Effects of COVID-19 early release of pension funds: The case of Chile

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Abstract
Amid the extraordinary economic effects of COVID-19, some policymakers have turned to retirement accounts to support individuals in financial hardship. Given the haste, the long-term impacts and their heterogeneity have scarcely been analyzed. Using Monte Carlo simulations on the Chilean Social Protection Survey linked with administrative data, this study quantifies the effects of a 10% early release of pension funds. Each withdrawn dollar brings losses of 1.59 dollars in future retirement savings, reducing monthly pension benefits by 7.26%. This policy raises income inadequacy and inequality in retirement, increasing government expenditure by 4.33% to counteract these effects for 65-year-old retirees. We propose four policies to mitigate these effects and address the current challenges of most defined contribution pension schemes. Increasing contributions combined with an intragenerational solidarity component shows the biggest impacts. Contribution enforcement, reducing tax evasion, and delaying retirement by at least 1 year via incentives have lower but significant effects.

Keywords
fiscal sustainability, pension adequacy, retirement savings

JEL Classification
G23, H55, J32
1 INTRODUCTION

The COVID-19 pandemic has put unprecedented pressure on people's finances and brought forward the urgency of accessing funds today as opposed to saving for later. Intertemporal allocation of money and time has been deeply analyzed since the lifecycle model proposed by Modigliani and Brumberg (1954). The modern view on intertemporal allocation relates to “consumption smoothing” (Hall, 1978), where individuals attempt to keep the marginal utility of consumption constant over time—an objective recognized as one of the main goals of pension savings (Barr & Diamond, 2006; A. M. Schwarz, 2006). In a world plagued by uncertainty and with sufficiently impatient individuals, however, savings behavior is better described by the “buffer-stock” version of the lifecycle theory (Gourinchas & Parker, 2002), in which individuals save (dissave) if their wealth goes below (above) some target wealth-to-permanent-income ratio.

For most Latin American countries, Bosch et al. (2020) find that voluntary savings to insure against economic uncertainty are not widespread and, if they exist, are insufficient to cover severe income shocks for extended periods. It is thus unsurprising that given the extraordinary economic effects of COVID-19, several policymakers have turned to “unlocking” retirement savings to “smooth consumption” and support those facing dire financial difficulties. Australia, Brazil, Chile, Costa Rica, Iceland, Malaysia, Mexico, New Zealand, Peru, the United States, among others, have eased conditions and/or penalties associated with accessing retirement accounts. At what cost, however? In other words, how much will early access to pension funds affect the retirement savings adequacy and financial sustainability of the public pension system? What are their distributional effects and how could they be mitigated?

This study considers the Chilean experience, where the COVID-19 pandemic and the strong social distancing measures designed to reduce its spread have severely affected the income adequacy of the working population. The Central Bank of Chile’s monetary policy reports for the second quarter of 2020 have shown (1) a GDP (gross domestic product) drop of 14.1%, the highest since the Chilean financial crisis of the early 1980s, (2) almost 50% of firms availing themselves of the Employment Protection Law provisions, and (3) the unemployment rate reaching 13.1%, the highest level since 2010. In response, the Chilean government implemented three relief packages aimed at protecting employment and labor income and supporting companies in financial hardship through credit schemes. The Chilean parliament subsequently went further by approving an additional support scheme financed via individual

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1http://www.iopsweb.org/iopsmembersmeasurestakentoaddressthecovid-19crisis.htm and https://openknowledge.worldbank.org/handle/10986/33635. Australia, Costa Rica, Malaysia, Mexico, New Zealand, and the United States have allowed access under specific circumstances. In Brazil, Chile, Iceland, and Peru no access requirements have been established other than having savings in private accounts. In the United States, the CARES Act allows qualified individuals impacted by the COVID-19 pandemic to pay back funds withdrawn from a qualified retirement plan over a 3-year period, waiving taxes and the 10% penalty for early withdrawals.

2Under this law, companies affected by COVID-19 can suspend employment contracts and reduce work schedules, retaining only obligations to pay health and social security contributions. Affected workers receive unemployment benefits, with the first payment corresponding to 70% of worker’s remuneration over the preceding 3 months, and gradually reducing to 30% in the seventh month. For more details, see http://www.proteccionempleo.cl/

3In particular, data from the Chilean Bureau of Statistics (INE in Spanish) shows that the largest and most persistent drops in employment are concentrated in sales and service workers, farmers and fishermen, and unskilled jobs. https://www.ine.cl/informeempleo/

4https://www.gob.cl/coronavirus/plandeaccion/
retirement funds, which are managed by private entities called “Administradora de Fondos de Pensiones” (AFPs) and are equivalent to 77% of national GDP. This new scheme became law on July 30, 2020; it allows people to access up to 10% of their pension savings in 12 months, with a maximum of USD 5664 and a minimum of USD 1322. Those with pension balances below USD 1322 can access all their funds.

Using nationally representative survey data linked with administrative pension information, this study conducts Monte Carlo simulations to forecast labor outcomes and compute future retirement savings balances; the idea is to quantify the effect of this policy on self-funded pension benefits and government supplements. We find that this policy results in an average withdrawal of 22.92% from individual accounts, representing a drop of 8% in the aggregate savings balance of the system and equivalent to USD 2623 per person. Regarding life annuities in the first year of legal retirement age, this scheme reduces their benefits by 7.26% on average, although the greatest effects are recorded for young people, women, and workers with low private pensions.

The consequences of this policy reinforce the need to strategically address the current challenges of most defined contribution (DC) schemes, some of them particularly imperative in the Chilean pension system, as are income inadequacy and inequality in retirement, integrity, risk-sharing, legitimacy, and fiscal sustainability. With the aim to propose a functional and efficient design, rather than only supplementing outcomes at the end of the working life, four different mitigation policies are analyzed: (1) contribution enforcement via fiscalization, incentives to formalize low-income jobs, and paying wages directly into a bank account, (2) reducing tax evasion and enforcing administrative taxable wages to be the same as self-reported taxable wages via fiscalization and reconciliation of bank statements, (3) delaying retirement through incentives related to making it optional to contribute beyond the statutory retirement age or via better employability opportunities for mature workers, and (4) increasing contribution rates by 4 pp and using 50% of that increase for intragenerational redistribution. We find that higher contributions with an intragenerational solidarity component show the biggest impacts. Contribution enforcement, reducing tax evasion, and providing incentives to delay retirement by at least 1 year have lower but significant effects. These measures would be effective policies and entail a lower political cost than a simple change on parameters such as an increase in the legal minimum retirement age, tightening eligibility rules, or reducing the size of pensions by adjusting benefit formulas.

We make a small but critical contribution to the literature. For instance, Butrica et al. (2010) and Argento et al. (2015) show that early access to 401(k) and IRA funds is strongly correlated with income shocks and is more common among vulnerable individuals, explaining their reliance on social security in retirement. Other papers, such as Copeland (2009), Engelhardt (2002), Engelhardt (2003), Hurd and Panis (2006) analyze preretirement lump-sum

5https://www.spensiones.cl/portal/institucional/594/w3-article-13686.html
6https://www.diariooficial.interior.gob.cl/publicaciones/2020/07/30/42718/01/1791258.pdf
7The average withdrawal (22.92%) is calculated using the Carli index formula, while the aggregate drop in the retirement savings balance (8%) considers the Dutot index formula. 
8Defining the net replacement rate as the individual net pension entitlement divided by net preretirement earnings, OECD Data shows that the Chilean net replacement rate is 37.3% and the OECD average is 58.6%. https://data.oecd.org/pension/net-pension-replacement-rates.htm. Mercer CFA Institute Global Pension Index 2020 evaluates 37 pension systems and reports: (1) a relevant fall in the adequacy index for Chile from 59.4 in 2019 to 56.5 in 2020, (2) a fall in the average adequacy index from 60.6 in 2019 to 60.2 in 2020, and (3) the Chilean adequacy index is consistently below the average. https://www.mercer.com.au/our-thinking/global-pension-index.html
distributions at job change across the population. They conclude that pension assets are used to buffer economic shocks, with limited erosion of retirement income for older individuals and those with higher balances. All these studies analyze similar public policies; however, the long-term effects of such interventions on retirement savings adequacy and fiscal sustainability have scarcely been studied. We aim to fill this gap and add to the literature by analyzing an early release policy in a realistic context that accounts for guaranteed minimum pensions and public benefit supplements.

