The impact of the Chilean pension withdrawals during the Covid pandemic on the future savings rate

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Abstract

Chile implemented pension withdrawals during the Covid pandemic at a much larger scale than other OECD countries. Estimating a life cycle model with I find that households consume a significant fraction of their noncontributory pension wealth, implying a tradeoff between improving public pensions and increasing savings. Counterfactual simulations show that the pandemic pension withdrawals may decrease the future savings rate by 1.7%. Furthermore, policy reforms may decrease the aggregate savings rate by 0.2% for each percentage point of solidarity rate tax from current workers. The solidarity taxes increase substantially the pension income of poor retirees, but their effects decline over time.

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1 Introduction

The determinants of household savings are an important question in economics, with wealth from accumulated savings being the main instrument that allows households to smooth consumption and leisure in the future and across positive and negative states of the world (Attanasio and Weber 2010). One of the most widely available form of savings and wealth across different countries comes from social security, either from personal accounts (which can be privately managed by companies or by a public institution, often through notional accounts) or from non-contributory public benefits (OECD 2021). This topic is more relevant now after the Covid pandemic, because several countries (such as Chile, Peru, Mexico, Australia, New Zealand, Portugal, Spain and Iceland) allowed their citizens to withdraw a substantial amount of funds from their individual pension accounts (OECD 2020), leaving their future contributory pension components at lower levels. This issue is especially relevant for Chile, because the size of their pension policy withdrawals was much larger relative to other OECD countries (OECD 2020), with the two withdrawals in 2020 and one withdrawal in 2021 representing a total rundown in pension assets around 20% of the GDP. Due to the size of the pension withdrawals in Chile it is relevant to study its implications for the future savings rate in Chile, especially as the economy will require domestic investment to recover its growth trajectory.

This article estimates a simple life cycle model of consumption and savings decisions (Attanasio and Brugiavini 2003, Attanasio and Rohwedder 2003) to simulate the potential impact on the savings rate and pension income of the pension withdrawals implemented in Chile in 2020 and 2021. I then analyze how different non-contributory pension benefits and different social security reforms under debate in Chile may affect the savings rate of working age households and the pension income of future cohorts of retirees. This analysis is particularly important now as Chile is facing several policy reform discussions in Parliament and the pension system became the main issue behind the large social disruption that Chile has faced since October 18, 2019 (Madeira 2022). A significant portion of the policy debate deals with how much income redistribution should be implemented through pensions. The depleted contributory pension savings imply that more households may receive some amount of public non-contributory pensions in the future. However, households may view the higher expected non-contributory benefits and their private wealth as substitutes, therefore decreasing their savings rate, with an impact on both individual wealth

(Hubbard 1986, Gale 1998, Attanasio and Brugiavini 2003, Attanasio and Rohwedder 2003) and aggregate investment (Feldstein 1974). Therefore one trade-off faced by policy makers in the future reforms is that a higher redistributive policy may improve social insurance and reduce longevity risk (Conesa and Krueger 1999), but at the cost of lower investment (Feldstein 1974).

Using the most recent Chilean Household Expenditure Survey (*Encuesta de Presupuestos Familiares*, EPF) of 2017, I estimate a standard life cycle model of the savings rate (Attanasio and Brugiavini 2003), which accounts for agents consuming each year a smoothed fraction (the inverse of the sum of the agents' discount factors over all periods of its remaining life) of the total wealth over their lifetime, with total wealth including the discounted value of future earnings, the contributory pension wealth (which sums the contributions accumulated over past periods with the expected contributions over the future working life) and the expected non-contributory pension wealth (Attanasio and Rohwedder 2003), plus a set of demographic variables to account for the presence of other household members such as children, older relatives, whether the spouse is employed (Attanasio and Weber 2010) and the households' labor income volatility as a measure of the precautionary savings motive (Gourinchas and Parker 2002).

The results show that savings rates increase with household income, labor income volatility (confirming the precautionary motive), but savings are lower for couples and families with children. The major result is that households prefer to save and accumulate their contributory pension wealth, but they consume a substantial fraction of their non-contributory pension wealth. This implies that Chilean policy makers face a trade-off between pension income distribution and maximizing the savings rate. The pension withdrawals in 2020 and 2021 reduced substantially the expected contributory pensions of many households, who now have firm expectations of receiving higher public benefits to complement their low contributory pension income. The estimated life cycle model shows that these measures may reduce the future economy-wide savings rate by 1.7%.

Furthermore, I simulate the potential impact of different policy reforms including an increase in the retirement age to 67 years for both genders and an increase in the contribution rate of 6%, but with a rate between 0 and 3% destined to public benefits for the poorest retirees. The results show that each additional percentage point of the solidarity public benefits rate can cause a decrease of 0.2% in the economy-wide savings rate. On the positive side, there is an improvement in the pensions of the poor and middle class retirees. In the case of a 3% solidarity rate the average pension replacement ratio improves by 5.2% in 2025, 4.1% in 2035, 2.8% in 2045 and 2.2% in 2055. The impact of the solidarity rate on the retirees' income declines over time due to the dwindling labor force and the increasing number of retiree beneficiaries. Therefore policy makers may be concerned that solidarity measures, while positive for income redistribution, have a reduced impact over time and may reduce the economy's savings and investment, affecting economic growth (Feldstein 1974).

This work is related to studies about the effects of non-contributory pensions on savings (Alonso-Ortiz, Amuedo-Dorantes and Juarez 2019), pension reform and regulation (Alonso-Ortiz 2014, Boon et al. 2018, Kristjanpoller abd Olson 2021), investments (Berstein et al. 2013), and the financial behavior of low income households (Madeira 2019a, 2019b, 2021). The life-cycle model and the negative impact of non-contributory pensions on household savings found in this study are qualitatively similar to past studies for the UK (Attanasio and Rohwedder 2003), Italy (Attanasio and Brugiavini 2003) and Mexico (Alonso-Ortiz, Amuedo-Dorantes and Juarez 2019). This study advances upon the literature by simulating the implications of the recent pension policy changes during the Covid pandemic in Chile, the long-run demographic change[1] and possible increases in solidarity taxes, for the households' savings and their future pension income. This is an extremely relevant topic, because the social security reform discussions in Chile are being made in a context of a high social unrest in which the perceived inadequacy of the pension amounts were one of the major causes (Madeira 2022). Social unrest is a shock with significant impact on economic activity across several countries, especially in countries with weak institutions and lower social protection (Bernal-Verdugo, Furceri and Guillaume 2013, Barrett et al. 2021), therefore the analysis of the impact of the Chilean case may hold lessons for other countries in relation to the trade-offs involved between more generous public pensions and lower private savings[2]. The policies studied in this paper are also relevant for other Latin American countries that implemented similar measures as Chile during the Covid pandemic (OECD 2020). Furthermore, in the next decade the Latin America social security systems will face intense pressure from the trends in informal work and demographic ageing (Cavallo and Serebrisky 2016, ECLAC 2020, OECD 2021) plus the debilitated government

[1] Latin America will age as quickly between 2000 and 2030 as Europe did between 1950 and 2010 (ECLAC 2020).

[2] According to the OECD (2021), at least 20 countries have adopted defined-contributory components as part of their mandatory pension systems, including Australia, Chile, Colombia, Costa Rica, Denmark, Estonia, Hong Kong (China), Iceland, Israel, Italy, Latvia, Lithuania, Mexico, Nigeria, Peru, Poland, Romania, Singapore, the Slovak Republic, Sweden, and the United Kingdom. It is worth noting that the value of non-contributory pensions, whether in defined benefit or defined-contribution systems, imply a similar trade-off between the equity goals achieved by public benefits and the economic efficiency goal of higher private savings (Feldstein 1974).

finances and social security funds after the Covid pandemic (OECD 2021). On the econometric side, this work improves upon previous studies by considering the separate savings propensity of different types of wealth, such as currently accumulated savings versus expected future wealth from different sources, such as pensions, labor income, rents, government transfers and financial assets.

This study is structured as follows. Section 2 explains the theoretical model of consumption and the calibration of the Chilean social security system. Section 3 shows the savings rate' model estimated from the EPF survey. Section 4 discusses the counterfactual results of the recent and the future policy reforms. Finally, section 5 summarizes the policy implications.

2 The Chilean pension system and the life-cycle savings model

2.1 The Chilean pension system

The Chilean pension system created in 1981 is mainly based on two pillars (Berstein 2010, Santoro 2017), with its major componed based on defined contribution accounts funded by the workers' wages and a supplementary component given by non-contributory "solidarity" pensions which are funded from general taxes. The general pension age is 65 years for men and 60 years for women, although the "solidarity" pensions are available only at age 65 for both genders.

Its first component is a system of fully-funded and defined-contribution private retirement accounts that belong to each worker (although the funds can only be withdrawn after the retirement age). Each worker can choose one among several pension company managers who offer five different funds for the pension savings (Berstein et al. 2013), with fund types ranging from very low risk (mostly government bonds) to higher risk and complexity (with participations in thousands of asset classes across the world), and with government serving a role of last resort guarantor under a scenario of unfavorable portfolio returns (Berstein 2010). Due to the long horizon of pension managers, the compulsory contributions for the pension system are one of the main funding sources for corporate investment in Chile, whether as equity or debt (Cerda et al. 2020). By the end of 2019, the Chilean pension funds amounted to 81% of the GDP.

The second pillar of the Chilean pension system consists of non-contributory "solidarity" pensions for the poorest families, which are funded from general taxes (Berstein 2010). Until December of

2019 each retired member of age 65 or more from a family within the three lowest quintiles of income would receive a pension subsidy of a varying amount. The pension subsidy would insure that the minimum total monthly pension of its beneficiaries would be 82,058 pesos and then the subsidy would decrease with the pension amount of the workers until the pension reached 266,731 pesos, with retirees receiving no public pension benefits above that income level.

Since its beginning as a defined-contribution system in 1982, the Chilean pension funds presented real interest rates close to 7.6%. The Chilean pension system was considered to have a high evaluation on the sustainability and efficiency of the system's funding, but a low adequacy in terms of the value of the pensions paid to retirees with a short history of formal employment (Berstein 2010, OECD 2020). Over the last few years there was public discontent due to the low amounts received by retirees from the pension system (Madeira 2022), with the low pension earnings being mostly caused by a low contribution rate of 10% of workers' earnings and by high rates of informality causing long periods without contributions from several workers, in particular women (with female labor participation having reached a peak of just 52% in the last decade, see Blagrave and Santoro 2017). According to OECD simulations for a representative average worker that earns the average wage over its entire working life, the Chilean pension system delivers a net replacement ratio of pension income relative to the labor earnings of just 39% for men and 35% for women, which is much lower than the OECD average of 62% for men and 61% for women (OECD 2021). Furthermore, Chile still keeps a retirement age of 65 for men and 60 for women, which is substantially lower than the current OECD average of 66 years for both men and women (OECD 2021).

2.2 Changes implemented to the pension system between 2019 and 2022

After the Social Explosion on October of 2019, which represented a large movement of social unrest and political protest (Madeira 2022), the Chilean pension system changed both the defined-contribution and the solidarity pillars. To reduce the civil unrest, the government enhanced the pension solidarity system on December 11th of 2019 (the Law 21190), establishing a minimum pension of 169649 pesos for any retired member above 65 years of age from a family within the three lowest income quintiles. The Covid pandemic in 2020 and 2021 further deepened the social and political unrest, therefore the government implemented an even larger increase of the Solidarity Pensions on January 29th of 2022 (the Law 21419), with a minimum solidarity pension of 185000 pesos and without any deduction from the contributory pension for amounts lower than 630,000 pesos.

The Covid crisis implied other measures which affected the Chilean defined-contribution pension accounts. On July 30th of 2020 the Congress implemented an exceptional measure (the Law 21248) that allowed all workers to withdraw a significant amount of their accumulated pension contributory wealth. A second pension withdrawal was legislated on December 10th of 2020 (the Law 21295) and a third pension withdrawal was implemented on the 28th of April of 2021 (the Law 21330). In ordinary times, these pension funds can only be used after age 65, but the laws allowed for a withdrawal in cash, check or deposit, without penalties. In the case of the first and third pension withdrawals there were also no taxes applied to the amounts received by the workers, although the second withdrawal implemented a tax fee which applied only to high income workers. All the pension withdrawals were structured in the same way in terms of the amount that each worker could request from its individual defined-contribution account. Each withdrawal legislation allowed every individual worker to withdraw an amount up to 150 UF[3] of their accumulated individual pension account. Any account member of the defined-contribution pension system (that is, anyone who has held a formal job in the past) could withdraw up to 100% of its funds for accounts with a value below 35 UF, up to 35 UF for accounts between 35 and 350 UF, up to 10% of the funds for accounts between 350 and 1,500 UF, and 150 UF for accounts above 1,500 UF.

In a country of 19 million people, there were 10.6 million workers making use of the first withdrawal, 7.9 million using the second withdrawal and 5.6 million using the third withdrawal, which corresponds to roughly 97%, 81% and 57% of the account holders before the Covid pandemic early in 2020 (Evans and Pienknagura 2021). Until the end of 2021, the first, second and third pension withdrawals implied, respectively, a total amount withdrawn of 20.3, 19.2 and 16.3 billions[4] of USD. Overall, the three pension withdrawals represented 20% of the GDP, 18% of the total pension assets that existed at the end of 2019, depleted the accounts of over 3.8 million workers, and reduced the future pensions of more than 10.5 million people (Evans and Pienknagura 2021).

