	2045	2050	2055
60	0.392	0.466	0.344	0.275	0.223	0.177	0.187	0.175	0.163
61	0.081	0.043	0.031	0.034	0.031	0.033	0.033	0.029	0.030
62	0.081	0.077	0.066	0.061	0.061	0.055	0.055	0.062	0.068
63	0.062	0.061	0.056	0.055	0.060	0.057	0.052	0.052	0.035
64	0.054	0.047	0.045	0.057	0.044	0.051	0.045	0.036	0.067
65	0.329	0.307	0.457	0.519	0.580	0.626	0.628	0.647	0.637

Table 12: Gradual increase in the official retirement age made by a new policy

Retirement Age	2015	2016	2017	2018	2019	2020	2021	2022
Male	65	66	66	66	66	66	67	67
Female	60	61	62	63	64	65	66	67

works in a different way from the increase of contribution rates. For this measure, the greatest impact in the pension replacement ratios of income happens immediately (since it affects all the new retired workers right away), but its effect wears off over time. In particular, this policy insures a 70% replacement ratio of income for more than 75% of the newly retired households until the year 2030. However, by the year 2055 more than 50% of the newly retired households are projected to be below the ideal 70% replacement ratio of income.

Figure 11 shows the results of combining both policies: increasing contribution rates to 13% and retirement age to 67 years of age. This policy combination appears to deliver good results, since it guarantees that more than 90% of the households have a pension replacement ratio at or above 70% by the year 2045 and this positive result persists at least until 2055.

7.3 Increasing the coverage of higher education in younger cohorts

Would the recent Chilean policies of increasing funds for college education improve the outcomes for future generations? This can be modeled by increasing the percentage of college educated workers in the new cohort of households with age 25 that enters the population in each year. Table 13 shows the percentage of household heads with technical and college education in the EPF 2012 for the cohort of age 25 and those between age 25 and 29. I consider an exogenous education policy that changes the education level of the new workers. For this reason I re-calibrate the model so that the new age cohorts have 20% and 38% of members with technical and college education, respectively. Since this new cohort of highly educated workers enters the labor market only in 2013, then it can only have an impact after 2048 when the first women start retiring at age 60 and its complete

Figure 10: Percentiles of Replacement Ratio of Pension for the new retired cohorts (age 67)