The rest of the paper is organized as follows. Section 2 describes the institutional setup in Chile and the government support scheme. Section 3 describes the data, and Section 4 presents the empirical strategy. In Section 5, we discuss the main results and evaluate several interventions that could potentially mitigate the impact of the policy we analyze. Section 6 concludes.

2 | THE CHILEAN PENSION SYSTEM

Since 1981, Chile has had an individual capitalization scheme complemented by a distributive tier aimed at reducing old-age poverty. This system works as private pension insurance with DCs, where each employee must contribute 10% of their monthly taxable wages. Those funds are managed by private entities called AFPs. Since August 2002, retirement savings are managed under the multifund scheme, which consists of five different funds (A, B, C, D, and E) differentiated by the proportion of their portfolio invested in equity. Fund A is the riskiest with a maximum investment limit of 80% in equities, Fund C has a moderate risk with a maximum limit of 40%, and Fund E is the most conservative with a maximum limit of 5%. Self-funded benefits can be claimed by women from the age of 60 and by men from the age of 65, where private insurance companies offer an annuity based on individual savings at retirement, life expectancy, future return rates, and the chosen pension mode.

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9This system boosts private savings, encourages contribution, aligns incentives, and reduces fiscal pressure. However, it also raises inequalities that come from the labor market, requiring government financial assistance for old age or disabled populations in the bottom income distribution. In 2006, a presidential commission found that an important part of the population would not have enough savings to finance their old age. The main reasons for that are the low contribution rate, the low density of contributions (explained by self-employed and informality), and the low labor participation for women.

10Everyone who starts their working life in the formal market and does not serve the army is automatically affiliated and must contribute to one AFP. For self-employed workers, membership is voluntary.

11The seven private entities that currently participate in this market charge, on average, 1.17% of monthly taxable wages for managing those funds; this rate varies between 0.69% and 1.45%. https://www.spensiones.cl/apps/estcom/estcom.php

12https://www.spensiones.cl/portal/institucional/594/w3-propertyvalue-9909.html

13For retirees, contribution to the pension system is not required but they have to keep contributing to the health insurance system. Section 1 of article 69 of Decree-Law No. 3,500 of 1980.

14Currently in Chile, there are four retirement modes: (1) programmed withdrawal, where the holder retains ownership of funds, can leave any remaining balance to heirs, but assumes longevity and investment risk, (2) immediate lifetime annuity, where fund ownership is transferred to a life insurance company, which assumes both financial and longevity risk, providing a monthly pension and a survivor's pension to any beneficiaries, (3) temporary income with a deferred life annuity, where the holder gets monthly payments for a defined period, and thereafter relies on a life annuity scheme, and (4) immediate annuity plus programmed withdrawals, where the holder purchases an immediate annuity and the remainder are paid out as programmed withdrawals.
In 2008, Chile replaced the old distributive tier with a more extensive and generous one called Solidarity Pillar ("Pilar Solidario" in Spanish), funded by general taxes. This reform came to guarantee a minimum pension, a supplementary scheme for people with low pension benefits, and create a third tier to manage additional voluntary pension savings funds. The monthly minimum benefit is called "Pensión Básica Solidaria" (PBS) and those entitled to it are individuals who claim for it, without other pensions, at least 65 years old, residents in the country by at least 20 years, registers on Social Registry of Households and belonging to the poorest 60% of the population. Workers who meet those conditions and have a positive monthly private pension benefit (PPB) but lower than a specified amount called “Pensión Máxima con Aporte Solidario” (PMAS), receive a government supplement named “Aporte Previsional Solidario” (APS).

Assuming the existence of no other survivors' pensions, Figure 1 illustrates the link between government supplements and private pension benefits. The 45-degree line represents the case where the final pension benefit is equivalent to the self-funded pension benefit (i.e., without government assistance). The horizontal line above represents the minimum pension guaranteed by the government (PBS). All pensioners without a private benefit will receive a government pension payment equal to PBS and those with a positive self-funded benefit will receive a lower supplement but the sum will always increase with private pension benefit up to the threshold PMAS. Hence, early withdrawals from private savings accounts not only affect future pension benefits but also could create incentives to save outside of the pension system to get higher government supplements.

3 | DATA

This study uses the biggest and oldest longitudinal Chilean survey, named Social Protection Survey (EPS in Spanish), which has a representative sample of around 16,000 individuals across the country. This survey was conducted in five rounds between 2002 and 2015, allowing the creation of a representative panel data set with 5920 individuals, which contains socio-demographic and family information, along with information about labor, pension system, education, health, assets, and wealth. As new rounds had not been released at the time of this

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15All monetary variables are measured in a unit of account adjusted monthly for inflation called “Unidad de Fomento” (UF). This paper considers US dollars on July 30, 2020. USD 37.76 = 1 UF = CLP 28,668.36.
study, it excludes new workers who entered the labor market later than 2015. The Chilean Ministry of Labor and Social Security publishes this data linked with monthly administrative pension information and labor histories until December 2017, which facilitates studying flows into and out of retirement accounts. Since then, forecasting of future labor trajectories—working probabilities, wages, and hours worked, as well as pension benefits—are possible based on sociodemographic data reported by EPS and the administrative labor records.

We consider an eligible population of 4940 individuals aged at least 20 years, affiliated with the DC scheme, and who do not serve in the army. Of these, 1265 workers have already reached the minimum statutory retirement age, and 730 of them have claimed their pension benefits since the implementation of the redistributive tier named Solidarity Pillar in January 2008: (i) 693 workers pensioned between the minimum statutory retirement age and 10 years later, (ii) 19 workers pensioned before the minimum statutory retirement age, being not eligible for public subsidies, and (iii) 21 extreme cases of workers pensioned after 10 years of the legal minimum age. This sample of 693 individuals represents 95% of the eligible pensioners’ population. We use immediate life annuity as the pension mode to calculate self-funded pension benefits; the reasons are detailed in Section 4.4.

Table 1 depicts the main statistics for the entire population, those who have already reached the minimum statutory retirement age, those workers pensioned since January 2008, and the sample of 693 pensioners discussed above. Comparing the first two columns, the whole population of 4940 individuals has relevant differences on sociodemographic variables from those who already reached the minimum retirement age; those at retirement age have a higher fraction of women and married, but lower number of children and years of schooling. Considering labor variables, this group has a smaller fraction of salaried jobs, working and contributing less; but those who continue working at that age have higher wages on average. The third column shows that workers pensioned since the implementation of the Solidarity Pillar are mostly women with similar sociodemographic variables; they work and contribute slightly more compared to those who only reached the retirement age, but a lower fraction of them work—being either pensioned or self-employed. The last column shows that the sample of 693 pensioners has similar values to the total population of those already pensioned, where these minor differences are because workers who lack data on their claiming period tend to be men with more and better job opportunities.

Multipanel Figure 2 describes the observed labor variables and pension benefits with no release for the eligible population of 4940 individuals; figures by gender are included in Appendix B. Figure 2a displays the fraction of workers in different labor statuses. Working and working/contributing show their highest levels before the age of 31, declining briefly up to

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16Workers who entered the labor market after 2015, tend to be youth and immigrants, with shorter labor force participation histories and lower savings balances. They should have withdrawn a higher percentage of their retirement accounts due to the stipulated minimum by the law, having a greater impact on their future pensions. Hence, the lack of information for the last 5 years of this data set produces underestimated effects of this policy.