It is worth noting that several other countries implemented some form of pension withdrawal during the Covid pandemic in 2020 and 2021 (OECD 2020, 2021). Besides Chile, during the Covid

[3]UF is a real monetary unit applied in Chile, which is updated according to the official consumer price inflation (CPI) index. 1 UF was roughly equivalent to 35 USD during 2020.

[4]The term billions here is used to denote "thousands of millions".

pandemic there were withdrawal programs or a relaxation of the eligibility criteria to receive benefits from the pension accounts in at least 30 other countries, including Australia, Barbados, Belgium, Belize, Bermuda, Canada, Colombia, Costa Rica, Denmark, Estonia, Fiji, Finland, France, Greece, Iceland, India, Israel, Malaysia, Mexico, New Zealand, Peru, Portugal, Samoa, Slovak Republic, South Africa, Spain, Turkey, United Kingdom, United States and Zimbabwe (OECD 2020). Other jurisdictions also implemented other measures such as a suspension, temporary deferral or reduction of social security contributions (Belgium, Bolivia, Brunei, Canada, Colombia, Croatia, Estonia, Fiji, Finland, France, Germany, India, Israel, Jordan, Kenya, Kosovo, Lithuania, Malaysia, New Zealand, Peru, Russia, Singapore, Slovak Republic, United Arab Emirates, United Kingdom, Zimbabwe) or taking loans from the pension plans (Israel, United States). The most significant pension withdrawals related to Covid policy measures were those in Peru and Chile, with withdrawal amounts above 18% of the total pension assets. As a comparison, the pension withdrawals in Iceland and Australia represented 3% and 1.4% of their systems' assets, respectively. In Mexico, New Zealand and Spain, the pension withdrawals were limited to workers experiencing unemployment or in extreme need, therefore their withdrawals represented less than 0.5% of their systems' pension assets (OECD 2020, 2021). The size of the pension withdrawals in Chile in relation to the GDP was much larger than in Peru, because the pension fund industry had accumulated much more assets in Chile over four decades since the system was created. Since the pension funds in Peru only represented 22.8% of the GDP in December of 2019, then its pension withdrawal consisted of just 4.2% of the pre-pandemic GDP (much less than the 20% of the GDP withdrawal in Chile). Due to its weight on the GDP, the economic implications of the Chilean pension withdrawals may have strong implications for investment and growth in the near and medium term future.

2.3 The life-cycle consumption optimization problem of the household

The conceptual framework for consumption and savings in this paper is the life-cycle model. Let's assume that in period t each household head i with current age $S(t,i)$ chooses a consumption path $\{C_{i,t}, C_{i,t+1}, ..\}$ that optimizes his lifetime utility until he/she dies at age T_t, with the utility of consumption in each period t being given by $u(C_{i,t})$. Each k member of the household has a different life expectation according to his gender and the time period t: $T_{k,t}$. Therefore I take the life expectancy of the household at time t to be the longest life expectancy of each of its household head plus its partner or spouse if that is the case: $T_t = \max_k \{T_{k,t}\}$. Other household members (such as senior people or children) are considered as additional covariates.

The household's optimal choice depends on the discounted value of his future earnings from its current age $S(t,i)$ until death at time T, including the present discounted value of his earnings $FE_{i,t}$, financial wealth $PW_{i,t}$ and the present value of non-contributory pensions $SPW_{i,t}$ (which the household may receive in old age even without having contributed to the pension system):

$$1)\ \max_{\{C_{i,t},C_{i,t+1},..\}} \sum_{h=S(t,i)}^{T_t} \beta^{h-S(t,i)} u(C_{i,h}) \text{ s.t. } \sum_{h=S(t,i)}^{T_t} \frac{C_{i,h}}{(1+r)^{h-S(t,i)}} \leq PW_{i,t} + SPW_{i,t} + FE_{i,t}.$$

I calibrate future earnings from the characteristics $x_{k,i,t}$ of each k adult member in household i, which includes the household head and its partner if there is such (therefore excluding adult children which may leave the main household). Each working member has a current labor income $W_{k,i,t}$, with exogenous annual income growth of $G_{k,i,h}$, while workers in unemployment (with probability $u_{k,i,t} = 1$) receive an income proportional to their wage earnings $RR_{k,i,h} W_{k,i,t}$. In Chile the replacement ratio of workers during unemployment $RR_{k,i,h}$ is estimated around 40% for the majority of the labor force, although it can be as low as 20% or 5% for unskilled workers (Madeira 2015). For members with no reported income, I use an imputed income from workers with similar characteristics $W_{k,i,t} = E\left[W_{k,i,t} \mid x_{k,i,t}\right]$. I then account for the probability that each household member is in the labor force in each period, $lfp_{k,i,t} \equiv \Pr(LFP_{k,i,t} = 1 \mid x_{k,i,t})$, the probability of being unemployed $u_{k,i,t} \equiv \Pr(U_{k,i,t} = 1 \mid x_{k,i,t})$ given that the member is in the labor force, and its expected annual income growth $G_{k,i,h} = E\left[\frac{W_{k,i,h}}{W_{k,i,t}} \mid x_{k,i,t}\right]$. The income of household i in period h, $P_{i,h}$, is then the sum of non-labor income a_i (such as government subsidies, returns from financial assets or real estate) plus the expected labor income of each of the k adult members of household i, $P_{k,i,h}$:

$$2)\ P_{i,h} = a_i + \textstyle\sum_k lfp_{k,i,h} P_{k,i,h}, \text{ with } P_{k,i,h} = G_{k,i,h} W_{k,i,t} (1 - u_{k,i,h} + u_{k,i,h} RR_{k,i,h}),$$

which is used to obtain an estimate of the present discounted value of all future earnings $FE_{i,t}$. The value of future earnings can be decomposed as the sum of the discounted non-labor earnings ($FENL_{i,t} = \sum_{h=S(t,i)}^{T_t} \frac{a_i}{(1+r)^{h-S(t,i)}}$) plus the discounted labor earnings of the household ($FEL_{i,t} = \sum_k \sum_{h=S(t,i)}^{R_k-1} \frac{lfp_{k,i,h} P_{k,i,h}}{(1+r)^{h-S(t,i)}}$) until the retirement age of each k member R_k: $FE_{i,t} = FENL_{i,t} + FEL_{i,t}$. In Chile, currently the retirement age R_k is 65 for men and 60 for women.

Contributory pension wealth is obtained as the sum of the value of the past pension contributions since workers joined the labor force at age 25 plus the present value of the future pension contributions until the retirement age R_k. Let $\tilde{cr}_{k,t} \equiv \left\{cr_{t-S(t,k)+25}, .., cr_{t-S(t,k)+R_k}\right\}$ denote the vector of all the personal contribution rates (cr_t) that worker k faced during his lifetime. In Chile only formal workers are obliged to make pension discounts. Although informal workers are allowed to make pension discounts, few of them do so (Berstein 2010). Therefore the probability of the worker k making a pension discount at time t, $pc_{k,i,t}$, is equal to the probability of being in the labor force times the probability of doing formal work, $pc_{k,i,t} = lfp_{k,i,t} \times fw_{k,i,t}$, with $fw_{k,i,t} = \Pr(FW_{k,i,t} = 1 \mid x_{k,i,t})$, giving a present value of household pension wealth $PW_{i,t}$ as the sum of individual k members wealth $PWI_{k,t}(\tilde{cr}_{k,t}, R_k)$:

3) $PW_{i,t} = \sum_k PWI_{k,t}(\tilde{cr}_{k,t}, R_k)$, with

4) $PWI_{k,t} = \sum_{h=25}^{S(t,k)-1} cr_{t-h+S(t,k)} \bar{r}_h pc_{k,i,t} \min(mc_t, P_{k,i,h}) + \sum_{h=0}^{R_k-S(t,k)} cr_{t+h} \beta^h pc_{k,i,t} \min(mc_t, P_{k,i,h})$,

with contributions applied until a maximum income level of mc_t (this value corresponds to 78.3 UF as a monthly wage[5], which in a year would correspond to 12 times such an amount). Between 1981 until 2020 the contribution rate has been 10% ($cr_t = 0.10$), although several policy discussions have proposed for increases to 13% or 16%, with a political agreement on the exact pension reform still lacking. $\bar{r}_h = \prod_{l=t+h-S(t,i)}^{t-1} (1 + r_l)$ is the accumulated real asset returns of the Chilean pension system between the past period $t + h - S(t, i)$ when the worker made its pension contribution and the current time t. Since real asset returns r_l are already observed for past periods $l \leq t - 1$, then I use their realized historical values instead of a constant expected return. It is assumed that the future accumulated pension contributions earn the riskless interest rate, $r = \beta^{-1} - 1 = 0.04$.

When each member k from the household i retires at age R_k in year t, its accumulated pension turns into a monthly annuity for their life, $\tilde{pa}_{k,t}(R_k) = \dfrac{rPWI_{k,t}(1/\beta)^{R_k-S(t,k)}}{1-(1/\beta)^{-12\times(T_{k,t}-R_k)}}$. Note that $PWI_{k,t}(1/\beta)^{R_k-S(t,k)}$ represents the expected value of member k's contributory pension wealth at the retirement age R_k. Each member of a family within the three lowest quintiles of income (denoted by the dummy variable SB_i) is also entitled to receive exogenous welfare benefits $B(\tilde{pa}_{k,t}(R_k))$ from the government ("Solidarity Pensions") as a complement for low pensions after the solidarity

[5] UF is a real monetary unit in Chile, updated according to the official consumer price inflation (CPI) index. 1 UF was roughly equivalent to 35.7 USD during the first three quarters of 2020.

retirement age R_S (which currently is 65 for both men and women). The Solidarity System gives each member k one basic pension BP which is the lowest value for all pensions and then reduces this payment at the rate of $\frac{BP}{MP}$ until it reaches a maximum pension equal to MP: $pa_{k,t}(R_k) = \tilde{p}a_{k,t}(R_k) + B(\tilde{p}a_{k,t}(R_k))$, with $B(\tilde{p}a_{k,t}(R_k)) = (BP - \frac{BP}{MP}\tilde{p}a_{k,t}(R_k)) \times 1(MP > \tilde{p}a_{k,t}(R_k))$. BP and MP are calibrated as 82,058 and 266,731 pesos, respectively[6]. Therefore the household's non-contributory pension wealth $SPW_{i,t}$ is given by:

$$5)\ SPW_{i,t} = 12 \times SB_i \sum_k \beta^{R_S - S(t,k)} \sum_{h=0}^{T_{k,t}-R_S} \beta^h B(\tilde{p}a_{k,t}(R_k)).$$

Assuming for simplicity that the utility function $u(C_{i,h})$ has continuous derivatives ($u'(.) > 0, u''(.) < 0$) and agents have no uncertainty about their life paths and no binding liquidity constraints, the maximum conditions for the consumption Euler equation gives a constant consumption over time: $u'(C_{i,h}) = \beta(1+r)u'(C_{i,h+1}) = u'(C_{i,h+1})$, which with $(1+r) = \beta^{-1}$ implies $C_{i,h} = C_{i,h+1} = ... = C_{i,T_t}$. Previous literature has used either a log utility of consumption ($u(c) = \ln(c)$) as in Attanasio and Rohwedder (2003) or a constant relative risk aversion (CRRA) utility function ($u(c) = \frac{c^{1-\eta}-1}{1-\eta}$) as in Attanasio and Brugiavini (2003), but the constant consumption decision is the outcome whatever utility function is chosen, as long as it has continuous second derivatives and the framework has no uncertainty and no credit constraints. Obviously, the assumptions of no uncertainty and no credit constraints are quite restrictive, therefore this approach must be seen only as a rough approximation to the true optimization behavior (Attanasio and Weber 2010). The solution to this problem gives current consumption as a multiple of the present value of financial wealth and their future earnings (Attanasio and Brugiavini 2003):

$$6)\ C_{i,t} = \frac{1}{\sum_{h=S(t,i)}^{T_t} \beta^{h-S(t,i)}} (PW_{i,t} + SPW_{i,t} + FE_{i,t}).$$

Also, the empirical model includes demographic characteristics $z_{i,t}$ which may affect consumption decisions. However, the variable of expenditures in absolute level may be harder to deal empirically and it is less representative of the typical consumer in the economy, since the least squares model would implicitly give a higher weight to minimizing the consumption error of a few rich households reporting very high values of expenditures. Therefore, as in Attanasio and Brugiavini (2003)

[6] These values are in pesos of 2012, when the Pension System reached its current state. The values are updated for the UF variation between 2012 (22840 pesos) and 2017 (26798 pesos), the year of the most recent EPF.

and Attanasio and Rohwedder (2003), I estimate a simple empirical model for the saving rate, $SR_{i,t} = \frac{Y_{i,t} - C_{i,t}}{P_{i,t}}$, with $Y_{i,t}$ being the current income reported by the household. The saving rate is defined as a ratio in terms of the permanent income to avoid households with very low values of current income reporting saving rates close to minus or plus infinity. As a robustness check I also estimate the saving rate of permanent income: $SRP_{i,t} = \frac{P_{i,t} - C_{i,t}}{P_{i,t}}$. I can then estimate an empirical regression for the saving rate including other observable covariates $z_{i,t}$ (such as demographics and household size, as suggested in Attanasio and Weber 2010) plus an unobservable factor $\varepsilon_{i,t}$ (such as an unpredictable expenditure or an unobserved taste for consumption):

$$7)\ SR_{i,t} = \theta z_{i,t} + \gamma \frac{DTW_{i,t}}{P_{i,t}} + \varepsilon_{i,t},$$

with the discounted value of the total wealth ($TW_{i,t} = PW_{i,t} + SPW_{i,t} + FE_{i,t}$) being $DTW_{i,t} = SD_{i,t}(PW_{i,t} + SPW_{i,t} + FE_{i,t})$, where $SD_{i,t}$ is the sum of the discount factors over the life of the agent $SD_{i,t} = \frac{1}{\sum_{h=S(t,i)}^{T_t} \beta^{h-S(t,i)}}$. It is expected $\gamma = -1$ if the simple life-cycle model is true (Attanasio and Brugiavini 2003, Attanasio and Rohwedder 2003).