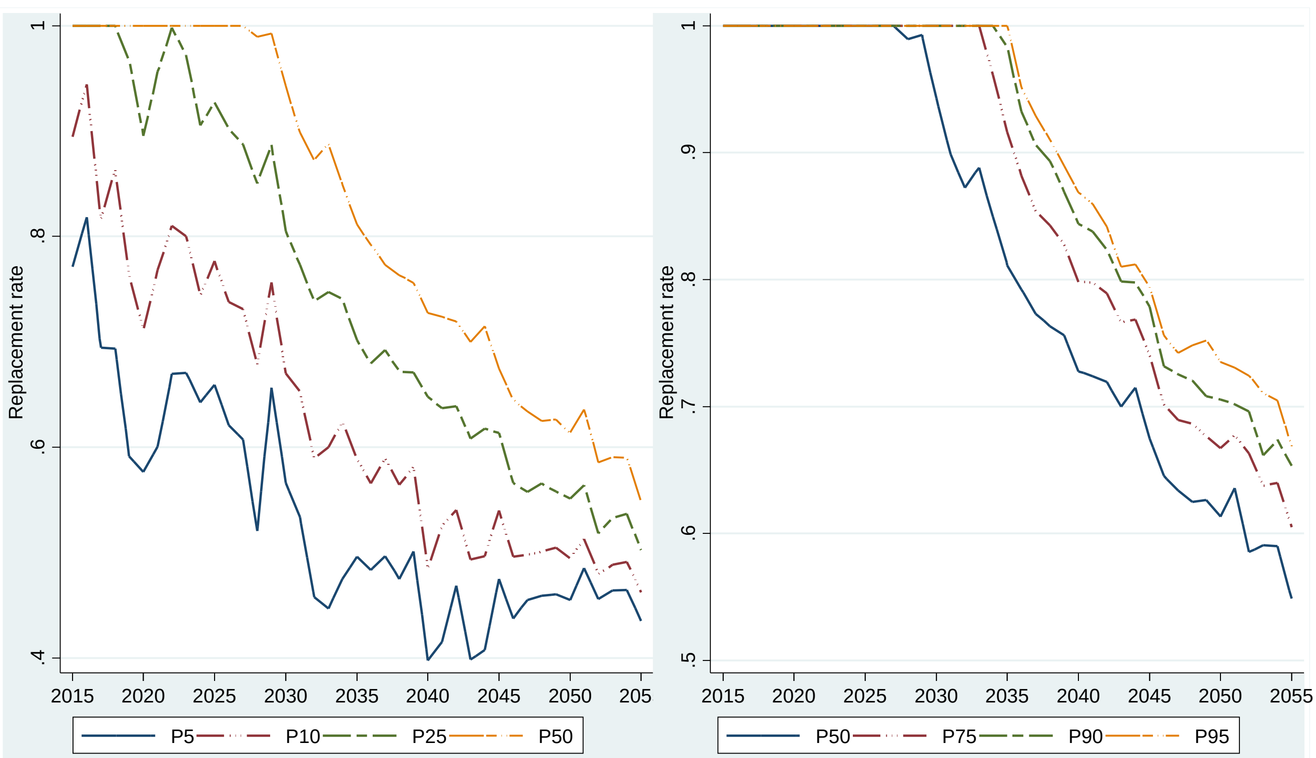


Figure 11: Pension Replacement Ratio for the new retired cohorts (age 67): 13% contribution rate