17The Chilean pension system allows age (and disability) pensioners to continue working, maintaining the duty to contribute to health insurance, but being exempt from the obligation to contribute to the pension funds. https://www.dt.gob.cl/portal/1628/w3-article-95283.html

18The Chilean pension system allows early retirement if the capital accumulated in the private account finances a pension that (1) replaces 70% of a worker's average wages in the last 10 years and (2) is at least 80% of the Maximum Welfare Pension (PMAS).

19This group is exceptional, with scarce labor and provisional information; the number of their monthly contributions is equal to a sixth of that of the eligible population.
37 years old due to a fall in the fraction of salaried workers, but increasing thereafter. Additionally, they experience major falls at women's minimum statutory retirement age, and even more at men's. It can be seen a considerable gap between working and those who additionally contribute, which is explained by the fact that a significant fraction of workers is self-employed or work in the informal market. The percentage of pension beneficiaries (henceforth pensioned workers) has a stable behavior and rates close to zero up to 50 years of age. Afterward, the portion of pensioned workers rises greatly at each minimum statutory retirement age, reaching 81.6% at the age of 65. Working/pensioned status jumps at women's minimum statutory age and slightly decreases until the age of 65, giving way to a transitory increase and reaching its maximum level of 22% at the age of 65. It then declines and stabilizes around 8% from age 73.

Self-reported labor income from EPS is adjusted to get self-reported taxable wages, which can then be compared with administrative taxable wages. Figure 2b shows that administrative taxable wage rises aggressively up to the age of 33, followed by a large decline and then a positive trend up to women's statutory retirement age. Self-reported taxable wages surge in the

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### TABLE 1 Descriptive statistics

| Variable                  | Across age | At the minimum statutory retirement age |
|---------------------------|------------|----------------------------------------|
|                           | Population | Population | Already pensioned | Pensioners' sample |
|                           | Mean | SD   | Mean | SD   | Mean | SD   | Mean | SD   |
| Female (%)                | 47.1  | 49.9 | 50.3  | 50.0 | 58.6  | 49.3 | 59.2  | 49.1 |
| Age (years old)           | 48.3  | 13.3 | 62.9  | 2.5  | 62.5  | 2.5  | 62.5  | 2.5  |
| Children (number)         | 1.4   | 1.3  | 1.0   | 1.1  | 0.9   | 1.1  | 1.0   | 1.1  |
| Married status (%)        | 42.8  | 49.5 | 50.4  | 50.0 | 50.2  | 50.0 | 50.0  | 50.0 |
| Schooling years           | 9.9   | 3.9  | 8.3   | 4.4  | 8.7   | 4.3  | 8.7   | 4.3  |
| Working (%)               | 62.1  | 48.5 | 47.6  | 49.9 | 48.1  | 50.0 | 48.1  | 50.0 |
| Working and contributing (%) | 48.2 | 50.0 | 28.6  | 45.2 | 30.5  | 46.0 | 30.5  | 46.1 |
| Salaried employee (%)     | 41.1  | 49.2 | 27.0  | 44.4 | 28.0  | 44.9 | 28.1  | 45.0 |
| Self-employed (%)         | 10.6  | 30.7 | 10.6  | 30.8 | 9.8   | 29.7 | 9.6   | 29.5 |
| Admin. taxable wage (USD) | 704.9 | 573.0 | 800.7 | 673.1 | 815.9 | 674.7 | 812.5 | 668.4 |
| Self-reported taxable wage (USD) | 1084.0 | 2022.4 | 1115.1 | 2012.8 | 992.1 | 1508.9 | 975.2 | 1470.0 |
| Individuals               | 4940  | 1265 | 730   | 730  | 693   | 693  |       |       |

Note: The pensioners' sample is workers from the eligible population pensioned since the implementation of Solidarity Pillar, aged between the minimum statutory retirement age and 10 years later. Real values at US dollars on July 30, 2020. USD 37.76 = 1 Unidad de Fomento = CLP 28,668.36.

Source: Author's calculation based on EPS (Social Protection Survey) and Chilean Pension Superintendency data.

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20In EPS, self-reported net incomes include deductions by worksheet of loans and consumption in commercial houses, union dues, sick leave, and voluntary contributions to the pension system. Additionally, it excludes contributions to the pension and health system, bonuses, and government subsidies.
first 16 years, then shows a negative trend up to 65 years old, followed by a transitory rise due to high salary workers staying a few years longer in the labor force. The sharp rise in wages for young workers and their subsequent decline can be partly explained by a cohort effect, due to the fact that the new generations of interviewees show higher levels of education. Both earnings fall aggressively after the age of 70 and increase at the age of 80 because only those earning high wages keep working until this age. The significant difference between those variables shown by this figure, and corroborated by tests of means, can be explained by the cap on taxable wages and under-reported earnings.\textsuperscript{21} Hours worked slightly increase with age up to 31 years, where it reaches its maximum level of 48.4 hours on average. After the age of 40, a negative trend is observed, until 40 hours at the age of 80.

Figure 2c depicts actual self-funded pension benefits with no release received by retirees and potential benefits retiring at those ages. Specifically, the forecasted labor trajectories and return rates are used to calculate expected savings balances, potential self-funded pension benefits, and given these, government supplements and support probabilities; this is described

\textsuperscript{21}Mean-comparison tests show a \textit{t}-test statistic of 310.17 and a \textit{p} value of 0.00 that allows rejection of the null hypothesis of equals means. In Chile, the monthly contribution amount to the pension system is defined by taxable wages up to one specific limit. Over this limit, there is no obligation to contribute. Since January 2019, that threshold is 79.3 UF.
in Section 4. Both pension benefits follow a common linear trend up to age 55, where they diverge, and actual benefits do not exceed USD 197/month on average. Meanwhile, potential pension benefits surge exponentially with age, showing that retirement delay and having to cover a shorter period in retirement drives the increase in pension benefits. Government supplement APS, which is a decreasing function of self-funded benefits, has a positive value only from age 65 and is relatively stable thereafter. Finally, the estimated government support probability is zero before the statutory age of 65, reaching 45.7% at age 73 and slightly decreasing to 41.5% at the age of 80.

This data set shows that already pensioned workers are mostly women with low labor income and pension benefits, widely different from active workers. Most workers claim pension benefits as soon as they reach the minimum statutory age, where some of them claim them to complement their labor income by sacrificing exponential growth in pension benefits when retirement age is delayed.22 Others may return to work out of need after a short period in retirement. Thus, retirement status is not unique and may vary across time depending on income shocks and preferences. Finally, a nonnegligible group of individuals work but do not contribute to the pension system and, if they do, their taxable wages base for what they contribute is lower than self-reported taxable wages, severely affecting their retirement savings adequacy.

## 4 | EMPIRICAL STRATEGY

This section describes the approach developed to compute the policy effect if everyone gets access to their pension funds and consumes those resources. The aggregate feedback effects of this policy on the real economy are incorporated through economic growth projections after the implementation of this policy and Monte Carlo simulations with different economic shocks. Future values of macroeconomic variables are simulated and given those values, individual labor trajectories and contributions to retirement accounts are computed. Using these values and withdrawals allowed by this policy, we compute future retirement savings balances and pension benefits.