In a similar way, I define the discounted value of the future earnings wealth, $DFE_{i,t} = SD_{i,t}FE_{i,t}$, the discounted value of the contributory pension wealth, $DPW_{i,t} = SD_{i,t}PW_{i,t}$, and the discounted value of the solidarity pension wealth, $DSPW_{i,t} = SD_{i,t}SPW_{i,t}$. As suggested in the previous literature (Attanasio and Weber 2010, Attanasio and Brugiavini 2003, Attanasio and Rohwedder 2003), households may treat private or contributory pension wealth differently way from the pensions freely provided by the government. For this reason I estimate a model with all the three components of discounted total wealth ($DTW_{i,t} = DPW_{i,t} + DSPW_{i,t} + DFE_{i,t}$) separately:

$$8)\ SR_{i,t} = \theta z_{i,t} + \gamma_1 \frac{DPW_{i,t}}{P_{i,t}} + \gamma_2 \frac{DSPW_{i,t}}{P_{i,t}} + \gamma_3 \frac{DFE_{i,t}}{P_{i,t}} + \varepsilon_{i,t}.$$

It is worthwhile noting that while the traditional life-cycle model expects the equality of $\gamma = \gamma_1 = \gamma_2 = \gamma_3 = -1$, this may not necessarily be the behavior of the real agents. In fact, if all agents behaved rationally as in this simple life-cycle model, then there should be no role for social-security and retirement benefits, since each agent would optimally save for its retirement. Instead of providing retirement benefits, the governments could give lump-sum transfers to each agent now as a means for income compensation and then each agent would optimally save for the future. The fact that most governments impose mandatory social security contributions for all workers can be justified if some fraction of the agents are not rational savers and suffer from cognitive limitations, commitment problems (Attanasio and Weber 2010) or temptation (Laibson et al. 1998, Attanasio and Weber 2010). Therefore in a world where many agents suffer substantial uncertainty or are either non-rational consumers or credit constrained (Attanasio and Weber 2010), then it is to be expected that $|\gamma| < 1$. Quantifying this relationship is therefore important to evaluate the impact of reforms to the pension system on savings (Attanasio and Brugiavini 2003).

The saving rates of current ($SR_{i,t} = \dfrac{Y_{i,t} - C_{i,t}}{P_{i,t}}$) and permanent income ($SRP_{i,t} = \dfrac{P_{i,t} - C_{i,t}}{P_{i,t}}$) correspond to the voluntary savings behavior of the household out of its disposable net income. It is also convenient to obtain the total savings rate for the current and permanent income, $TSR_{i,t}$ and $TSRP_{i,t}$, which account for the compulsory savings ($CS_{i,t}$) that each worker k makes to the social security system with a probability $pc_{k,i,t}$ (which equals the probability of being in the labor force times the probability of doing formal work, $pc_{k,i,t} = lfp_{k,i,t} \times fw_{k,i,t}$) at a contributory rate cr_t (equal to 0.10 in Chile) which is applied to a maximum contributory income of mc_t:

9) $TSR_{i,t} = SR_{i,t} + CS_{i,t}$, with $CS_{i,t} = cr_t \sum_k pc_{k,i,t} \min(mc_t, P_{k,i,h})/P_{i,t}$,

10) $TSRP_{i,t} = SRP_{i,t} + CS_{i,t}$.

The total household savings rates, $TSR_{i,t}$ and $TSRP_{i,t}$, are by definition bigger than the voluntary savings rates, due to the addition of the compulsory savings $CS_{i,t}$. However, these two concepts are useful because some of the future policy reforms being discussed in Chile may change not only the voluntary savings ($SR_{i,t}$ and $SRP_{i,t}$), but also increase the compulsory contributions ($CS_{i,t}$). Therefore the total household savings may reflect a more complete view of the alternative reforms' impact, which is not captured solely by examining the voluntary component.

2.4 Robustness checks to the main regression model

Finally, I conduct other robustness checks to the main model. The model can also be estimated by decomposing the role of future earnings wealth ($DFE_{i,t}$) into wealth from the separate components of future earnings from labor ($DFEL_{i,t} = SD_{i,t}FEL_{i,t}$) and future earnings from non-labor sources ($DFENL_{i,t} = SD_{i,t}FENL_{i,t}$). Given that non-labor earnings are given by the sum of earnings from properties' rent ($rent_i$), government transfers ($transfers_i$), and financial assets' returns ($FinAssets_i$), their effect can be further decomposed into the discounted flow of consumption of these three non-labor components: $DFE{-}rent_{i,t} = SD_{i,t}FE{-}rent_{i,t} = SD_{i,t}\sum_{h=S(t,i)}^{T_t}\frac{rent_i}{(1+r)^{h-S(t,i)}}$, $DFE{-}transfers_{i,t} = SD_{i,t}FE{-}transfers_{i,t} = SD_{i,t}\sum_{h=S(t,i)}^{T_t}\frac{transfers_i}{(1+r)^{h-S(t,i)}}$, $DFE{-}FinAssets_{i,t} = SD_{i,t}FE - FinAssets_{i,t} = SD_{i,t}\sum_{h=S(t,i)}^{T_t}\frac{FinAssets_i}{(1+r)^{h-S(t,i)}}$. Note that the rent from properties, $rent_i$, includes both the cash income from properties rented to others and also the implicit income from the properties that you use for living (since in this case the fact that you are using your own house saves you the money of paying rent to someone else). Furthermore, I also estimate the model with further controls such as a dummy for whether the household head is an informal worker ($ILFP_{i,t}$). These robustness checks make sense, because households can have different propensities to consume out of distinct components of the non-labor earnings, with some components such as transfers being more liquid than property rent, for instance. Furthermore, it is possible that household heads that are informal workers can be different from the other agents not just in terms of their future earnings ($FE_{i,t}$), contributory pension wealth ($PW_{i,t}$) and solidarity pension wealth ($SPW_{i,t}$), but also in the sense of their consumption patience, exhibiting a lower preference for saving.

A second robustness check is to separate the effect of the contributionary pension wealth ($DPW_{i,t}$) into an effect coming from the pension wealth already accumulated until the present ($DPW - current_{i,t} = SD_{i,t}PW - current_{i,t}$) and an effect from the pension wealth that is expected to accumulate from future contributions ($DPW - future_{i,t} = SD_{i,t}PW - future_{i,t}$). This robustness check can be justified if, for instance, the households have more centainty about the pension wealth already accumulated and prefer to consume out of such wealth rather than contributory wealth that is more uncertain in the sense of depending on future wages and pension returns. These variables are simply a sum over all the household members of the two components for the past and future pension contributions that are explained in equation 4):

11) $PW - current_{i,t} = \sum_k \sum_{h=25}^{S(t,k)-1} cr_{t-h+S(t,k)}\bar{r}_h pc_{k,i,t}\min(mc_t, P_{k,i,h})$,

12) $PW - future_{i,t} = \sum_k \sum_{h=0}^{R_k-S(t,k)} cr_{t+h}\beta^h pc_{k,i,t}\min(mc_t, P_{k,i,h})$.

A third robustness check is to include other variables in the vector $z_{i,t}$, which controls for the monthly permanent income ($\ln(\frac{1}{12}P_{i,t})$), income surprises of current income relative to permanent income ($(Y_{i,t} - P_{i,t})/P_{i,t}$, a measure of liquidity frictions), plus demographics and household size. Since demographics such as ageing, the presence of children or the care for older relatives tend to be exogenous expenditure shocks (Attanasio and Weber 2010), all the regressions include in the vector $z_{i,t}$ the dummies for the age of the household head (5 year age dummies from age 25-29 until 60-64), plus dummies for whether the household has a couple, a dummy for the presence of one child or more aged 0 to 18, a dummy for whether the female partner in the household is employed, a dummy for whether there are any senior members aged 65 or more in the household, and a dummy for whether the household resides outside of the metropolitan capital region. However, I add more variables as a robustness check, such as the covariance beta between the pension fund returns (rPF_t) and the consumption pricing kernel returns (rCK_t) with the unemployment rate $u_t(x_k)$ and labor income volatility of the household head's occupation $\sigma_t(x_k)$. The pension fund returns (rPF_t) represents the return on the overall pension wealth of the households (including risky assets such as equity, foreign assets, and riskless assets such as government bonds), while the consumption pricing kernel represents the riskless interest rate or the stochastic discount rate of the agents over different time periods or stages of the business cycle (Campbell 2018).

The pension fund returns rPF_t is given by the real rate of return of the Pension Fund C[7], with data available from the Chilean Superintendency of Pensions. The vector x_k for each worker k of household i consists of 538 distinct types of workers, given by $x_k \in$ {Santiago Metropolitan area or not, Industry (primary, secondary, tertiary sectors), Formal sector, Gender, Age (3 brackets, ≤ 35, $35-54$, ≥ 55), Education (secondary school or less, technical degree, college), and Household Income quintile}. These Betas are obtained from performing the linear regressions:

13.1) $rPF_t = \alpha_k + \beta^{rPF,u(x_k)} u_t(x_k) + \varepsilon_k$, estimated at a quarterly frequency from 1990 to 2016,

13.2) $rPF_t = \tilde{\alpha}_k + \beta^{rPF,\sigma(x_k)} \sigma_t(x_k) + \tilde{\varepsilon}_k$, estimated at an annual frequency from 1990 to 2016,

13.3) $rCK_t = \dot{\alpha}_k + \beta^{rCK,u(x_k)} u_t(x_k) + \dot{\varepsilon}_k$, estimated at a quarterly frequency from 1996 to 2016,

13.4) $rCK_t = \ddot{\alpha}_k + \beta^{rCK,\sigma(x_k)} \sigma_t(x_k) + \ddot{\varepsilon}_k$, estimated at an annual frequency from 1996 to 2016.

The reason why these regressions are performed for different time windows is because the

[7] The fund C is the default fund that is chosen for the Chilean workers, unless they prefer another fund (Berstein et al. 2013). It is the largest and the oldest fund in existence for the Chilean pension system. The fund C exists since 1982, while the other pension funds were only created after 2000 and therefore represent a much shorter time series.

Table 1: Betas of the worker types' unemployment rate $u_t(x_k)$ and wage volatility $\sigma_t(x_k)$ relative to pension returns (rPF_t) and consumption pricing kernel returns (rCK_t) across the Chilean population

Percentiles	$\beta^{rPF,u(x_k)}$	$\beta^{rPF,\sigma(x_k)}$	$\beta^{rCK,u(x_k)}$	$\beta^{rCK,\sigma(x_k)}$
p5	-0.085	-0.018	-0.026	-0.045
p10	-0.058	-0.007	-0.017	-0.028
p25	-0.028	0.000	-0.008	-0.014
p50	-0.001	0.012	-0.002	-0.004
p75	0.024	0.030	0.005	0.007
p90	0.075	0.057	0.012	0.029
p95	0.119	0.072	0.017	0.054

All values are weighted for the population value of each worker type at the national level.

time series is because the unemployment rate for each type of worker $u_t(x_k)$ is calculated from the quarterly Chilean Employment Survey, but the measure of income volatility $\sigma_t(x_k)$ is only available for the fourth quarter of each year and therefore is available only with an annual frequency since 1990 (Madeira 2015). The pension fund real rate of return series is available at a monthly rate since 1982, therefore it can be calculated for quarterly or yearly averages for any period. The consumption pricing kernel returns for the representative agent's appropriate real interest rate (Campbell 2018) are obtained from quarterly series for the aggregate consumption of households in Chile (available from the time series of National Accounts at the Central Bank of Chile's website at a quarterly frequency since 1996), being computed as: $rCK_t = \frac{1}{\beta}(\frac{\ln(C_t)}{\ln(C_{t-1})})^{\gamma} - 1$, with the standard calibration $\beta = 0.96$, $\gamma = 1.5$ and C_t being the aggregate real consumption of households. The estimated series rCK_t is quarterly and can therefore be used in both quarterly or yearly averages.

Overall, the betas of the returns series with the worker types' unemployment and labor income volatility measure how correlated labor income can be with asset returns (Campbell and Viceira 2002, Benzoni et al. 2007). Table 1 shows that unemployment and labor income volatility have a low correlation with aggregate asset returns, with Betas ranging from a low of -8.5% to a maximum of 11.9%. This result matches the standard model assumption about human capital and labor income being uncorrelated with financial investments (Campbell and Viceira 2002).