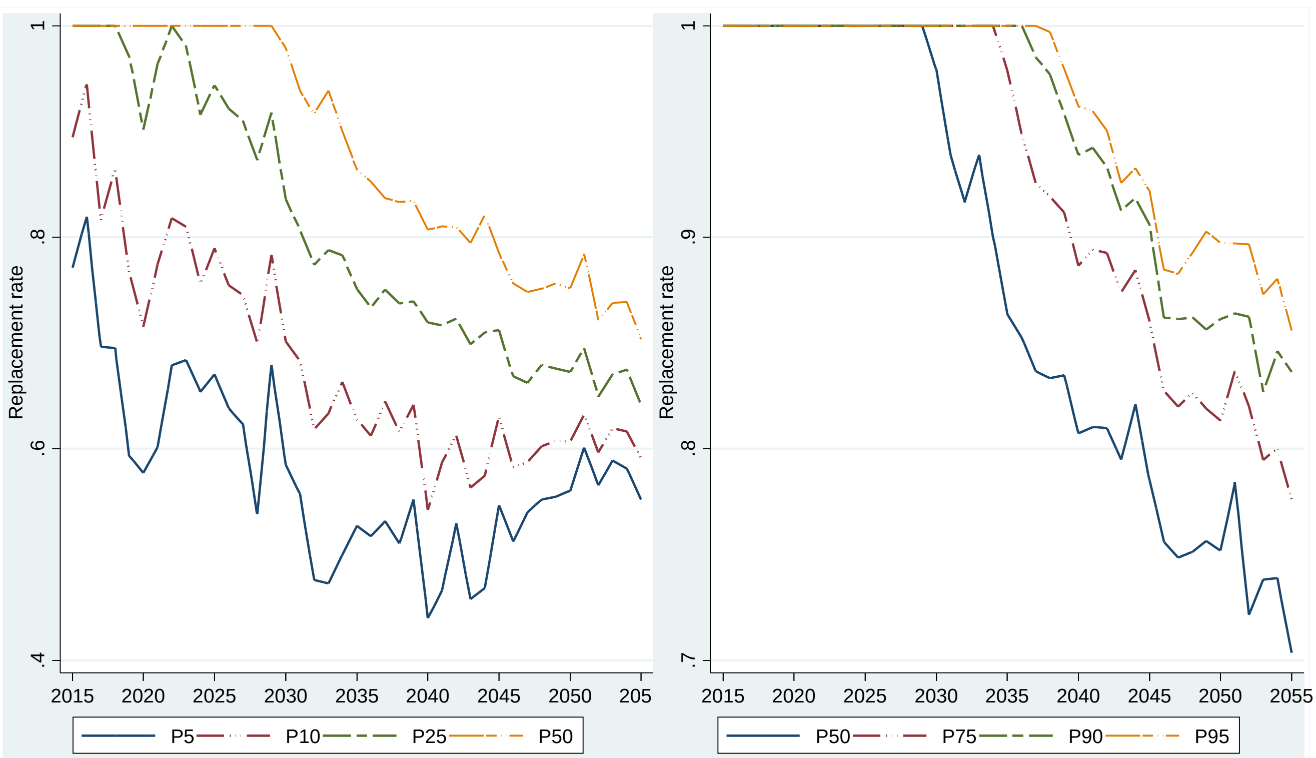


Table 13: Percentage of households by education level in the data vs suggested policy

Education degree by age (EPF 2012)	age 25	age 25-29	age 25 after new policy
Head with Secondary or less	0.520	0.501	0.42
Head with Technical education	0.197	0.148	0.20
Head with University education	0.284	0.351	0.38

Table 14: Simulated impact of the new education policy on the pension replacement ratios

Period	2045-47	2048-52	2053-55	2045-47	2048-52	2053-55	2045-47	2048-52	2053-55
Percentile	With no growth in education			With growth in education			Impact of higher education		
1	0.368	0.388	0.347	0.357	0.389	0.362	-0.011	0.001	0.015
5	0.459	0.461	0.42	0.459	0.463	0.427	0	0.002	0.007
10	0.503	0.494	0.453	0.500	0.493	0.459	-0.003	-0.001	0.006
25	0.556	0.536	0.501	0.556	0.535	0.503	0	-0.001	0.002
50	0.610	0.591	0.54	0.612	0.592	0.543	0.002	0.001	0.003
75	0.658	0.643	0.598	0.659	0.643	0.601	0.001	0	0.003
90	0.683	0.672	0.645	0.682	0.672	0.646	-0.001	0	0.001
95	0.697	0.693	0.658	0.696	0.693	0.663	-0.001	0	0.005

impact is only achieved after 2053 when the first men retire at age 65. For this reason I do not use a graphical approach to show how this policy differs from the baseline for all years of the period 2013-2055, since its difference relative to baseline happens only in the last few years of the period. Table 14 compares the percentiles of the distribution of the pension replacement ratios for the new cohort of retirees in the baseline results versus the simulation of the new education policy. The conclusion is that the new education policy has no impact on pension benefits either before 2047 (before the new educated women start to retire) or during the period of 2048-52 (when the new educated women can opt for early retirement after age 60). The new education policy does have a positive impact during the period 2053-55 after both men and women in the new generation of highly educated workers enter retirement. This impact on the pension replacement ratios is less than 0.5% for workers above the percentile 25 of the population, but it gives an increase between 0.6% and 1.5% for workers in the poorest part of the replacement ratios (those in the percentile 10 and lower). This increase of 0.6% to 1.5% represents a reasonable improvement for households that have replacement ratios below 50% of their last labor income.

7.4 Increasing female labor force participation

The baseline simulation does not include a recent Chilean policy designed to support female labor participation of women in poor households. The Female Labor Subsidy (in Spanish, Bono Trabajo

Table 15: Percentiles of the probability of labor force participation for women aged 25-64 in the EPF sample (baseline simulation versus the new policy)