### 4.1 | Macroeconomic variables

To forecast wages, labor status, retirement savings balance, and pension benefits, a set of macroeconomic indicators were considered. Table C1 describes those variables, their assumptions, and the time since the assumptions were considered. We consider an inflation rate of 3%, a stable pension contribution rate of 10%, and a nominal growth rate of 5% for minimum wage and government pension benefits. The GDP growth rates23 for 2020 and 2021 correspond

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22Pensioners keep 100% of government supplements if their labor earnings are below the national minimum wage. Government supplements are reduced gradually (linearly) and after 2 years when pensioner’s labor incomes are higher than the national minimum wage but less than twice. Pensioners lose government supplements after 2 years when their income from work is more than double the national minimum wage. [https://www.spensiones.cl/portal/institucional/594/w3-article-4200.html](https://www.spensiones.cl/portal/institucional/594/w3-article-4200.html)

23Interannual real GDP variation is approximated in Chile by the Monthly Index of Economic Activity (IMACEC), which is an estimate that summarizes the activity of the different sectors of the economy in a given month at prices from the previous year.
to the most recent IMF projections, which consider the three relief packages implemented by the Chilean government and the forecasted feedback effects of this policy.\textsuperscript{24} Future values from 2022 are assumed to account for some persistence about recent events under three economic scenarios: (1) mild economic growth, with an average real GDP growth rate of 2% per year, (2) moderate economic growth, where real GDP is assumed to rise 3% annually, and (3) remarkable economic growth, with an annual real GDP growth rate of 4% on average. Additionally, the values consider a disturbance term with a zero mean and a variance defined by the last 20 years before the pandemic.\textsuperscript{25}

This study conducts Monte Carlo simulations for the three economic scenarios mentioned above. Using simulated future economic growth rates and an error term distributed as in the last 20 years before the pandemic, future unemployment and return rates that are used to calculate life annuity are forecasted through a multivariate autoregressive (MAR) process. Moreover, the Chilean pension system allows workers to allocate their contributions in five different portfolios, where “A” is associated with the highest risk and “E” with the lowest. As random errors across portfolios are correlated with each other, there might be a problem of simultaneous equation bias when estimating by ordinary least-squares, as Berndt and Christensen (1974) show. To consider heteroskedasticity and error correlation, some studies, such as Westerlund and Narayan (2015) and Phan et al. (2015), have proposed the use of the FGLS procedure. Thus, the parameters are estimated by a seemingly unrelated regression specification to increase the efficiency, with the number of lags selected by information criteria and including macroeconomic indicators as covariates. Expected return rates for each portfolio are forecasted using the future (simulated) real GDP growth rates and a variance–covariance matrix for observed data in the last 20 years before the pandemic.

4.2 Labor variables and government support

To calculate future contributions and pension savings balances, it is necessary to forecast individual labor trajectories; labor status and earnings. Considering labor and superannuation histories, along with sociodemographic and macroeconomic indicators, we use dynamic models to allow for serial correlation and forecast those variables of interest. For those observations without lagged values and/or macroeconomic indicators, only sociodemographic variables were considered to forecast their values.

Dynamic Probit (DP) models were used to estimate the parameters and forecast monthly labor status; being working, and being working and contributing to the pension system. Considering the best specification for each labor status and the estimated parameters, future probability values were estimated using sociodemographic variables and simulated macroeconomic indicators as covariates.\textsuperscript{26} Then, a rolling forecast probability is compared with a random variable uniformly distributed between 0 and 1 to define the success cases, and given

\textsuperscript{24}Outlook for Latin America and the Caribbean: A Long and Difficult Ascent. International Monetary Fund. October 2020.

\textsuperscript{25}National Accounts of the Chilean Central Bank report that the annual real GDP growth rate was vigorous since the return to democracy in 1990 up to 1998, reaching 6.82%. Since then, the economic growth has slowed down, with an annual real GDP growth rate of 3.76% in the last two decades.

\textsuperscript{26}The number of lags for the dependent variable and macroeconomic indicators were selected by the values of Akaike (1974) and G. Schwarz (1978) information criteria.
that, the labor trajectories. As the access to government supplements is not automatic after meeting the requirements, and eligible individuals must apply for these benefits, a probabilistic model is used. Hence, the probability of government support models the uncertainty of being eligible and claiming such benefits, relying on sociodemographic variables and private pension benefits as covariates.

To obtain estimated parameters and forecast the administrative and self-reported monthly taxable wages, we employ the ratio of these variables to contemporaneous minimum wage as dependent variables and MAR models. Considering the best specification for each variable and the estimated parameters, future wages values of dynamic models were estimated using sociodemographic variables and simulated macroeconomic indicators. As a nonnegligible part of the working population has missing values on administrative or self-reported taxable wages, and because of some persistence effect for those with valid data, we consider the arithmetic mean symmetrically weighted between a pure demographic model and the dynamic one. The average is then considered with a rolling forecast approach to obtain future values.

To assess the performance of each model in economic baseline Scenario 2, we compare in-sample and out-of-sample values with actual data across age; see multipanel Figure C1. The selected models and specifications result in forecasted values that follow the same trend and similar levels to actual data across age, with only a minor difference for self-reported income. More details about specification models, estimated parameters, the selected number of lags, and information criteria are reported in the online version of Appendix C.

4.3 | Simulation of early access

The data used enables the identification of individual savings balances at each period \( t(SB_t) \) until December 2017. Since then, savings balances are computed using the forecasted labor trajectories and wages, together with the official return rates and macroeconomic variables. Several surveys have shown that a vast majority of them would ask for the entire benefit, and although this benefit can be requested at any time during the 12-month period, 74% of those eligible asked for it in the first week of implementation. Hence, we assume that each worker had access to 10% of their pension funds during the first month of implementation of this policy.

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27 As before, the number of lags for the dependent variable and macroeconomic indicators were selected by the values of Akaike (1974) and G. Schwarz (1978) information criteria.

29 The CADEM survey reported that at least 84% of those eligible would ask for this benefit, and of them, 95% would ask for the whole 10%. Likewise, Survey from "Camara Comercio de Santiago" reveals that 82% of those eligible would ask for this benefit. Three months after the implementation of this policy, 92% of the members of the system have claimed this benefit, and of those, 96% have already received those resources. Of those who claimed: (1) 52.8% were men, with an average withdrawn amount of USD 2124 (median of USD 1338) which represents 33.6% of their balances (median of 13%), and (2) 47.2% were women, with an average withdrawn amount of USD 1569 (median of USD 1322) which represents 45.6% of their balances (median of 28%). Finally, from those who claimed this benefit; 20.3% withdrew everything they had in their accounts, 43.2% obtained the minimum of USD 1322 that represented more than 10% of their balances, 29.6% withdrew 10% of their balances, 6.3% got the maximum amount of USD 5664, and 0.5% do not report balance information.
in August 2020, with a minimum of USD 1322 and a maximum of USD 5664. Those workers with less than USD 1322 have access to as much as is available in their funds. Thus, the withdrawn amount \( W_A \) at the time of implementation of this policy \((t = 0)\) is defined as:

\[
W_A = \min\{SB_0, \max\{1332, \min\{0.1 \times SB_0, 5664\}\}\}. \tag{1}
\]

At the beginning of the next period \((t = 1)\), the private savings balance is computed as the remaining amount at the implementation period plus the mandatory contribution, given the working/contributing status, and incorporating the monthly returns.

\[
SB_t = (1 + r_{t-1}) \times (SB_{t-1} - W_A + 0.1 \times TW_{t-1} \times WC_{t-1}) \quad \text{for } t = 1, \tag{2}
\]

where 0.1 corresponds to mandatory contribution rate, \( TW_{t-1} \) denotes the forecasted taxable wage and \( r_{t-1} \) is the forecasted return rate for each chosen portfolio. Additionally, \( WC_{t-1} \) is the forecasted working/contributing status, being 1 when individuals work and contribute to the pension system and 0 otherwise. From the second period onwards, the private savings balance at the beginning of each period \( t \) is computed as:

\[
SB_t = (1 + r_{t-1}) \times (SB_{t-1} + 0.1 \times TW_{t-1} \times WC_{t-1}) \quad \text{for } t \geq 2. \tag{3}
\]

Berstein et al. (2013) point out the relevance of a default lifecycle investment strategy in light of the economic behavior of members, characterized by low financial knowledge, inertia, and myopia in decisionmaking. Thus, one default behavior is considered, along with annual return rates for each risk portfolio under the economic Scenario 2 as described in Table C1. Each worker stays in the currently registered risk portfolio under some conditions: (1) the riskiest option can be chosen only by workers at least 15 years younger than their minimum statutory retirement age, (2) workers at least 10 years younger than their minimum statutory retirement age can choose up to the second riskiest option, (3) those at least 5 years younger than their minimum statutory retirement age can choose up to the third riskiest option, (4) workers who can claim private pension benefits in 5 years or less can choose up to the second least risky option, and (5) those in retirement age must choose the least risky option.