Another possible robustness check would be to consider different growth rates for specific types of earnings. For instance, there could be different growth rates for the earnings coming from transfers, rents or financial assets. In such a case each wealth term would be instead given as a result of a growing annuity: $\frac{1}{r-g}(1 - (\frac{1+g}{1+r})^n)$, with g being the constant real growth rate of the payments, $r = \beta^{-1} - 1 = 0.04$ and $n = T_t - S(t,i)$. If one would want to correct the value of the wealth stocks for this growth rate, then one could multiply the wealth stocks by the growth annuity and divide it by a no-growth annuity, which gives: $\frac{r}{r-g}\frac{(1+r)^n-(1+g)^n}{(1+r)^n-1}$. I do not consider this adjustment to the wealth ratios, because it is difficult to calibrate in practice. One could consider that rent or transfers may grow at a real rate of 1% or 2% or more, although a higher rate than 4% is unlikely because with a riskless interest rate of 4% then a higher growth of earnings would also denote earnings with some level of risk. However, it is highly uncertain which growth rate, whether 1% or 2% or another value, is reasonable for each component of earnings. Even if it was easy to find a growth rate for transfers and rents, for instance, then one could also consider that this growth would have an effect on the optimal consumption through a trend in the habit formation channel (Campbell 2018). Note, for instance, that most of the rental income ($rent_i$) consists of the own rent that households are getting from the property where they live in or a second property that provides an implicit income in terms of vacation services, but then this implicit income is both earned and consumed by the households (Attanasio and Weber 2010). Furthermore, note that the empirical model allows for enough flexibility that the discounted consumption flow of each wealth[8] component is already multiplied by a coefficient γ, which can be larger if the agents consider that the stock of wealth is in fact higher than the zero-growth assumption taken in the calibration of this paper. For this reason, I prefer to keep the no-growth calibration for the non-labor earnings components. The labor earnings components ($lfp_{k,i,h},\ P_{k,i,h}$) already consider some growth, because the labor force participation and the permanent income of each worker type x_k changes with age categories.

2.5 Data on households' consumption, labor participation and income risk

To estimate the saving rate model I use the Chilean Expenditure Survey (*Encuesta de Presupuestos Familiares*, hence EPF) wave of 2017, which covers an exhaustive list of expenditures on over 1,668 types of goods from both receipts and memory reports elicited over several interviews for 15,239 households. 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 (expansion factors),

[8] The discounted wealth measure turns the wealth stock into a consumption flow that would be obtained by a rational agent with no credit frictions by multiplying the wealth by the value $SD_{i,t} = \frac{1}{\sum_{h=S(t,i)}^{T_t} \beta^{h-S(t,i)}}$.

due to a higher probability of selecting poorer urban areas, therefore all the population statistics in this paper are estimated with population weights. Exercises in an online appendix show that all the results are robust to using a pooled cross-section of all the previous survey waves since 1997.

Using the Chilean Employment Survey (ENE), I estimated the labor force participation, formal work, income growth, and unemployment risk parameters ($lfp_{k,i,t}, fw_{k,i,t}, G_{k,i,t}, u_{k,i,t}, RR_{k,i,t}$), using the methodology in Madeira (2015), with around 500 mutually exclusive worker types given by the characteristics $x_k \in \{$Santiago Metropolitan area or not, Industry (primary, secondary, tertiary sectors), Formal sector, Gender, Age (3 brackets, ≤ 35, $35-54$, ≥ 55), Education (secondary school or less, technical degree, college), and Household Income quintile$\}$. These parameters are then used to calibrate the present value of future earnings $FE_{i,t}$ and pension wealth ($PW_{i,t} + SPW_{i,t}$).

The vector $z_{i,t}$ includes demographics and labor income volatility ($\sigma_{i,t}$). Demographic variables account for shocks to household expenditures over the life-cycle such as aging, marriage and children (Gourinchas and Parker 2002) and help to control for measurement error in estimates of financial wealth and future earnings (Attanasio and Brugiavini 2003). Using the Chilean Employment Survey (ENE) and the same worker types k (Madeira 2015, 2019a), I obtain the labor income volatility of each household i given by a weighted average according to the permanent labor income of each member: $\sigma_{i,t} = \sum_k \frac{P_{k,i,t}}{\sum_h P_{h,i,t}} \sigma_{k,i,t}$. The coefficient of labor income volatility $\sigma_{i,t}$ is expected to be positive due to precautionary savings motives (Gourinchas and Parker 2002).

Finally, to calculate the savings and pensions for each cohort retiring between 2018 until 2055, then each year uses the life expectancy estimates after age 60 for each gender in Chile to obtain the values of $T_{k,t}$ and adjusts the population weights as follows: $w_{i,t} = w_i^{EPF} \frac{Pop_t(s_i, age_i)}{Pop_{2017}(s_i, age_i)}$, with w_i^{EPF} denoting the original EPF weights in 2017 and $Pop_t(s_i, age_i)$ being the number of people in each sex-age bracket. Life expectancy $T_{k,t}$ and population by sex-age $Pop_t(s_i, age_i)$ for each year t are obtained from United Nations estimates (ECLAC 2020).

3 Estimating the effect of pension wealth on saving rates

Like in the previous literature (Gourinchas and Parker 2002, Attanasio and Weber 2010, Attanasio and Brugiavini 2003, Attanasio and Rohwedder 2003) I restrict the consumption and saving analysis to households during their prime working-life, that is, those aged 25 to 64, since after 65 most households are already retired and dis-saving out of their accumulated wealth. Table 2 shows the characteristics of the household heads in the EPF 2017 by age brackets. The saving rates out of current income ($SR_{i,t} = \frac{Y_{i,t} - C_{i,t}}{P_{i,t}}$) tend to be negative, because sample averages count households in the same way[9] and some households of low income have highly negative saving rates. However, saving rates out of permanent income ($SRP_{i,t} = \frac{P_{i,t} - C_{i,t}}{P_{i,t}}$) are positive, especially after considering the compulsory contributions for social security ($TSRP_{i,t} = SRP_{i,t} + CS_{i,t}$).

Younger households (aged 25-29 and 30-39) have the highest values of total wealth ($TW_{i,t}/P_{i,t}$), which is due to high values of future earnings of labor ($FE_{i,t}/P_{i,t}$). Note that this does not mean that younger households are richer in terms of financial wealth (such as cash in their deposit accounts), since all the value in the wealth measure presented comes from the households' implicit human capital which is measured in terms of the present value of future earnings ($FE_{i,t}/P_{i,t}$) plus the pension wealth through compulsory contributions ($PW_{i,t}/P_{i,t}$) or solidarity funds ($SPW_{i,t}/P_{i,t}$). Therefore all the wealth measures are presented in terms of a present value from a life-cycle perspective that considers all lifetime income (Attanasio and Weber 2010, Attanasio and Brugiavini 2003, Attanasio and Rohwedder 2003), rather than from a wealth already accumulated in some financial account. Since Chile has a low compulsory contribution rate of 10% (among the lowest in the OECD), then most of the wealth of households comes from future labor earnings rather than from future pensions, especially for younger households. However, young households have the lowest values for the compulsory pension ($PW_{i,t}/P_{i,t}$) and the solidarity pension ($SPW_{i,t}/P_{i,t}$) wealth, which is due to older households having received high returns ($\bar{r}_t$) for their pension wealth portfolio in previous decades: the real pension returns of 7.6% in previous decades were far above the 4% riskless interest rate (equal to $1/\beta - 1$) which is considered for the future. Agents are expected to consume only a small portion of their wealth in each period equal to $SD_{i,t} = (\sum_{h=S(t,i)}^{T_t} \beta^{h-S(t,i)})^{-1}$. Young households still have many years left in their life, therefore they consume lower fractions of their lifetime wealth. However, even older households (aged 60-64) are expected to live above 80 years and therefore consume a small fraction of their wealth.

In terms of the non-labor earnings, Table 2 shows that rents are the main component, representing 80% of the overall non-labor earnings and being more than 4 times bigger than transfers. Income from non-pension financial assets is almost negligible across all the age cohorts. This makes sense,

[9] National Accounts sum the value of monetary transactions, therefore aggregate economy values are implicitly weighted by the total amount of income and savings of each agent.

because only 25.1% of the households have financial assets (Madeira 2022).

Households with heads of age 25-29 have the highest education levels, but also the lowest income and highest unemployment. Curiously, the volatility of permanent income is U-shaped, being high for young households (aged 25-29) and then increasing substantially for the older households (aged 50-59 and 60-64). Households of all ages are likely to be married or with a living partner, with more than 75% of marriage or co-living arrangements for households in each bracket. However, the presence of children is more common among ages 30 to 49, while the presence of senior aged members (those above age 65) is below 10% for most age brackets, except for those aged 60-64 (which sometimes have older spouses, as well). Only around 50% of the female spouses/partners are employed, which matches aggregate statistics that show female labor participation in Chile is still around 50% (Madeira 2015, Blagrave and Santoro 2017).

Table 3 shows the results of the empirical model of expenditures for the saving rate out of current income ($SR_{i,t} = \frac{Y_{i,t}-C_{i,t}}{P_{i,t}}$). Model 1 estimates the most basic lifecycle model as shown in equation 7), therefore it only includes demographics and the discounted total lifetime wealth ($\frac{DTW_{i,t}}{P_{i,t}}$). Model 2 adds different saving rates according to the permanent income of the household (measured at the monthly level, $\ln(\frac{1}{12}P_{i,t})$), since a substantial literature shows that richer households save more, Dynan et al. 2004). It also adds a propensity to save out of current income surprises ($\frac{Y_{i,t}-P_{i,t}}{P_{i,t}}$). Model 3 includes wage volatility and decomposes total wealth ($\frac{DTW_{i,t}}{P_{i,t}}$) into labor wages ($\frac{DFEL_{i,t}}{P_{i,t}}$), non-labor earnings ($\frac{DFENL_{i,t}}{P_{i,t}}$), and pension wealth ($\frac{DPW_{i,t}+DSPW_{i,t}}{P_{i,t}}$) separately. Model 4 decomposes the effect of the pension wealth into the personal contributory pension wealth ($\frac{DPW_{i,t}}{P_{i,t}}$) and solidarity wealth ($\frac{DSPW_{i,t}}{P_{i,t}}$) components. Model 5 further decomposes the effect of the contributory pension wealth ($\frac{DPW_{i,t}}{P_{i,t}}$) into already accumulated wealth ($DPW - current_{i,t}/P_{i,t}$) and wealth that is expected to be contributed in the future ($DPW - future_{i,t}/P_{i,t}$). Finally, model 6 decomposes the effect of non-labor earnings ($\frac{DFENL_{i,t}}{P_{i,t}}$) into rents ($\frac{DFE-rent_{i,t}}{P_{i,t}}$), transfers ($\frac{DFE-transfers_{i,t}}{P_{i,t}}$) and financial assets' income ($\frac{DFE-FinAssets_{i,t}}{P_{i,t}}$). Models 5 and 6 further include a dummy for informal labor force participation and the betas for the covariance of unemployment and wage volatility with asset fund returns. All models include dummies for the age of the household head, region, couples, children, senior adults, and female spouse employment.

The results show that households save around 70% of their income surprises and that saving rates increase with monthly permanent income. Couples and households with children have lower saving

Table 2: Characteristics of the EPF 2017 families by age of its household head (all values in %)