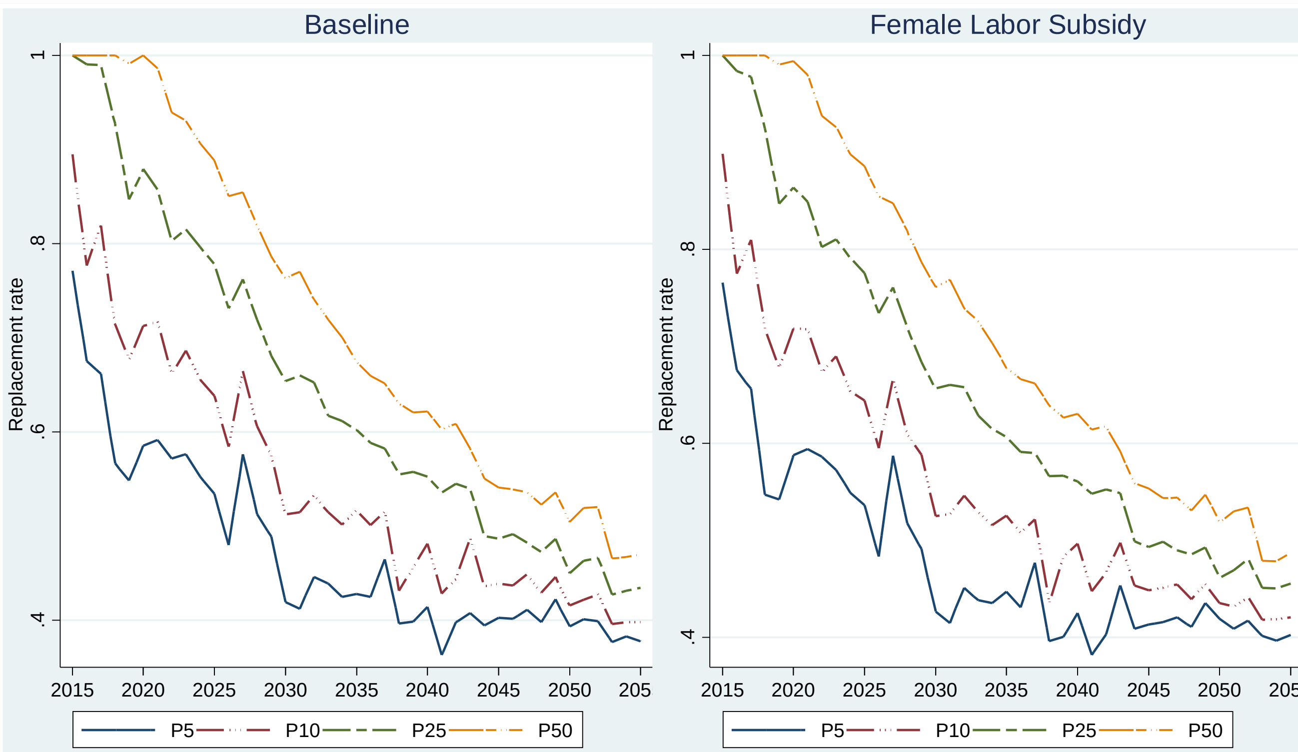
Percentiles	P5	P10	P25	P50	P75	P90	P95
$\Pr(LFP_{i,t} = 1 \mid LFP_{i,t-1} = 1)$: Baseline	0.691	0.739	0.810	0.875	0.934	0.966	.977
$\Pr(LFP_{i,t} = 1 \mid LFP_{i,t-1} = 1)$: New	0.762	0.804	0.862	0.914	0.957	0.979	0.986
$\Pr(LFP_{i,t} = 1 \mid LFP_{i,t-1} = 1)$: New + Labor Subsidy							
$\Pr(LFP_{i,t} = 1 \mid LFP_{i,t-1} = 0)$: Baseline	0.057	0.070	0.107	0.135	0.178	0.221	0.253
$\Pr(LFP_{i,t} = 1 \mid LFP_{i,t-1} = 0)$: New	0.076	0.093	0.143	0.154	0.184	0.223	.256

Mujer) is a new policy just implemented in a 2012 legislation. Female workers below age 60, living in the poorest 40% of households and with monthly wages below 383,391 pesos are eligible to receive a subsidy proportional to their wage income, of which 2/3 is directly given to the female worker and 1/3 is given to its employer. The female labor subsidy $fls_{i,t}$ increases proportional to 30% of the monthly wage until it reaches a maximum amount of 52,500 monthly pesos. For women with monthly wages above 208,391 pesos, the subsidy declines 30% with each extra peso until the subsidy declines to 0 for women with wages equal or above 383,391 pesos. This subsidy is received only if women work and can only be received for In this simulated model there are no firms deciding to hire workers or not, but employers in a competitive labor market should increase their wages to reflect the new subsidy, therefore I consider that women receive 100% of their subsidy.