### 4.4 Pension variables

This paper uses immediate life annuity as the pension mode to calculate private pension benefits due to: (1) this pension mode is used to compute the self-funded benefits that determine the access to government supplements and (2) this calculus method allows for easy quantification of the effect on a fully smoothed consumption pattern, expected lifetime resources and government supplements. For more details, see Appendix A. Thus, the monthly private pension benefit at \( t \) when retiring at period \( r \) is:

\[\text{https://www.cadem.cl/encuestas/especial-retiro-10/}\]
\[ \text{PPB}_t(r) = \frac{\text{SB}_r}{12 \times \text{CNU}_r}, \]  

where CNU represents the amount of capital that a person drawing a pension needs to finance one annual monetary unit of the life annuity pension benefit for herself or potential beneficiaries. This term is multiplied by 12 to get the monthly amounts. The formula to get CNU values is officially reported by the Chilean Superintendency of Pensions, and collapses information about: gender, the life expectancy of the beneficiary and that of their spouse, family composition, the pension mode, and its respective annual expected return rate. We follow the process and code described in Vega (2014), considering individual information contained in the EPS survey to get CNU values for each beneficiary.

Since 2008, Chile has had a new distributive tier called Solidarity Pillar funded by general taxes, which guarantees (i) a monthly minimum benefit called PBS for those individuals without other pensions, at least 65 years old, and belonging to the poorest 60% of the population and (ii) a government supplement named APS for those workers with a positive monthly PPB but lower than a specified amount called PMAS. Thus, all low-income workers receive at least a minimum pension level; those with a higher self-funded benefit receive a lower solidarity supplement; however, the sum will always be higher. Assuming the existence of no other survivors’ pensions, this government support amount is calculated as:

\[ \text{APS} = \begin{cases} 
\text{PBS} & \text{if PPB} = 0 \\
\text{PBS} - \frac{\text{PPB} \times \text{PBS}}{\text{PMAS}} & \text{if PPB} > 0 \& \text{PPB} \leq \text{PMAS} \\
0 & \text{if PPB} > \text{PMAS}
\end{cases} \]  

(5)

Given the probability of claiming and receiving this government support \( \pi_t^{\text{GS}} \), the FPB benefit when retiring at \( r \) in period \( t \) is computed as:

\[ \text{FPB}_t(r) = \text{PPB}_t(r) + \text{APS}_t(r) \times \pi_t^{\text{GS}}. \]  

(6)

5 | RESULTS

This section describes the effects of this policy, in addition to proposing four mitigation policies and analyze their potential effects. The results are based on nonpensioned workers from the eligible population, under an intermediate economic growth scenario that assumes average real GDP growth to be 3% from 2022 and a Monte Carlo simulation with 500 replications. Other scenarios are considered for robustness in Appendix D.
5.1 Policy effects

This subsection describes the effects of this policy in terms of private pension benefits, government supplements, and the cost of each dollar withdrawn. The negative effects of this policy on private pension benefits would reduce preparedness for retirement and affect retirement age decision, so it should be modeled properly using behavioral and structural models, which is beyond the scope of this paper. However, Figure 2a and figures by gender in Appendix B show that most workers claim pension benefits as soon as they reach the minimum statutory age, and some of them doing so to complement their labor income. Thus, and to simplify the analysis, we assume that workers claim pension benefits at their earliest eligibility age; 60 years old for women and 65 for men to claim private pension benefits, and 65 years old to claim government supplements. All monetary variables are calculated in a unit account adjusted monthly for inflation, called UF, and converted to US dollars for illustrative purposes.36

Table 2 shows that workers withdraw USD 2623 on average, with USD 3044 for males and USD 1968 for females. Thus, this policy results in an average withdrawal of 22.92% from individual accounts because of the minimum stipulated amount, representing a drop of 8% in the aggregate savings balance of the system, and these percentages are higher for women than for men.37 The total cost ratio is calculated as the loss in present value pension funds at the minimum statutory retirement age over the withdrawal amount. This cost ratio is on average $-1.59$ and larger for men, due to their longer working lives and the greater loss of compound returns. Considering the simplest version of the lifecycle hypothesis, where consumption in each period is a constant proportion of expected lifetime resources,38 each withdrawn dollar reduces aggregate consumption over the remaining life by 0.59 dollars, in addition to the permanent decrease in consumption caused by the COVID-19 pandemic itself. As a result, this policy would be more harmful than a short-term fiscal stimulus package financed with debt as proposed by Ricardo (1951), which would yield less cost and distortions to consumption decisions.39 Furthermore, and perhaps more importantly, a stimulus package financed with public debt would be a more socially desirable outcome due to its redistributive nature. The future tax burden would be borne by: (a) future generations not affected by a severe economic shock such as during the COVID-19 pandemic and (b) higher-income individuals with lower marginal consumption utility or lower social welfare weights.

Under the assumption that workers claim their benefits during the first year of legal retirement age and choose immediate life annuity pension, Table 2 also shows that this policy reduces private pension payments by USD 20.61/month on average: USD 25.74 for men and USD 12.63 for women. This drop is equivalent to a 7.26% reduction, which increases slightly

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35The robustness checks show that a higher economic growth raises compound returns and government supplements, but reduces inequality in retirement under no mitigation policies.

36This paper considers US dollars on July 30, 2020. USD 37.76 = 1 UF = CLP 28,668.36.

37The average withdrawal considers the Carli index formula $X_C(x^0, x^1) = \frac{1}{N} \sum_{n=1}^{N} x^1_n$, and the aggregate drop in the retirement savings balance uses the Dutot index formula $X_D(x^0, x^1) = \sum_{n=1}^{N} x^1_n / \sum_{n=1}^{N} x^0_n$.

38For a representative individual with a life expectancy of $T$ years and who plans to remain in the labor force for $N$ years, the simplest version of the lifecycle hypothesis states that $C_t = \frac{1}{T} [Y_t + (N - 1) \bar{Y} + A_t]$. With $Y_t$ as current annual labor income in time $t$, $\bar{Y}$ the present value of average annual labor income expected over the future $(N - 1)$ years, and $A_t$ the present value of retirement savings (or total assets).