Variables (mean values)	25-64	25-29	30-39	40-49	50-59	60-64
Saving Rates (as a share of permante income):						
$SR_{i,t} = \dfrac{Y_{i,t} - C_{i,t}}{P_{i,t}}$	-21.3	-23.5	-17.9	-21.7	-22.2	-23.6
$SRP_{i,t} = \dfrac{P_{i,t} - C_{i,t}}{P_{i,t}}$	3.3	-1.2	3.7	1.3	5.3	4.5
$TSR_{i,t} = SR_{i,t} + CS_{i,t}$	-15.7	-17.2	-12.0	-16.0	-16.6	-19.1
$TSRP_{i,t} = SRP_{i,t} + CS_{i,t}$	8.9	5.2	9.6	7.0	10.8	9.0
Wealth ratios over permanent income:						
$TW_{i,t}/P_{i,t}$	1199.4	1909.6	1752.7	1251.5	828.4	485.7
$FEL_{i,t}/P_{i,t}$	945.7	1746.3	1553.6	1012.7	516.4	187.2
$FENL_{i,t}/P_{i,t}$	194.9	222.0	240.8	233.2	162.5	78.7
$PW_{i,t}/P_{i,t}$	211.5	145.2	177.0	204.8	258.6	208.9
$SPW_{i,t}/P_{i,t}$	42.2	18.1	22.1	34.0	53.3	89.5
Discounted wealth ratios (or consumption flow from the wealth): $SD_{i,t}Wealth/P_{i,t}$						
$SD_{i,t} = (\sum_{h=S(t,i)}^{T_t} \beta^{h-S(t,i)})^{-1}$	5.2	4.3	4.5	4.9	5.6	6.6
$DTW_{i,t}/P_{i,t}$	58.8	82.2	78.6	60.8	46.2	32.4
$DFEL_{i,t}/P_{i,t}$	45.4	75.1	69.6	49.2	28.7	12.3
$DFENL_{i,t}/P_{i,t}$	9.6	9.5	10.8	11.3	9.0	5.1
$DPW_{i,t}/P_{i,t}$	11.2	6.2	7.9	10.0	14.6	14.3
$DPW - current_{i,t}/P_{i,t}$	16.0	1.9	3.9	8.3	22.8	50.5
$DPW - future_{i,t}/P_{i,t}$	3.8	5.5	4.6	3.4	3.5	3.2
$DSPW_{i,t}/P_{i,t}$	2.3	0.8	1.0	1.7	3.0	5.9
$DFENL - rent_{i,t}/P_{i,t}$	7.7	6.0	8.4	9.0	7.6	4.4
$DFENL - transfers_{i,t}/P_{i,t}$	1.8	3.5	2.1	2.1	1.3	0.6
$DFENL - FinAssets_{i,t}/P_{i,t}$	0.1	0.1	0.2	0.2	0.1	0.1
Labor variables:						
$\ln(\frac{1}{12}P_{i,t})$	1395.4	1371.0	1397.2	1398.3	1396.1	1398.0
Labor income volatility $\sigma_{i,t}$	5.8	5.9	5.6	5.2	6.0	7.0
Unemployment (household head)	5.3	9.4	6.6	4.6	4.4	3.9
Contribution probability (head)	62.3	70.6	71.0	65.3	57.2	45.5
Education level (household head):						
Elementary education	16.0	3.6	6.4	14.6	23.1	27.6
Secondary education	42.6	34.7	38.6	44.8	47.2	38.2
Technical or Some college	12.6	16.0	12.3	14.1	11.4	11.0
College education	22.3	39.1	33.3	19.1	14.1	19.3
Post-graduate education	6.4	6.6	9.4	7.4	4.3	3.8
Household structure:						
Dummy for couple	80.8	76.2	77.6	80.4	85.0	79.6
Dummy for Children	61.3	49.7	74.4	79.2	50.3	29.1
Female spouse employed	49.1	49.9	56.8	50.0	45.3	40.4
Dummy for senior (>65)	7.6	2.4	2.9	8.0	9.1	15.8
Informal worker (head)	22.9	12.6	18.3	24.5	25.7	27.8
Fraction of households aged 25-64	100	7.2	23.6	26.6	31.8	10.9
Number of households	11111	806	2386	3074	3419	1426

rates, but senior citizens (above age 65) do not have an impact on savings, perhaps because they have pension income which they consume and also have access to state subsidized health insurance. As shown in section 2, the standard lifecycle model predicts that the coefficients of the discounted total wealth and its sub-components are negative one ($\gamma = \gamma_1 = \gamma_2 = \gamma_3 = -1$). However, as in previous empirical studies (Attanasio and Brugiavini 2003, Attanasio and Rohwedder 2003), the real agents do not really follow the standard lifecycle model. After accounting for permanent income and income surprises (model 2 and above), the discounted total wealth ($\frac{DTW_{i,t}}{P_{i,t}}$) and its largest sub-component which is the labor earnings wealth ($\frac{DFEL_{i,t}}{P_{i,t}}$) have small coefficients, which agrees with the previous empirical literature showing demographics and income to be the strongest factors in lifecycle consumption (Gourinchas and Parker 2002, Attanasio and Weber 2010). Income volatility ($\sigma_{i,t}$) is positively associated with saving rates, which is a sign of precautionary savings (Gourinchas and Parker 2002), but informal labor participation is associated to lower savings rates, perhaps due to informal households having fewer financial instruments available.

Decomposing the pension wealth into its two sub-components, the results (model 4) show that the personal contributory pension wealth ($\frac{DPW_{i,t}}{P_{i,t}}$) has a positive coefficient, which is against the traditional lifecycle theory that agents should consume their lifetime wealth, but it is consistent with empirical studies showing that the rich save more (Dynan et al. 2004, Gandelman 2017). Since personal contributory wealth is bequeathable to heirs, then wealthier agents have fewer reasons to consume it quickly (Attanasio and Weber 2010). The wealthy may also prefer to save towards some level of "target wealth" or a buffer-stock (Carroll 1997) or more due to tax incentives (Attanasio and Weber 2010). Agents do consume a substantial fraction of their solidarity wealth with a coefficient around -0.200, which is lower in absolute value than the theoretical parameter of one. This makes sense due to real world credit constraints making this wealth illiquid (Attanasio and Weber 2010). The result also coincides with previous studies showing that agents consume higher fractions of the solidarity wealth (Hubbard 1986, Gale 1998, Attanasio and Brugiavini 2003, Attanasio and Rohwedder 2003), confirming that private contributory and public solidarity wealth are not perfect substitutes. Furthermore, the result may be due to solidarity wealth offered by the government being perceived as more secure (since it is not affected by equity market returns or divorce/separation) and because it is not bequeathable (therefore it must be consumed quickly). Mode 6 also shows that agents consume a substantial fraction of their rental wealth, which makes

Table 3: The empirical household Savings Rate ($SR_{i,t} = \frac{Y_{i,t} - C_{i,t}}{P_{i,t}}$) model (EPF 2017)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Household income surprise:		0.691***	0.731***	0.728***	0.728***	0.755***
$(Y_{i,t} - P_{i,t})/P_{i,t}$		(0.0157)	(0.0160)	(0.0160)	(0.0156)	(0.0158)
Monthly household permanent		0.103***	0.112***	0.102***	0.100***	0.100***
income: $\ln(\frac{1}{12}P_{i,t})$		(0.00370)	(0.00412)	(0.00482)	(0.00481)	(0.00484)
Dummy for couple	-0.189***	-0.0996***	-0.111***	-0.109***	-0.108***	-0.0990***
	(0.00882)	(0.00850)	(0.00854)	(0.00853)	(0.00866)	(0.00870)
Dummy for children	-0.0892***	-0.0722***	-0.0612***	-0.0624***	-0.0623***	-0.0645***
in the household	(0.00684)	(0.00602)	(0.00606)	(0.00607)	(0.00605)	(0.00605)
Female spouse is	-0.0185**	-0.000250	-0.00565	-0.00335	-0.00180	0.00309
employed	(0.00761)	(0.00668)	(0.00667)	(0.00669)	(0.00690)	(0.00690)
Dummy for senior	-0.0102	0.00677	-0.00811	-0.00623	-0.0121	-0.00871
members in the household	(0.0112)	(0.00995)	(0.00990)	(0.00991)	(0.00998)	(0.00997)
Dummy for regions	-0.0162***	-0.0230***	-0.0170***	-0.0167***	-0.0144***	-0.0171***
(outside of capital)	(0.00617)	(0.00538)	(0.00541)	(0.00541)	(0.00552)	(0.00550)
Discounted	0.423***	0.0229				
total wealth: $DTW_{i,t}/P_{i,t}$	(0.0160)	(0.0163)				
Discounted labor earnings			-0.111***	-0.103***	-0.104***	-0.138***
wealth: $DFEL_{i,t}/P_{i,t}$			(0.0226)	(0.0228)	(0.0227)	(0.0227)
Discounted non-labor earnings			-0.385***	-0.360***	-0.350***	
wealth: $DFENL_{i,t}/P_{i,t}$			(0.0379)	(0.0385)	(0.0389)	
Discounted total pension wealth:			0.0688*			
$(DPW_{i,t} + DSPW_{i,t})/P_{i,t}$			(0.0357)			
Discounted contributory pension				0.0701**		
wealth: $DPW_{i,t}/P_{i,t}$				(0.0356)		
Discounted current contributory					0.0298*	0.0268*
pension w.: $DPW - current_{i,t}/P_{i,t}$					(0.0160)	(0.0157)
Discounted future contrib. pension					-0.126	-0.0437
wealth: $DPW - future_{i,t}/P_{i,t}$					(0.121)	(0.121)
Discounted solidarity pension				-0.260***	-0.232**	-0.178*
wealth: $DSPW_{i,t}/P_{i,t}$				(0.101)	(0.0966)	(0.0961)
Wage volatility: $\sigma_{i,t}$			0.119***	0.148***	0.186***	0.181***
			(0.0462)	(0.0474)	(0.0476)	(0.0477)
Informal labor force worker:					-0.0451***	-0.0439***
$ILFP_{i,t}$					(0.00711)	(0.00708)
Discounted rent wealth:						-0.583***
$DFE - rent_{i,t}/P_{i,t}$						(0.0478)
Discounted transfers wealth:						-0.0524
$DFE - transfers_{i,t}/P_{i,t}$						(0.0563)
Discounted financial income						0.335**
wealth: $DFE - FinAssets_{i,t}/P_{i,t}$						(0.139)
N	11,111	11,111	11,111	11,111	11,111	11,111
R-squared	0.133	0.341	0.349	0.350	0.354	0.358

Other controls (see Table A.1 in the appendix): 5-year household head age dummies. Models 5 and 6 add controls for the Betas between occupational unemployment $u_{i,t}$ and income volatility $\sigma_{i,t}$ with the Pension Fund and the Consumption Kernel returns.

Robust Standard-errors in (). ***,**,* denote 1%, 5%, 10% statistical significance.

sense since this wealth is often calculated as implicit consumption.

Table 4 shows the results of the empirical models of expenditures for the saving rate out of permanent income ($SRP_{i,t} = \frac{P_{i,t}-C_{i,t}}{P_{i,t}}$), with results qualitatively similar to the saving rate from current income in Table 3. In this case, surprises to current income ($\frac{Y_{i,t}-P_{i,t}}{P_{i,t}}$) have a negative effect on the permanent saving rate (around -0.33 to -0.24), which makes sense since the income surprise has no effect on permanent income but it increases consumption. Again, the results show that couples and families with children have significantly lower permanent saving rates. Total wealth ($\frac{DTW_{i,t}}{P_{i,t}}$), future labor earnings ($\frac{DFE_{i,t}}{P_{i,t}}$) and total pension wealth ($\frac{DPW_{i,t}+DSPW_{i,t}}{P_{i,t}}$) have a positive impact on savings, which is the opposite of the standard lifecycle model's predictions and perhaps a sign of agents with target stocks of wealth (Attanasio and Weber 2010) or due to a higher preference for savings among the rich (Dynan et al. 2004, Gandelman 2017). However, again the model shows that, while the personal contributory wealth ($\frac{DPW_{i,t}}{P_{i,t}}$), whether in its current or future components, is positively associated with the permanent savings rate, agents are likely to consume a substantial fraction (with a coefficient of -0.45) of their solidarity wealth ($\frac{DSPW_{i,t}}{P_{i,t}}$). Both the current ($SR_{i,t}$) and permanent ($SRP_{i,t}$) savings rates are therefore negatively impacted by solidarity wealth, implying that policy makers reforming social security must be careful to avoid depressing private savings (Feldstein 1974, Hubbard 1986, Attanasio and Brugiavini 2003). Agents also consume a substantial fraction of their future rents, financial assets' income and transfers, with transfers having a lower coefficient in absolute value due to their illiquidity.

4 Possible effects of Pension Reform alternatives

4.1 Pension legislation implemented between 2019 and 2022

After the Social Explosion on October 18th of 2019, the Chilean government implemented several policy measures to reduce the civil unrest, enhancing the Pension Solidarity System by a legislation on the December 11th of 2019 (the Law Nr 21190) establishing the minimum pension as 169649 pesos for any retired member above 65 years of age from a family within the three lowest income quintiles. The new solidarity benefits of each retiree k are now expressed as $B^{19}_{k,t} = \max(a_1 - \tilde{p}a_{k,t}(R_k), B(\tilde{p}a_{k,t}(R_k))$, therefore the solidarity wealth for $t > 2019$ and $t < 2022$ is:

Table 4: The Permanent Savings Rate ($SRP_{i,t} = \dfrac{P_{i,t} - C_{i,t}}{P_{i,t}}$) model (EPF 2017)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Household income surprise:		-0.331***	-0.289***	-0.285***	-0.248***	-0.242***
$(Y_{i,t} - P_{i,t})/P_{i,t}$		(0.0156)	(0.0158)	(0.0158)	(0.0167)	(0.0167)
Monthly household permanent		0.164***	0.178***	0.158***	0.149***	0.151***
income: $\ln(\frac{1}{12}P_{i,t})$		(0.00356)	(0.00398)	(0.00472)	(0.00481)	(0.00490)
Dummy for couple	-0.0129	-0.123***	-0.134***	-0.127***	-0.136***	-0.133***
	(0.00858)	(0.00839)	(0.00841)	(0.00840)	(0.00848)	(0.00849)
Dummy for children	-0.0882***	-0.0690***	-0.0567***	-0.0590***	-0.0609***	-0.0621***
in the household	(0.00682)	(0.00612)	(0.00617)	(0.00616)	(0.00615)	(0.00617)
Female spouse is	0.0704***	-0.00942	-0.0134**	-0.00794	-0.00806	-0.00644
employed	(0.00745)	(0.00682)	(0.00680)	(0.00684)	(0.00705)	(0.00706)
Dummy for senior	0.0451***	-0.0142	-0.0277***	-0.0234**	-0.0369***	-0.0366***
members in the household	(0.0108)	(0.00997)	(0.0100)	(0.01000)	(0.01000)	(0.0100)
Dummy for regions	-0.0347***	-0.0205***	-0.0182***	-0.0177***	-0.0165***	-0.0173***
(outside of capital)	(0.00604)	(0.00545)	(0.00547)	(0.00546)	(0.00557)	(0.00557)
Discounted	0.219***	0.233***				
total wealth: $DTW_{i,t}/P_{i,t}$	(0.0161)	(0.0149)				
Discounted labor earnings			0.0549**	0.0661***	0.113***	0.105***
wealth: $DFEL_{i,t}/P_{i,t}$			(0.0221)	(0.0222)	(0.0218)	(0.0219)
Discounted non-labor earnings			-0.395***	-0.350***	-0.329***	
wealth: $DFENL_{i,t}/P_{i,t}$			(0.0370)	(0.0376)	(0.0380)	
Discounted total pension wealth:			0.390***			
$(DPW_{i,t} + DSPW_{i,t})/P_{i,t}$			(0.0356)			
Discounted contributory pension				0.387***		
wealth: $DPW_{i,t}/P_{i,t}$				(0.0355)		
Discounted current contributory					0.105***	0.104***
pension w.: $DPW - current_{i,t}/P_{i,t}$					(0.0165)	(0.0165)
Discounted future contrib. pension					0.514***	0.542***
wealth: $DPW - future_{i,t}/P_{i,t}$					(0.129)	(0.130)
Discounted solidarity pension				-0.281***	-0.454***	-0.429***
wealth: $DSPW_{i,t}/P_{i,t}$				(0.102)	(0.0979)	(0.0979)
Wage volatility: $\sigma_{i,t}$			-0.106**	-0.0470	0.00623	0.00153
			(0.0448)	(0.0461)	(0.0465)	(0.0465)
Informal labor force worker:					-0.0274***	-0.0266***
$ILFP_{i,t}$					(0.00711)	(0.00712)
Discounted rent wealth:						-0.414***
$DFE - rent_{i,t}/P_{i,t}$						(0.0475)
Discounted transfers wealth:						-0.206***
$DFE - transfers_{i,t}/P_{i,t}$						(0.0547)
Discounted financial income						-0.387***
wealth: $DFE - FinAssets_{i,t}/P_{i,t}$						(0.134)
N	11,111	11,111	11,111	11,111	11,111	11,111
R-squared	0.054	0.234	0.244	0.248	0.248	0.249

Other controls (see Table A.2 in the appendix): 5-year household head age dummies. Models 5 and 6 add controls for the Betas between occupational unemployment $u_{i,t}$ and income volatility $\sigma_{i,t}$ with the Pension Fund and the Consumption Kernel returns.

Robust Standard-errors in (). ***,**,* denote 1%, 5%, 10% statistical significance.

14) $SPW_{i,t} = 12 \times \sum_k SB_{i,t+R_S-S(t,k)} \beta^{R_S-S(t,k)} \sum_{h=0}^{T_{k,t}-R_S} \beta^h B_{k,t}^{19}$.

However, due to persistent insatisfaction of the voters with the pension system, a new solidarity pension law with even higher benefits and greater coverage was legislated on the 29th of January of 2022 (the Law Nr 21419). This law gave all the retirees in households within the lowest 9 deciles of income (therefore almost universal coverage, except for the richest 10%) a solidarity monthly pension of 185,000 pesos for retirees with monthly pensions below 630,000 pesos and then a decreasing linear amount until the benefit reaches 0 pesos for pensions equal or above one million pesos. The new solidarity benefits of each retiree k can therefore be expressed as $B_{k,t}^{22} = b_1 1(\tilde{p}a_{k,t}(R_k) \leq b_2) + b_1(1 - \frac{\tilde{p}a_{k,t}(R_k)-b_2}{b_3-b_2})1(b_2 < \tilde{p}a_{k,t}(R_k) < b_3)$, with $b_1 = 185,000$, $b_2 = 630,000$, and $b_3 = 1,000,000$. Therefore the solidarity wealth for $t \geq 2022$ is:

15) $SPW_{i,t} = 12 \times SB_i^{22} \sum_k \beta^{R_S-S(t,k)} \sum_{h=0}^{T_{k,t}-R_S} \beta^h B_{k,t}^{22}$,

with SB_i^{22} being a dummy for whether the household i is within the lowest 9 deciles of income.

Let $pw_{k,i,t=2020}^{d=1}$, $pw_{k,i,t=2020}^{d=2}$ and $pw_{k,i,t=2021}^{d=3}$ denote respectively the amount of the first, second and third pension withdrawals, respectively. Let with $PWI_{k,t=2020}^{d=1} = PWI_{k,t=2020}$, $PWI_{k,t=2020}^{d=2} = PWI_{k,t=2020} - pw_{k,i}^{d=1}$ and $PWI_{k,t=2021}^{d=3} = PWI_{k,t=2021} - pw_{k,i}^{d=1} - pw_{k,i}^{d=2}$ denote the contributory wealth of worker k from household i before the first, second and third pension withdrawal, respectively, with $PWI_{k,t=2020}$ being given as in equation 4). The counterfactual pension wealth in 2021 corresponds to the value of 2020 plus an additional year of contributions as in equation 4): $PWI_{k,t=2021} = PWI_{k,t=2020} + cr_{2021} pc_{k,t=2021} \min(mc_{t=2021}, P_{k,t=2021})$. The value of each pension withdrawal is given by $pw_{k,i,t}^d = \min(PWI_{k,t}^d, 35UF)1(PWI_{k,t}^d \leq 35UF) + 35UF \times 1(35UF < PWI_{k,t}^d \leq 350UF) + 0.10 \times 1(350UF < PWI_{k,t}^d \leq 1500UF) + 150UF \times 1(PWI_{k,t}^d > 1500UF)$. The accumulated contributory pension wealth of worker k ($PWI_{k,t}^{d=1+2+3}$) and household i ($PW_{i,t}$) after the three withdrawals for any period from $t \geq 2022$ is given by:

16) $PW_{i,t} = \sum_k PWI_{k,t}^{d=1+2+3}$, with $PWI_{k,t}^{d=1+2+3} = PWI_{k,t} - pw_{k,i,2020}^{d=1} - pw_{k,i,2020}^{d=2} - pw_{k,i,2021}^{d=3}$.

This implies that the expected annuity pension value of each worker k after the three pension withdrawals is reduced, therefore it is now given by $\tilde{p}a_{k,t}^{d=1+2+3}(R_k) = \dfrac{rPWI_{k,t}^{d=1+2+3}(1/\beta)^{R_k-S(t,k)}}{1-(1/\beta)^{-12\times(T_{k,t}-R_k)}}$,

Table 5: Policy reform alternatives under discussion (+6% in the total contribution rate[a)])

Reform parameters	Baseline	A	B	C	D	E
Retirement age	60 women, 65 men	67 both sexes	67	67	67	67
Personal Contribution rate (cr_t)	current level: 10%	+0%	+6%	+5%	+4%	+3%
Solidarity contribution (sc_t)	current level: 0%	+0%	+0%	+1%	+2%	+3%

a) Contributions are a fraction of the income up to a maximum level of mc (79.3 UF).
All the scenarios consider the changes to the pension system between 2019 to 2022.

while the solidarity wealth ($SPW_{i,t}$) increases due to lower values of $\tilde{pa}_{k,t}^{d=1+2+3}(R_k)$ and also due to the more generous benefits from the 2022 solidarity law ($B_{k,t}^{22}$).

4.2 The possible reforms to the pension system

Several possible reforms to the Chilean pension system have been discussed over the last 10 years with the goal of increasing retirees' income, either through increased contributions or an enlargement of the solidarity system (Santoro 2017). So far, the only changes were the expansion of the Solidarity System in December of 2019 and January of 2022 described in section 4.1. However, the pension withdrawals implemented in 2020 and 2021 as a reaction to the Covid crisis have put Chile further away from the goal of increasing their future pension income.

Most reforms under discussion in the Chilean Congress propose an overall increase of 6% in the social security contributions, although with different shares in the fraction going to the personal pension accounts of the workers. Some proposals consider an increase in 6% of the contribution rate with the total amount going to the contributory wealth of the workers ($PW_{i,t}$). However, other proposals consider that at least 1% of the contributions should be destined for solidarity pension payments instead of the personal account of the worker. Some proposals even go as far as proposing an equal distribution of the increased contributions into personal accounts (+3%) and solidarity (+3%). Another reform widely discussed in Chile and other countries is the increase of the retirement age and a possible indexation to increases in life expectancy (OECD 2021). In Chile this may be particularly necessary, because the retirement age for men is 65 and for women it is 60 (which is on the low side of most countries, OECD 2021). Since the Chilean government has not yet settled its reform, Table 5 considers 6 alternatives for the possible future pension system, with the first one considering no changes in policy after 2020 (Baseline) and the second one considering just an increase of the retirement age to 67 years (A). The other four policy alternatives (B, C, D, E) all consider both an increase in the retirement age for 67 years plus an increase in contributions of 6%, although they differ in the share destined for the solidarity rate, with B destining 0% to solidarity, then positive shares of 1% (C) and 2% (D), and E destining equal amounts to personal contributions and solidarity (+3%). All the policy alternatives consider the expansion of the Solidarity system and the three pension withdrawals implemented between 2019 and 2022.

There is not yet a formula for the distribution of the solidarity funds among its possible beneficiaries. For this reason I consider an amplified scheme with beneficiaries including all retirees with a contributory pension below the minimum wage mw (currently, $mw = 326500$ monthly pesos) and from families of the lowest three income quintiles. As denoted in section 4.1, the expected contributory annuity pension value of each worker k after $t > 2022$ is given by $\tilde{pa}_{k,t}^{d=1+2+3}(R_k)$. The expected Solidarity Pension wealth of household i at time $t > 2022$ is then given by:

$$17)\ SPW_{i,t} = 12 \times SB_i \textstyle\sum_k \beta^{R_S - S(t,k)} \displaystyle\sum_{h=0}^{T_{k,t}-R_S} \beta^h (SP_k + B_{k,t}^{22}),$$

with $SP_k = \dfrac{rSPT_k}{1-(1/\beta)^{-12\times(T_{k,t}-R_k)}}$, with $SPT_k = \displaystyle\sum_{t=0}^{T_{k,t}-R_S} \beta^h e_{k,t}(MP_t - (pr_{k,t}-1))$, with $MP_t = \dfrac{SC_t}{NR_t} + \dfrac{mp-1}{2}$ and $e_{k,t}$ is a dummy variable determining whether retiree k is eligible to receive the solidarity funds, which is calibrate as $e_{k,t} = SB_i 1(\tilde{pa}_{k,t}^{d=1+2+3} < mw)$. $NR_t = \sum_k e_{k,t}$ is the total number of beneficiaries from the new solidarity revenue. SC_t is the total revenue that is collected each year from the social contributions for the solidarity system which a fraction of the labor income up until an amount mc_t (which remains constant at 79.3 UF): $SC_t = \sum_k sc_t \times pc_{k,t} \min(mc_t, P_{k,t})$. In this expression $mp = 10001$ is the total number of groups among whom the solidarity funds are distributed and $pr_{k,t}$ is the ranking of the group of retiree k among the total number of retirees that can benefit from the solidarity system. Every retiree beneficiary is classified into a group from low to higher income: $pr_{k,t} = 1, ..., mp$. The formula $e_{k,t}(MP_t - (pr_{k,t} - 1))$ therefore insures that all the solidarity revenues in each period t are spent among all the beneficiaries, with the higher income beneficiaries receiving less. The government calculates the total present value of the solidarity benefits that each retiree k has to receive (SPT_k) and then gives the retiree an equivalent annuity to that amount, SP_k. Note that the redistribution of the future solidarity benefits may not necessarily follow this formula. This is just a calibrated example of how the government could distribute the increased solidarity revenues with an amount decreasing in the retirees' income.

4.3 Counterfactual impact of the reforms on the household savings rate

Now I summarize the impact of the different policy alternatives on the savings rate of the households. To build the counterfactual effects on the current and permanent savings rate I use model 4 from Tables 3 and 4, since this model takes into account the differential impact of the personal contributory wealth and the solidarity wealth on savings (as in Attanasio and Brugiavini 2003, Attanasio and Rohwedder 2003). The model is then calibrated to take into account the effects of the pension policies implemented between 2019 and 2022 for each of the policy scenarios in Table 5, which have effects on the wealth sub-components of future earnings ($DFE_{i,t}/P_{i,t}$), personal contributory pensions ($DPW_{i,t}/P_{i,t}$) and public solidarity funds ($DSPW_{i,t}/P_{i,t}$).

For simplicity, I show only the impact for the year 2022. The reason is that the calibrated model is focused on structural household decisions, rather than the short-term frictions of the business cycle. Furthermore, the savings rate for the other future years are quite similar to the year 2022, since the only factor changing over time is the age structure of the population.