Furthermore, I also consider there is an exogenous increase in female labor participation for all groups. This exogenous increase in female labor supply could be justified by other policies, such as an expanded network of childcare and pre-schools or more flexible work schedules for women. In the model I implement this exogenous increase in female labor supply by changing the constant in the Female Labor Force participation for employed women ($\Pr(LFP_{i,t} = 1 \mid LFP_{i,t-1} = 1)$) from -2.714 to -2.500 and changing the constant for non-working women ($\Pr(LFP_{i,t} = 1 \mid LFP_{i,t-1} = 0)$) from -0.883 to -0.500. Table 15 shows the impact of these changes in constants for the expected labor supply of women in 2013:

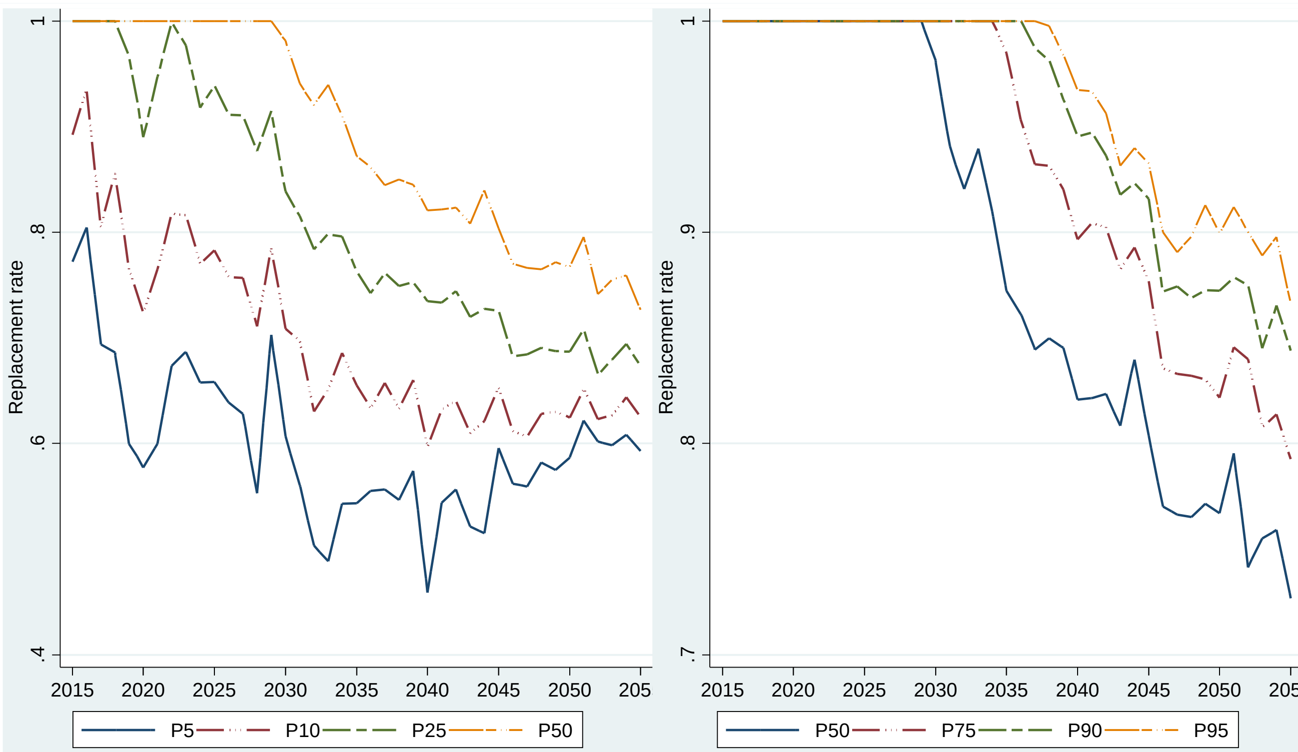
Figure 12 shows the impact of the Female Labor Subsidy policy in terms of the percentiles of the pension replacement ratios of each new generation of retired households. The simulated results show that the new policy does not prevent the replacement ratio of the median household to fall below 70% after 2022. However, it does improve substantially the replacement ratios of income for the percentiles 5, 10 and 25 of newly retired households. In Figure 12 the new female labor supply policy guarantees a replacement ratios above 50% for the percentiles 5 and 10 in 2055,