39The empirical evidence of Ricardian equivalence is inconclusive. Tested in a life-cycle framework this hypothesis is usually rejected, but it is usually accepted under optimizing models (Ricciuti, 2003).
| Variable                          | Male Mean | CI (95%)            | Female Mean | CI (95%)            | Total Mean | CI (95%)          |
|----------------------------------|-----------|---------------------|-------------|---------------------|------------|-------------------|
| Average withdrawal (USD)         | 3044      | [3040, 3051]        | 1968        | [1960, 1986]        | 2623       | [2618, 2631]      |
| Average withdrawal (%)           | 16.24     | [15.95, 16.47]      | 33.31       | [32.54, 33.88]      | 22.92      | [22.62, 23.18]    |
| Aggregate withdrawal (%)         | 7.78      | [7.74, 7.83]        | 9.09        | [8.95, 9.28]        | 8.00       | [7.95, 8.06]      |
| Total cost ratio                 | −1.68     | [−2.56, −1.10]      | −1.45       | [−1.98, −1.09]      | −1.59      | [−2.33, −1.09]    |
| PPB with release (USD)           | 349.02    | [270.20, 455.27]    | 127.67      | [103.78, 162.17]    | 262.34     | [206.03, 340.50]  |
| PPB no release (USD)             | 374.77    | [289.17, 491.73]    | 140.29      | [113.91, 178.38]    | 282.94     | [221.27, 368.75]  |
| Effect on PPB (USD)              | −25.74    | [−35.68, −18.93]    | −12.63      | [−16.40, −9.96]     | −20.61     | [−28.31, −15.44]  |
| Effect on PPB (Δ%)               | −6.84     | [−7.42, −6.33]      | −8.99       | [−9.59, −8.40]      | −7.26      | [−7.80, −6.74]    |
| Effect on FPB (USD)              | −25.05    | [−34.97, −18.36]    | −12.19      | [−15.94, −9.56]     | −20.00     | [−27.70, −14.96]  |
| Effect on gov. support (USD)     | 7.13      | [5.66, 8.81]        | 4.14        | [3.30, 5.18]        | 5.96       | [4.74, 7.42]      |
| Effect on gov. expenditure (Δ%)  | 5.87      | [3.34, 8.56]        | 2.17        | [1.24, 3.59]        | 4.33       | [2.51, 6.23]      |
| Gini index × 100, PPB with release| 45.81    | [44.34, 48.36]      | 60.12       | [58.60, 61.95]      | 53.58      | [52.46, 55.22]    |
| Gini index × 100, PPB no release | 44.62    | [43.17, 47.21]      | 57.79       | [56.41, 59.56]      | 52.21      | [51.10, 53.95]    |
| Gini index × 100, FPB with release| 45.77    | [44.29, 48.32]      | 60.12       | [58.60, 61.95]      | 53.56      | [52.43, 55.19]    |
| Gini index × 100, FPB no release | 44.59    | [43.13, 47.17]      | 57.79       | [56.41, 59.56]      | 52.18      | [51.07, 53.93]    |

Note: Real values at US dollars on July 30, 2020. USD 37.76 = 1 UF = CLP 28,668.36. The mean and CI come from a Monte Carlo simulation with 500 replications. Abbreviations: FPB, final pension benefits; PPB, private pension benefits; UF, Unidad de Fomento.

Source: Author’s construction based on EPS (Social Protection Survey) and Chilean Pension Superintendency data.
On average, the reduction is 6.84% for men and 8.99% for women due to their lower pension benefit levels. Given these falls in self-funded pension benefits, we analyze the effects at age 65 on government supplement APS and fiscal expenditure, also considering changes in the probability of support. Government supplement APS surges USD 5.96/month on average for those benefited, while fiscal expenditure rises by 4.33%; being USD 7.13 (5.87%) for men and USD 4.14 (2.17%) for women. The growth in APS reduces losses on final pension benefits at age 65, reaching USD 20 on average. Lastly, the Gini index means tests show that this policy significantly raises income inequality in retirement, where the Solidarity Pillar has a negligible effect on lessening aggregate inequality measures.

Considering the remaining number of years to reach the minimum statutory retirement age, multipanel Figure 3 shows how withdrawal is distributed across the current age, its effects on

**FIGURE 3** Early access by current age (Economic Scenario 2). Real values at US dollars on July 30, 2020. USD 37.76 = 1 Unidad de Fomento = CLP 28,668.36. Estimated values come from a Monte Carlo simulation with 500 replications. Source: Author’s construction based on EPS (Social Protection Survey) and Chilean Pension Superintendency data

with age. On average, the reduction is 6.84% for men and 8.99% for women due to their lower pension benefit levels. Given these falls in self-funded pension benefits, we analyze the effects at age 65 on government supplement APS and fiscal expenditure, also considering changes in the probability of support. Government supplement APS surges USD 5.96/month on average for those benefited, while fiscal expenditure rises by 4.33%; being USD 7.13 (5.87%) for men and USD 4.14 (2.17%) for women. The growth in APS reduces losses on final pension benefits at age 65, reaching USD 20 on average. Lastly, the Gini index means tests show that this policy significantly raises income inequality in retirement, where the Solidarity Pillar has a negligible effect on lessening aggregate inequality measures.

Considering the remaining number of years to reach the minimum statutory retirement age, multipanel Figure 3 shows how withdrawal is distributed across the current age, its effects on

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40Fisher (1922) was the first to establish the upward bias in the Carli index formula, then Szulc (1983) was extremely influential showing that the Dutot index formula is preferred over the Carli one. Hence, and because of the sensitiveness of the Carli formula to outliers, this paper computes the aggregate percentages using the Dutot index formula.

41Despite the overlapping confidence intervals, the t-test statistic comparing the means with release and without the release of resources is 481.56 for private pensions and 480.49 for final pensions. In both cases with a p-value of 0.00 which allows us to reject the null hypothesis of equals means.

42Despite the overlapping confidence intervals, the mean t-test statistic comparing private pension versus final pension benefits with the early release is 132.27 and 136.36 without the early release. In both cases with a p-value of 0.00 which allows us to reject the null hypothesis of equals means.
private pensions, and the total cost on future retirement income. Specifically, Figure 3a reveals that men and mature workers get access to higher withdrawals of money as their savings balances are larger. However, Figure 3b shows that, due to the established maximum and minimum thresholds, they withdraw a lower percentage from the aggregate savings balance compared to young female workers. Figure 3c depicts how the effect on self-funded benefits is distributed, with an aggregate average effect relatively stable around $-7.3\%$, and where young women have the highest reductions in future private pensions. Lastly, Figure 3d shows that after controlling for the remaining years until the minimum statutory retirement age, the total cost of each withdrawn dollar on retirement savings is similar across gender. However, it rises considerably to minus four times for the youngest workers, due to the loss of compound returns over a longer period.

Multipanel Figure 4 shows how effects on private pensions and government support are distributed by retirement age, gender, and income distribution. The negative impact on self-funded benefits is higher for men and rises in magnitude with retirement age, as shown in Figure 4a. This can be explained by the exponential effect of delaying retirement and the higher loss of cumulative returns. As before, we calculate life annuity benefits when retirement occurs in the first year of legal retirement age, and given these benefits, their respective government supplements. To analyze the effects of this policy by private pension distribution, the ratio

![Figure 4](image-url)
between self-funded benefits and contemporaneous PBS is ranked in ascending order to define private pension benefit deciles. Figure 4b shows that women and workers with low private pensions are most affected, losing much of their self-funded benefits. Figure 4c reveals that the growth in fiscal expenditure due to this policy is higher for males and decreases sharply until the age of 75, while it is stable at around 2% for females. The average increase of government support APS per worker is depicted in Figure 4d. As the impacts on private pensions are larger for men, the rise in APS is higher for them; the APS increases with age given the real growth of government supplements, with an average of USD 7.6 per male worker. The required growth in APS for women follows a similar shape but is lower, with an average of USD 4.2 per female worker.

Therefore, early access to individual savings accounts is not innocuous and reduces private pension benefits by 7.3% on average, exacerbating income inadequacy in retirement and increasing pressure on government supplements funded by general taxes. This impact is not homogeneous; women are less affected in levels but suffer a higher percentage loss given their lower pension levels. Because the highest percentage losses are concentrated in women and workers with a low private pension, this policy increases private income inequality in retirement. This outcome is reinforced by the fact that high-income workers have additional savings or assets out of the compulsory pension system and are less likely to get into financial difficulties that force them to ask for early access to retirement accounts. Thus, government supplements must rise to counteract these effects, placing more fiscal and political pressure on a system unable to bestow proper pension benefits. Additionally, the Chilean pension system stipulates that only those workers who have sufficient funds to finance private pension benefits at least equal to PBS can access a life annuity pension mode. Given the effect of this policy, the percentage of workers not eligible to access this pension mode rises from 59.1% to 62.3%, leaving them only with programmed withdrawal as pension mode and forcing them to assume the longevity risk.