The pension withdrawals in 2020 and 2021 imply that a significant fraction of the households now have zero accumulated contribution wealth (although many of them, especially the young, may still increase their contributions in the future) and several households should expect to receive lower future pensions even if their solidarity pension wealth increases. Table 6 summarizes the average household savings rates out of current and permanent income before and after the pension withdrawals. The scenario before the pension withdrawals only considers the improvement of the Solidarity System in 2019, while the scenario after the pension withdrawals takes into account both the pension withdrawals and the new 2022 solidarity pension law. Neither scenario considers further changes to the pension system. Like in Table 2, the current saving rate ($SR_{i,t}$) for the average household is negative even if one takes into account the total savings rate ($TSR_{i,t}$) which adds the compulsory pension contributions. However, the permanent savings rate ($SRP_{i,t}$) and the total savings rate of permanent income ($TSRP_{i,t}$) are both positive for the average household, either before or after the pension withdrawals. The income weighted averages (with weights that account for both population weights and income: $w_{i,t}^{INC} = w_{i,t} \frac{P_{i,t}}{\sum_j P_{j,t}}$) take into account that richer

Table 6: Savings rate before and after the 3 pension withdrawals (in 2022), values in %
Calibration uses Model 4 from Table 3 and Table 4. Household heads aged 25 to 64.

Mean values	Voluntary Savings Rate				Total Savings Rate			
for age 25-64	$SR_{i,t} = \dfrac{Y_{i,t} - C_{i,t}}{P_{i,t}}$		$SRP_{i,t} = \dfrac{P_{i,t} - C_{i,t}}{P_{i,t}}$		$TSR_{i,t}$		$TSRP_{i,t}$	
Income quintile[a)]	Before	After	Before	After	Before	After	Before	After
1 (poor)	-39.1	-41.2	-10.4	-13.2	-35.4	-37.4	-6.6	-9.4
2	-29.0	-31.1	-3.5	-6.5	-23.6	-25.7	1.9	-1.1
3	-22.7	-24.5	2.9	0.2	-16.6	-18.4	9.0	6.4
4	-14.9	-16.2	8.8	6.7	-8.1	-9.4	15.6	13.5
5 (rich)	1.2	0.5	21.3	20.1	7.0	6.3	27.1	25.9
Household average	-20.9	-22.5	3.8	1.5	-15.3	-16.9	9.4	7.1
Income-weighted	-7.5	-8.5	14.6	12.9	-2.0	-3.1	20.1	18.4

a) Values give the averages across households in each quintile.

households have a higher impact on the overall economy (Attanasio and Weber 2010). Since richer households present higher savings rates, then the income weighted values are substantially larger than the household averages (with rich and poor counting the same).

The results show that the counterfactual saving rate of the average household fell by 1.6% and 2.3% in terms of current ($SR_{i,t}$) and permanent income ($SRP_{i,t}$), respectively. Declines are substantially larger for the poor, with a drop of the permanent saving rate of 2.8% and 3% for the quintiles 1 and 2, respectively. This result is in line with the model predictions, since these are the families with higher expectations of replacing their pension withdrawals with public solidarity funds. Even taking into account the income-weighted values, I still find a drop of 1% ($SR_{i,t}$) and 1.7% ($SRP_{i,t}$) for the current and permanent savings rates, respectively.

Table 7 summarizes the impact of the whole set of policy reforms. Delaying the retirement age to 67 only increases the average household's permanent savings rate by 0.1%. Increasing the personal contribution rate in 6% (plan B) adds a further 0.8% to the average permanent saving rate. However, decreasing the value of the personal contributions and increasing the solidarity rate in 1%, 2% and 3%, would imply a considerable reduction of the average saving rate, especially for the two lowest income quintiles (although there is also a more moderate reduction for the quintiles 3 and 4). This result makes sense, because the increasing solidarity funds are distributed among the first three income quintiles but at a declining rate with retiree income (therefore the third quintile gets the lowest amounts). In fact, the average household's average permanent savings rate and its

Table 7: Permanent savings rates under the different policies (in 2022), values in %
Calibration uses Model 4 from Table 4. Household heads aged 25 to 64.

Reform plan policy Mean values for age 25-64	Base-line	A Retire-ment at 67	B +6% contrib. +0% solida-rity	C +5% contrib. +1% solida-rity	D +4% contrib. +2% solida-rity	E +3% contrib. +3% solida-rity
Income quintile	$SRP_{i,t} = \frac{P_{i,t} - C_{i,t}}{P_{i,t}}$ (Voluntary Savings Rate)					
1 (poor)	-13.2	-13.1	-12.7	-13.2	-13.7	-14.1
2	-6.5	-6.4	-5.7	-6.0	-6.4	-6.8
3	0.2	0.3	1.3	1.0	0.8	0.5
4	6.7	7.0	8.1	7.9	7.7	7.5
5 (rich)	20.1	20.2	21.1	20.9	20.8	20.6
Household average	1.5	1.6	2.4	2.1	1.8	1.5
Income-weighted	12.9	13.0	13.8	13.7	13.5	13.3
Income quintile	$TSRP_{i,t} = SRP_{i,t} + CS_{i,t}$ (Total Savings Rate)					
1 (poor)	-9.4	-9.4	-6.6	-7.1	-7.6	-8.1
2	-1.1	-0.9	3.0	2.7	2.3	1.9
3	6.4	6.5	11.1	10.8	10.6	10.3
4	13.5	13.8	19.0	18.8	18.6	18.4
5 (rich)	25.9	26.0	30.3	30.2	30.0	29.9
Household average	7.1	7.2	11.4	11.1	10.8	10.5
Income-weighted	18.4	18.5	22.5	22.3	22.2	22.0

income weighted value with a 3% solidarity rate (plan E) are similar to the values of the plan A (with no increase in contributions). The total permanent savings rate (which adds the voluntary savings rate plus the compulsory personal contribution and the compulsory solidarity rate) also falls substantially between plan B and E, with a drop of 0.9% and 0.5% in terms of the household average and income weighted value, respectively. This exercise shows that pension policies can have a moderate impact on the household sector's saving rate, depending on how its benefits distributed.

4.4 Counterfactual simulations of the future pension incomes

Now I analyze the impact of the different reforms on the total pension (contributory plus solidarity) replacement ratio of income of the retirees k with age 67 in year t defined as: $PRatioT_{k,t} = \min(1, \frac{\tilde{p}a_{k,t}+SB_i(SP_k+B^{22}_{k,t})}{\min(mc_t,W_{k,t-1})})$, with values censored above 1 (which can happen for workers with low wages and access to solidarity funds). The pension measurement at age 67 is chosen in order to compare the same households over all the possible policy reforms. Note that the pension replacement ratios can consider either the average wage of the worker over the last few years before retirement or over its entire contributory life (OECD 2021). I consider the last wage of the worker, because it is a proxy of the potential drop in well-being at the end of active life (Attanasio and Weber 2010, OECD 2021). The denominator is censored above the maximum contributory income of mc_t (since high-income workers are limited to that maximum contribution value).

In a small sample like the EPF survey every cohort differs from previous ones in terms of characteristics such as education, income and labor force attachment, therefore the cohort lines by sex and household income quartile[10] are not as smooth as the stock of the entire population of retirees or a representative agent that is kept the same over time. Calibrating a set pre-specified agents has the advantage of showing the mathematical impact of the change in policy parameters in a clean way. However, showing only a few pre-specified agents has the disadvantage of ignoring that new generations may differ from previous ones, since the younger generations have more education and a higher female labor force attachment. Therefore the analysis in this section has the advantage of showing how the pension policy reforms may play out in Chile by also taking into account that cohorts by sex-quartile may differ over time across a wide range of characteristics.

[10] Pension income quartiles are used to divide the sex-cohorts into 4 groups. The household pension income quartiles are calculated for the population of retirees (not the total population of households).

Future generations may face longer life expectancies (which decreases pensions), but may also have higher labor force participation and less informal jobs (which increases pensions).

Figure 1 plots the pension replacement ratios in the Baseline framework, under Plan A (with a delaying of the retirement until age 67 for both genders) and Plan B (which also increases contributions by 6%) for each retiree cohort until 2055. In terms of the Baseline, the most striking feature is that the replacement ratios of both men and women above the median income (quartiles 3 and 4) are expected to fall substantially, while those of the lower quartiles (1 and 2) will increase until 2055. For the men from households in the quartile 4 (the highest income households) and 3 (those in the percentiles 50 to 75), the Baseline's replacement ratio between 2025 and 2055 is expected to fall from 70% to 62% and from 61% to 57%, respectively. For men in the quartile 2, the Baseline's replacement ratio grows from 53% in 2025 to 59% in 2039 and then fluctuates until reaching 63% in 2055. Men from the poorest households (quartile 1) see their Baseline's replacement ratio increase from 41% in 2025 to 66% in 2055.

Women's Baseline replacement ratios in the quartile 4 falls slightly from 55% in 2025 to 52% in 2055, while the female quartile 3 increases slighly from 55% in 2025 to 59% in 2055. The female quartile 2 begins at 55% in 2025, then it flucutuates around 60% for several years, but it increases sharply after 2045, reaching 71% in 2052, before falling again to 66% in 2055. Women's quartile 1 shows the most significant Baseline improvement, increasing from 40% in 2025 to 66% in 2055.

In Figure 1, Plan A improves the replacement ratios for all men and women substantially. For men the replacement ratios in 2055 reach a level of 70% for quartiles 1, 2 and 4, and a level of 64% for quartile 3, which are values between 5% and 8% bigger than in the Baseline. For women the replacement ratios in 2055 reach 59% for the quartile 4, 64% for the quartile 3, and close to 70% for the quartiles 1 and 2, representing a gain around 4% relative to the Baseline for all the quartiles.

Plan B (with both a delay of the retirement age and a 6% increase of the contribution rate), however, shows a much stronger improvement in the pensions of men and women of all income levels, with all replacement ratios improving steadily until 2055. The reason for this continued improvement is that the increased contributions have a low impact for workers retiring in a few years, but it has a strong effect for the younger generations retiring in the distant future. Men's replacement ratios in 2055 improve to 94% for the quartile 4, 86% for quartiles 2 and 3, and 80% for the quartile 1. Women's replacement ratios until 2055 increase to around 82% for all the quartiles.

Figure 1: Projections of the replacement ratio of the age 67 cohort under the current framework, a delaying of retirement, and an increase in contributions (by gender and household income quartile)

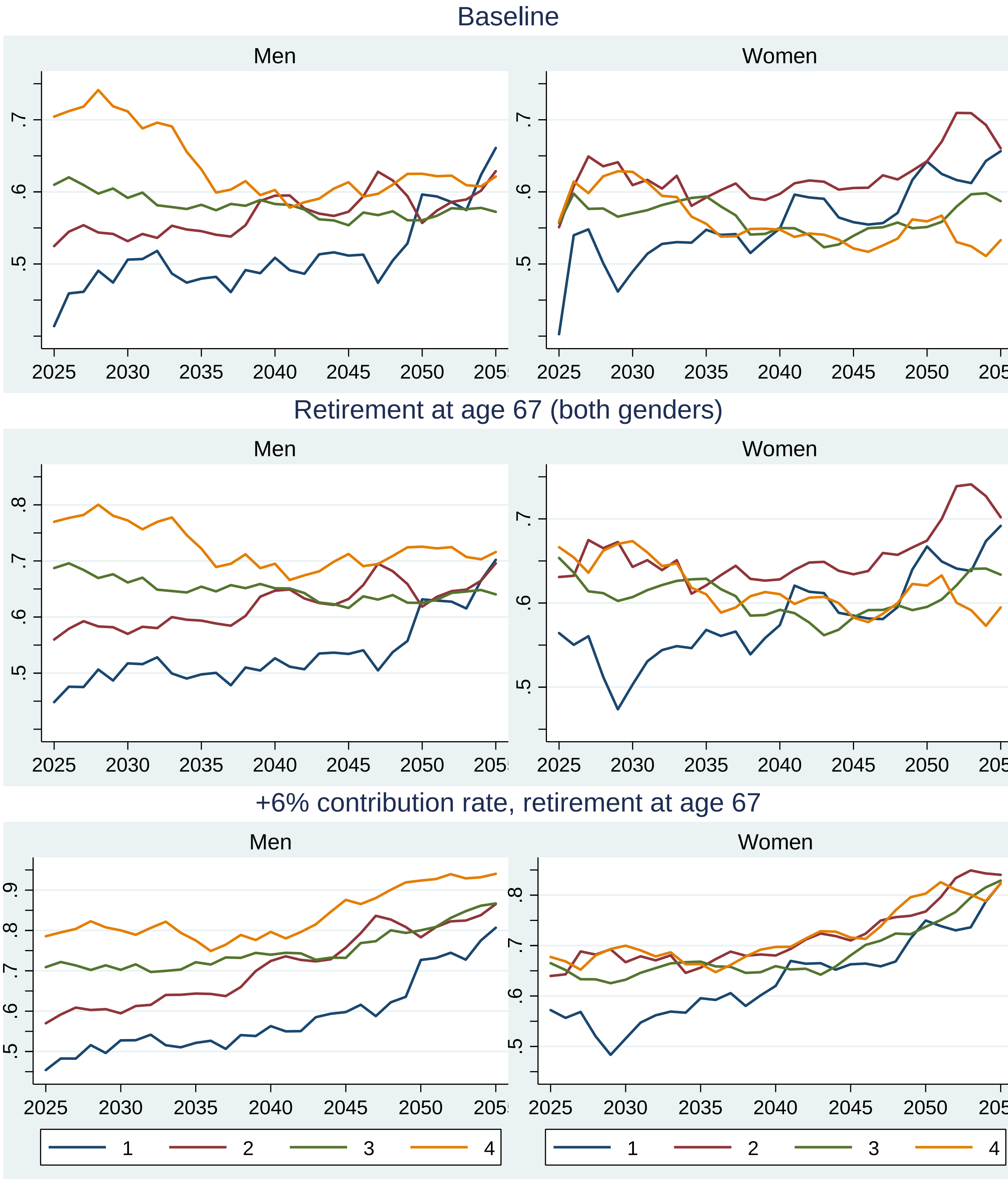

Figure 2: Projections of the pension replacement ratio of the age 67 cohort under policy reforms with differing levels of solidarity contributions (by gender and household income quartile)