Figure 12: Replacement Ratio of Pensions: Baseline vs Female Labor Subsidy



while in the baseline scenario (Figure 8) both percentiles are below 45%. Also, the percentile 25 of the lowest replacement ratios after the new female labor supply is close to 60% during the period from 2050 until 2055 (Figure 12), while this percentile drops to a level close to 50% in the baseline scenario (Figure 8). This shows that for the poorest retirees (as measured by the lowest 5, 10 and 25 percentiles of the pension replacement ratios of income), the Female Labor Subsidy program implies an improvement between 5% to 10% in terms of their pension replacement rate of income. This impact tends to be more significant in the last decades of the simulation. The reason is because women have strong returns to work experience (as shown in Figure 5), therefore younger female workers are more likely to receive higher wages and participate in the labor market after they benefit from a work subsidy in their early years.

Figure 13: Replacement Ratio of Pensions if all the policy alternatives are implemented



7.5 All policies

Finally, to complete this section I present the results of the pension replacement ratios over time if all policy alternatives are implemented jointly: i) the increase in contribution rates to 13%, ii) the increase of retirement age to 67 years, iii) the higher education rates of the new generations, and iv) the Female Labor Subsidy program. Figure 13 confirms that joining all these policies actually has strong effects and it guarantees a pension replacement ratio of 70% or more for at least 75% of the newly retired population between 2040 and 2055.

8 Conclusions

In this paper I estimate and calibrate a micro based household model to simulate the savings rates of Chilean households until 2055. For this I take into account the consumption profile of different households, plus the demographic changes over time in terms of ageing, new fertility and increased longevity of retired households. I show that the Chilean pension system is projected to deliver worse replacement ratios in the future, unless policy makers increase retirement age and contribution rates. Increasing contribution rates to 13% and retirement age to 67 years of age appears to be the most adequate policy combination for improving the pension income of Chilean households. This policy combination manages to improve the pension income immediately and to make this improvement sustained over time. However, the impact of increasing the contribution rate has a lagged effect and takes a long time until reaching the most positive impact, since it improves the pensions of new generations but not of the oldest cohorts.

The recent Female Labor Subsidy program implemented in 2012 for poor families is also a good instrument to improve the replacement ratios of income among the lowest pensions (those below the percentile 25 of the newly retired population). The Female Labor Subsidy program represents an improvement between 5% to 10% in terms of the pension replacement rate of income in the lowest 25 percentile of the newly retired population. This impact tends to be more significant in the last decades of the simulation. The reason is because women have strong returns to work experience, therefore younger female workers are more likely to receive higher wages and participate in the labor market after they benefit from a work subsidy in their early years.

References

[1] Aiyagari, Rao (1994), "Uninsured Idiosyncratic Risk and Aggregate Saving," *Quarterly Journal of Economics*, 109(3), 659-684.

[2] Attanasio, Orazio and James Banks (1998), "Trends in household saving don't justify tax incentives to boost saving," *Economic Policy*, 13(27), 547-583.

[3] Attanasio, Orazio and Miguel Székely (2000), "Household Saving in Developing Countries – Inequality, Demographics and All That: How Different are Latin America and South East Asia?," Inter-American Development Bank Working Paper 427.