5.2 Mitigation policies

The consequences of this policy reinforce the need to strategically address the current challenges of most defined contribution schemes, some of them particularly imperative in the Chilean pension system, as are income inadequacy and inequality in retirement, integrity, risk-sharing, legitimacy, and fiscal sustainability. Aiming to propose a functional and efficient design, rather than only supplementing outcomes at the end of the working life, this subsection offers four mitigation policies and quantifies their potential effects.

The first mitigation policy is contribution enforcement. Figure 2a shows a considerable gap between working and those who additionally contribute. For those who work in our data set, the noncontribution rate is 61.56% for self-employed workers, 48.48% for domestic workers, and 13.58% for salaried employees. The amendments to Law No. 21,269 that regulate labor relations with domestic workers began to take effect on October 1, 2020, incorporating the duty to contribute to the pension system. Successive laws had delayed the obligation to contribute to self-employed workers. Only in 2019, when law 21,133 came into force, the obligation to contribute to the Pension System of independent workers debuted for the first time. However, in the first years, it will be possible to...
enforcement and lowering labor informality via an increase and improvement of fiscalization (Oviedo et al., 2009), incentives to formalize low-income jobs (Loayza, 2018; Oviedo et al., 2009), and/or for example, by making it compulsory to pay wages directly into a bank account. The experiences of Brazil (Cardoso, 2016; Catão et al., 2009), Peru (Morón et al., 2012), and Uruguay (Gandelman & Rasteletti, 2016) show that firms with higher access to financial services (bankarization) would decrease informality for their workers.

Second, reduce tax evasion and narrow the significant gap between self-reported and administrative taxable wages shown in Figure 2b. This could be achieved through an increase and improvement of fiscalisation, increasing penalties or rewards (Falkinger & Walther, 1991; Watson, 1985), and/or reconciliation of bank statements to detect unreported labor earnings (Nawawi & Salin, 2018). Besides, Kleven et al. (2011) show that third-party reported information raises tax law enforcement and those who self-report income have the lowest levels of tax compliance.

Third, some public policies aimed to incentivize retirement delay could be considered. Figure 2a shows that most individuals are impatient and claim benefits as soon as they can, while pension benefits grow exponentially with retirement age as is shown by Figure 2c. Specifically, after reaching the minimum statutory retirement age, the exponential growth in private pension benefits is explained almost exclusively by having to cover a shorter period in retirement, with only a minuscule part of these gains explained by continued contributions.46 Thus, stopping contributions beyond the minimum statutory age, or improvement in labor market conditions for mature workers via employment and training programs, would increase the expected value of being nonpensioned and encourage retirement delay. Laitner and Silverman (2012) find that eliminating Social Security payroll taxes on workers aged 60 and older, coupled with higher taxes at younger ages, would increase labor supply and would be welfare-improving for most people. French and Jones (2012) and Laun (2017) show that, as labor supply elasticities rise with age, relatively lower tax rates for mature workers would encourage late retirement. Hernæs et al. (2016) show that increased work incentives may constitute a highly effective strategy for increasing mature labor force participation due to the relatively high labor elasticity. Albanese and Cockx (2019) find that the wage cost subsidy significantly increases the retention rate in employment of workers at high risk of early retirement, with limited effect on employment at the intensive margin.47

Fourth, we analyze an increase in the contribution rate and the introduction of an intragenerational redistributive component. Under this new scheme, a part of the workers’ monthly contributions is used to create a solidarity fund, which is distributed equitably among its contributors each month. As a result, this policy encourages the formality and contributions of low-income workers, who are net beneficiaries, tackling income inequalities that come from the labor market. Meghir and Phillips (2010) and Karabarbounis (2016) show that extensive and intensive labor supply elasticities are lower for net contributors; middle-aged, wealthy, and male taxpayers. Saez (2003) evidence that labor income responses to payroll taxation are lower for married and high-income workers, while Lehmann et al. (2013) find similar behavior in

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46 Since the minimum statutory retirement age, 99.9% of those yearly gains is explained by having to cover a shorter period in retirement for men and 99.8% for women.

47 Moreover, Böheim et al. (2019) show that older and younger workers are complements for each other rather than substitutes; increasing the retirement age and job opportunities for older workers coincides with higher employment and wages for younger workers. Additionally, this paper shows that lowering the retirement age decreases the incentives to train and invest in additional skills, and therefore leads to lower economic growth.
men and top-wage earners. Thus, net contributor workers would be less keen to change their labor supply decisions and taxable wages, attenuating the inefficiency costs of this policy.\textsuperscript{48} Although government pension benefits at retirement funded by general taxes could create fewer distortions in the labor market, the inclusion of a solidarity component has some advantages: (a) increase in social acceptance and legitimacy for a system highly criticized for its individual orientation and low replacement rates, (b) address main problems like lack of contribution and informality of low-income workers through the working life, and not come only to supplement private pension benefits in retirement, and (c) easy to implement, and with no fiscal cost as it would result only in monthly transfers of resources between private accounts.

Table 3 depicts the effects on self-funded benefits, inequality, and government expenditure of these four mitigation policies.\textsuperscript{49} Robustness checks under other economic scenarios are shown by Table D2 in Appendix D.

1. Halving the gap between working and working/contributing probabilities raises monthly private pension benefits at the minimum statutory retirement age by 3.94%, and 7.86% enforcing all those who work to contribute to the pension system. As the gap between working and those who additionally contribute is higher for women and low-income workers, contribution enforcement would increase more private pension benefits for women and significantly reduce inequality in retirement incomes. Besides, the fiscal expenditure would be lessened by 2.73% cutting half of the contribution avoidance and 5.31% under full contribution enforcement, but most of this effect is concentrated on men.

2. Halving the gap between self-reported and administrative taxable wages increases monthly private pension benefits at the minimum statutory retirement age by 6.18%, and 12.37% enforcing administrative taxable wages to be the same as self-reported taxable wages. As the gap between these variables is higher for men than for women and there are minor differences across the income distribution, private pension benefits rise more for men with limited changes in inequality. Thus, the fiscal expenditure would be reduced by 3.11% cutting half of the tax evasion and 5.92% eliminating tax evasion. However, the falls on government expenditure are highly concentrated on men.

3. Delaying retirement by 1 year upon the minimum statutory retirement age raises monthly private pension benefits by 3.17% when 50% of workers do so and 6.36% when all of them do. As the minimum statutory retirement age is higher for males and private pension benefits grow exponentially with retirement age, the effects on men are higher with negligible effects on inequality. Besides, the fiscal expenditure would be reduced by 1.48% when retirement is delayed for 50% of workers and 2.92% when this is done for all of them, but most of this effect is concentrated on men.

4. An increase in the contribution rate by 4 pp and the use of 50% of that raise for intragenerational redistribution shows the greatest effect. This mitigation policy would raise monthly private pension benefits at the minimum statutory retirement age by 8.66% with no changes in labor decisions, and 14.10% halving the gap between working and working/contributing probabilities.

\textsuperscript{48}Furthermore, several papers show a small elasticity of taxable income in the medium and long term (Goolsbee, 2000; Sammartino & Weiner, 1997; Slemrod, 1995), limiting the behavioral implications of this policy on long-term contributions to the retirement accounts.