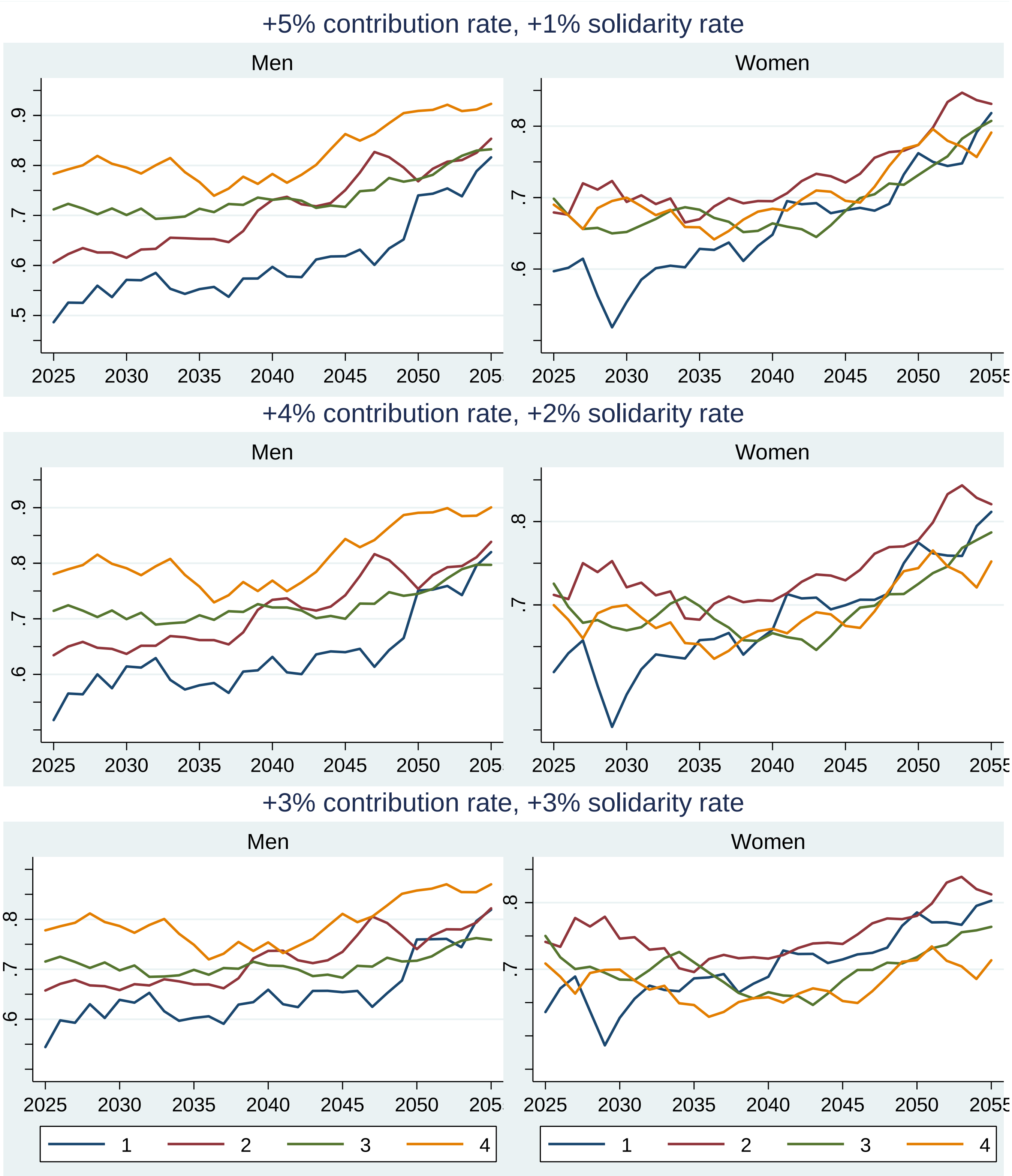

Figure 2 shows the replacement ratios when part of the increase in contributions are dedicated to solidarity (1%, 2%, 3%). The results are qualitatively similar to plan B in Figure 1, but with flatter increases for the quartiles 2, 3 and 4 (the ones paying solidarity contributions) and stronger improvements in the quartile 1 (which receive larger solidarity funds). Men's quartiles 4, 3 and 2 see their respective replacement ratios by 2055 lower to 92%-83%-86%, 90%-80%-85%, 87%-76%-82%, for plans C, D and E, respectively. Men's quartiles 1 see their 2055 replacement ratios improve to 81%, 82% and 83%, for plans C, D and E, respectively.

Women's replacement ratios in 2055 with plan C (only 1% solidarity rate) are between 79% and 84% for all quartiles, therefore very close to the plan B (around 82% for all the quartiles), but with a small improvement for women in the quartiles 1 and 2 and a worse income for women in the quartiles 3 and 4. For the plans D and E, the female replacement ratios for quartiles 1 and 2 remain very similar to the plan C. Perhaps this is because the solidarity funds are spent on the retirees for each period and do not accumulate for the future. However, the replacement ratios in 2055 of the quartiles 3 and 4 fall to 78%-75% and to 76%-75% with the plans D and E, respectively.

Finally, Table 8 shows the average replacement ratios for all the retirees population in a few selected years (2025, 2035, 2045, 2055). It differs from the previous analysis in the sense that it includes all the retirees and not just the cohort reaching 67 in that year. Besides the total pension replacement ratio, $PRatioT_{k,t} = \min(1, \frac{\tilde{pa}_{k,t}+SB_{i,t}(SP_k+B^{22}_{k,t})}{\min(mc_t, W_{k,t-1})})$, I also include the Baseline contributory replacement ratio (that is, without any solidarity funds, $PRatioC_{k,t} = \min(1, \frac{\tilde{pa}_{k,t}}{\min(mc_t, W_{k,t-1})})$) to show how the solidarity intervention affect the outcomes. The results show that the Baseline contributory replacement ratios in 2025 are especially low for the quartile 1, with a mean value of just 2.8%. This result is driven by the low rates of labor participation and high rates of informality among the poorest households (Berstein 2010) plus the pension withdrawals of 2020 and 2021, which resulted in more than 4 million affiliates remaining with zero accumulated contributions (Evans and Pienknagura 2021). Even for the highest income households, the average contributory replacement ratio in 2025 is only 46%, due to both a low contribution rate in the baseline framework (10%) and the low labor force participation of women (Berstein 2010).

Under the Baseline there is a slight improvment in the mean total pension replacement ratios from 55% in 2025 to around 58% between 2035 and 2055, perhaps as the retirees recover from the pension withdrawals. The total pension replacement ratio is significantly higher for Plans A (an

Table 8: Replacement ratios (means, in %) across policies for all retirees in 2025, 2035, 2045, 2055

Income Quartile	Contributory Rep. Ratio Baseline	Total pension (contributory plus solidarity) replacement ratio Baseline	A	B	C	D	E	Fraction of retirees hurt by solidarity relative to plan B (%) C	D	E
					2025					
1	2.8	32.7	55.0	55.5	57.5	59.0	60.4	20.3	19.0	16.6
2	7.3	48.9	56.3	57.0	61.8	65.2	68.2	16.8	16.2	15.7
3	25.8	57.5	68.7	69.9	72.3	73.9	75.1	43.6	40.2	40.1
4	45.5	65.8	75.7	76.6	77.1	77.5	77.8	66.6	66.8	66.9
Total	24.8	54.8	66.3	67.2	69.4	71.0	72.4	36.8	35.6	34.8
					2035					
1	5.7	46.1	52.8	54.0	57.4	60.6	63.2	26.4	26.5	23.5
2	15.0	56.3	60.7	62.9	65.8	68.2	70.4	23.3	22.4	21.2
3	26.1	58.2	65.3	68.1	69.5	70.6	71.4	57.3	55.2	53.0
4	42.4	65.0	71.9	74.3	74.3	74.1	74.0	70.7	71.4	71.6
Total	25.4	58.1	64.4	66.7	68.3	69.6	70.8	44.4	43.9	42.3
					2045					
1	6.9	48.4	53.9	56.0	59.3	62.2	64.7	20.5	20.2	18.1
2	16.6	56.9	61.2	64.6	66.9	68.8	70.6	27.8	26.5	24.7
3	26.6	57.6	64.4	68.6	69.5	70.1	70.6	62.2	59.8	58.9
4	42.1	62.7	69.8	74.6	74.1	73.6	73.0	73.8	75.7	77.3
Total	26.1	57.7	63.8	67.7	68.8	69.8	70.5	46.1	45.6	44.8
					2055					
1	7.6	48.9	54.9	57.7	60.8	63.5	65.7	21.8	21.4	19.5
2	17.2	57.2	61.7	66.0	68.1	69.9	71.4	29.2	28.3	27.0
3	27.5	57.6	64.5	69.9	70.5	70.9	71.2	63.9	62.2	61.1
4	43.1	62.6	69.9	76.3	75.6	74.9	74.0	72.8	75.4	78.7
Total	27.1	57.8	64.2	69.2	70.2	70.9	71.4	46.9	46.8	46.6

increase in the retirement age to 67) and B (increases in retirement age and +6% in the personal contribution rate) than for the Baseline for any of the comparison years and for all the income quartiles. The differences between Plans A and B are smaller for the lowest income households (quartiles 1 and 2), but the benefits of higher contributions are starker for the quartiles 3 and 4, which have higher contribution rates and less access to solidarity. Plan B has a higher impact relative to Plan A over time as the younger generations accumulate more contributions.

In 2025 the solidarity plans give higher mean pension replacement ratios for all the quartiles of retirees (which could be because even the richest retirees only contributed a few years of solidarity before reaching retirement). However, note that the solidarity schemes are not a gain for all income quartiles for all periods. In fact, even in 2025, Table 8 shows that around 35% to of the retirees are "hurt" by the solidarity schemes in the sense that their pension is worse under plan C, D or E, relative to plan B without any solidarity (implying that they pay for 1%, 2% or 3% of solidarity, but receive few or no benefits). However, the policy reform options only enter into effect in 2022, therefore as the years go by, the fraction of retirees that are hurt by the solidarity schemes steadily increases, reaching more than 42%, 44% and 46% in 2035, 2045 and 2055, respectively. Also, in 2035 the plans D and E are already worse for the mean retiree in quartile 4, with their mean replacement ratios slightly worse than plans B and C. By 2045 and 2055, the mean replacement ratios for the quartile 4 in the solidarity plans C, D and E are worse than plan B. The mean replacement ratios for quartiles 1, 2, 3, continue to be higher under the solidarity plans in 2035, 2045 and 2055. However, after 2025 there is a significant increase in the share of retirees hurt by the solidarity for quartiles 2, 3 and 4. More than 60% and 70% of the retirees in quartile 3 and 4, respectively, are hurt by the solidarity scheme by 2055.

5 Conclusions

This work studies the impact on the household savings rates and future pensions of the Chilean policy changes implemented between 2019 and 2022 and some of the current policy reforms under debate, which consider among several options the delaying of the retirement age and an increase in the contributions with some share being destined for solidarity funds. Using the EPF survey to estimate a simple lifecycle model of savings, I find that households treat expected contributory and non-contributory wealth differently, with agents dis-saving a significant fraction of their promised public pension benefits. The pension withdrawals during the Covid pandemic put more people on the brink of receiving public benefits. This may significantly impact household savings, with the permanent savings rate declining by 2.3% for the average household and 1.7% for the economy.

The planned increase in personal contributions (+6%) and delay in retirement age to 67 years is expected to raise the savings rate by 0.9% for both the average household and the total economy. However, the savings rate would be reduced by 0.3% for the average household and 0.3% for the economy with each percentage point that is destined for solidarity funds instead of the personal pensions. Therefore the plan of a 3% solidarity rate would decrease the economy-wide savings rate by 0.5% relative to a full personal contribution plan.

Pension replacement ratios improve significantly with a delaying of retirement age, increasing by 11.5% in 2025 and 6.4% in 2055 for the average retiree. The increase in the personal contribution rate also improves the replacement ratios, but it takes a slower time to make its full effect, since its strongest impact is on the workers recently joining the labor force. However, by 2055 the increase of 6% in personal contributions has improved replacement ratios by 5%. The solidarity schemes could contribute to increasing the average replacement ratios and the replacement ratios among the lower income households even more, since a given amount that is redistributed represents a higher fraction of the income for poorer households than the fraction that is taxed at the top. However, the pensions of higher income households decline with solidarity and by 2055 more than 45% of the retirees do not benefit from the solidarity scheme.

Future research should account that non-contributory pensions may reduce the benefits of formal employment relative to less taxable informal jobs (Ghilarducci et al. 1995, OECD 2021), woth informal labor in Chile representing 22% of the employment. Welfare evaluations of the social security system must consider the behavioral and market imperfections that agents face regarding employment, health, taxes and savings (Laibson et al. 1998, Conesa and Krueger 1999).

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