[4] Attanasio, Orazio and James Banks (2001), "The assessment: household saving - issues in theory and policy," *Oxford Review of Economic Policy*, 17(1), 1-19.

[5] Attanasio, Orazio and Guglielmo Weber (2010), "Consumption and Saving: Models of Intertemporal Allocation and Their Implications for Public Policy," *Journal of Economic Literature*, 48(3), 693-751.

[6] Azevedo, Joao, Gabriela Inchauste and Viviane Sanfelice (2013), "Decomposing the recent inequality decline in Latin America," World Bank Policy Research Working Paper 6715.

[7] Braun, Anton, Daisuke Ikeda and Douglas Joines (2009), "The saving rate in Japan: Why it has fallen and why it will remain low," International Economic Review, 50(1), 291-321.

[8] Butelmann, Andrea and Francisco Gallego (2000), "Ahorro de los Hogares en Chile: Evidencia Microeconómica", Chilean Economy, 3(1).

[9] Butelmann, Andrea and Francisco Gallego (2001), "Estimaciones de los Determinantes del Ahorro de los Hogares en Chile (1988-1997)", in Análisis Empírico del Ahorro en Chile, edited by F. Morandé and R. Vergara, Central Bank of Chile.

[10] Campbell, John and Gregory Mankiw (1989), "Consumption, Income and Interest Rates: Reinterpreting the Time Series Evidence," NBER Macroeconomics Annual, 1989 (4), 185-246.

[11] Bloom, D. E., D. Canning and J. Sevilla (2003), "The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change." Population Monograph 1274, RAND.

[12] Carroll, Christopher and Andrew Samwick (1997), "The nature of precautionary wealth," *Journal of Monetary Economics*, 40 (1), 41-71.

[13] ECLAC (2013), "Long Term Population Estimates and Projections 1950-2100," Economic Commission for Latin America and the Caribbean, Population Division, United Nations.

[14] Fry, Maxwell and Andrew Mason. 1982. "The variable rate-of-growth effect in the lifecycle saving model," *Economic Inquiry*, 20(3), 426-442.

[15] Gordon, Robert (2012), "Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds", NBER Working Paper 18315, NBER.

[16] Gordon, Robert (2014), "The Demise of U.S. Economic Growth: Restatement, Rebuttal, and Reflections", NBER Working Paper 19895, NBER.

[17] Gourinchas, Pierre-Olivier and Jonathan Parker (2002), "Consumption Over the Life Cycle," *Econometrica*, 70(1), 47-89.

[18] Gruber, Jonathan (1997), "The Consumption Smoothing Benefits of Unemployment Insurance," *American Economic Review*, 87(1), 192–205.

[19] Lustig, Nora, Luis Lopez-Calva and Eduardo Ortiz-Juarez (2013a), "Deconstructing the decline in inequality in Latin America," World Bank Policy Research Working Paper 6552.

[20] Lustig, Nora, Luis Lopez-Calva and Eduardo Ortiz-Juarez (2013b), "Declining Inequality in Latin America in the 2000s: The Cases of Argentina, Brazil, and Mexico," *World Development*, 44(C), 129-141.

[21] Higgins, Matthew (1998), "Demography, national savings, and international capital flows," *International Economic Review*, 39(2), 343– 69.

[22] OECD (2012), "Pensions at a Glance", OECD, Paris.

[23] Madeira, Carlos (2014), "Earnings dynamics of Chilean workers: employment transitions, replacement ratio, and income volatility," Central Bank of Chile mimeo.

[24] Mason, Andrew (2005), "Demographic Transition and Demographic Dividends in Developed and Developing Countries," United Nations.

[25] Rios-Rull, J.-V. (2001), "Population Changes and Capital Accumulation: The Aging of the Baby Boom," The B.E. Journals in Macroeconomics, Advances in Macroeconomics.

[26] Saad, Paulo (2009), "Demographic Trends in Latin America and the Caribbean", ECLAC.