\textsuperscript{49}Despite the overlapping confidence intervals, all the \( p \) value of \( t \)-test statistics comparing the means of Gini indexes are 0.00. This allows rejection of the null hypothesis of equals means and assures that all proposed policies significantly reduce inequality in self-funded pension benefits.
|                              | Male Mean | Male CI (95%) | Female Mean | Female CI (95%) | Total Mean | Total CI (95%) |
|------------------------------|-----------|--------------|-------------|-----------------|------------|---------------|
| **Private pension benefits (Δ%)** |           |              |             |                 |            |               |
| 50% less contributions avoidance | 3.89      | [2.45, 5.86] | 4.18        | [2.49, 6.20]    | 3.94       | [2.76, 5.79]  |
| Full contribution enforcement  | 7.75      | [4.90, 11.56]| 8.33        | [4.96, 12.47]   | 7.86       | [5.54, 11.41] |
| 50% less tax evasion          | 6.43      | [4.65, 8.67] | 5.14        | [3.87, 6.70]    | 6.18       | [4.60, 8.20]  |
| No tax evasion                | 12.85     | [9.30, 17.34]| 10.28       | [7.74, 13.41]   | 12.37      | [9.20, 16.40] |
| 50% workers delay retirement  | 3.24      | [2.42, 4.11] | 2.89        | [1.90, 3.89]    | 3.17       | [2.37, 3.98]  |
| 100% workers delay retirement | 6.49      | [4.91, 8.23] | 5.78        | [3.79, 7.65]    | 6.36       | [4.79, 8.07]  |
| Solidarity fund—No behavioral response | 8.53 | [6.37, 11.19] | 9.18 | [7.07, 11.74] | 8.66 | [6.64, 11.14] |
| Solidarity fund—With behavioral response | 13.86 | [10.7, 18.37] | 15.14 | [11.98, 19.24] | 14.10 | [11.09, 18.51] |
| **Gini index × 100**          |           |              |             |                 |            |               |
| With release and no mitigation policy | 45.81 | [44.34, 48.36] | 60.12 | [58.60, 61.95] | 53.58 | [52.46, 55.22] |
| 50% less contributions avoidance | 44.37 | [43.15, 46.69] | 58.63 | [57.27, 60.37] | 52.29 | [51.28, 54.04] |
| Full contribution enforcement  | 43.32 | [42.13, 45.68] | 57.60 | [56.11, 59.47] | 51.37 | [50.33, 53.26] |
| 50% less tax evasion          | 45.36 | [43.98, 47.62] | 59.90 | [58.29, 61.97] | 53.29 | [52.17, 55.12] |
| No tax evasion                | 45.23 | [43.75, 47.60] | 59.83 | [58.04, 62.07] | 53.23 | [52.04, 55.16] |
| 50% workers delay retirement  | 45.74 | [44.26, 48.31] | 60.06 | [58.56, 61.87] | 53.54 | [52.42, 55.22] |
| 100% workers delay retirement | 45.68 | [44.18, 48.28] | 60.01 | [58.50, 61.82] | 53.51 | [52.38, 55.27] |
| Solidarity fund—No behavioral response | 45.00 | [43.62, 47.37] | 59.49 | [57.71, 61.76] | 52.87 | [51.70, 54.80] |
| Solidarity fund—With behavioral response | 43.26 | [42.10, 45.65] | 57.63 | [56.00, 59.79] | 51.29 | [50.22, 53.29] |

(Continues)
|                              | Male              | Female             | Total              |
|------------------------------|-------------------|--------------------|--------------------|
|                              | Mean CI (95%)     | Mean CI (95%)      | Mean CI (95%)      |
| **Government expenditure (Δ%)** |                   |                    |                    |
| 50% less contributions avoidance | -3.79 [-5.83, -2.29] | -1.24 [-2.50, -0.26] | -2.73 [-3.96, -1.69] |
| Full contribution enforcement | -7.35 [-10.15, -4.61] | -2.43 [-4.28, -1.02] | -5.31 [-7.18, -3.50] |
| 50% less tax evasion         | -4.54 [-6.15, -3.17] | -1.09 [-2.16, -0.59] | -3.11 [-4.14, -2.22] |
| No tax evasion               | -8.60 [-11.12, -6.42] | -2.14 [-3.60, -1.22] | -5.92 [-7.63, -4.54] |
| 50% workers delay retirement | -2.14 [-3.40, -1.19] | -0.57 [-1.26, -0.28] | -1.48 [-2.25, -0.89] |
| 100% workers delay retirement| -4.19 [-6.10, -2.49] | -1.12 [-2.14, -0.58] | -2.92 [-4.23, -1.79] |
| Solidarity fund—No behavioral response | -6.70 [-8.86, -4.95] | -2.10 [-3.49, -1.25] | -4.79 [-6.28, -3.63] |
| Solidarity fund—With behavioral response | -11.70 [-15.11, -8.47] | -3.85 [-6.01, -2.34] | -8.45 [-10.56, -6.30] |

**Note:** Mean and confidence intervals (CI) come from a Monte Carlo simulation with 500 replications. Real values at US dollars on July 30, 2020. USD 37.76 = 1 Unidad de Fomento = CLP 28,668.36.

**Source:** Author’s construction based on EPS (Social Protection Survey) and Chilean Pension Superintendency data.
contribute probabilities due to incentives. As women contribute a percentage of their lower taxable wages, but this fund is equitably distributed, women’s private pension benefits grow more than men’s, reducing the gender gap in retirement incomes. Similarly, as low-income workers are the net beneficiaries and high-income workers are net contributors, this policy significantly reduces inequality in self-funded pension benefits. Given these effects, the increase in the contribution rate along with the creation of this solidarity fund shows the greatest effects on lessening fiscal expenditure, with a drop of 4.79% under no behavioral responses and 8.45% considering changes in labor decisions.

6 | CONCLUSION

During severe and extended economic crises, some policymakers worldwide have turned to retirement accounts to support individuals in financial hardship, without properly analyzing the long-term impacts on retirement savings adequacy and fiscal sustainability. Using a nationally representative survey complemented with administrative pension information and Monte Carlo simulations, this study describes the effect on self-funded benefits and government supplements of early access to individual savings accounts in Chile during the COVID-19 pandemic.

The implemented law of a 10% release of retirement savings results in an average withdrawal of 22.92% from individual accounts, representing a drop of 8% in the aggregate savings balance of the system and equivalent to equivalent to USD 2623 per person. Considering life annuities in the first year of legal retirement age, this erosion on private savings balances will reduce pension benefits by 7.26% on average, with higher percentage losses for women and low-income workers. Such effects translate into a considerable rise in income inadequacy and inequality in retirement, which would take 4.33% higher government expenditure to counteract for those aged 65.

The consequences of this policy reinforce the need to strategically address the current challenges of most defined contribution schemes with a functional and efficient design, rather than only supplementing outcomes at the end of the working life. This paper analyzes four mitigation policies that go in that direction, addressing challenges associated with inequalities coming from the labor market and exacerbated by the pension system, demographic change, and risk-sharing. A better design including this kind of policy would not only improve pension benefits but also increase legitimacy, along with lessening political and fiscal pressure on defined contribution pension schemes. Finally, these measures would be effective policies and entail a lower political cost than a simple change on parameters such as an increase in the legal minimum retirement age, tightening eligibility rules, or reducing the size of pensions by adjusting benefit formulas.

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**SUPPORTING INFORMATION**

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APPENDIX A: ADDITIONAL INSTITUTIONAL CONTEXT

At the claiming period, the Chilean pension system computes the Self-funded Pension of Reference (PAFE in Spanish) considering an immediate life annuity pension mode, without special coverages, considering age, life-annuity return rates, family composition, and the private balance cumulated by mandatory pension contributions. The PAFE plus other survivors’ pensions define the Private Base Pension (PBase). This PBase determines the access to government supplements, which is computed considering the PBS and PMAS. The programmed withdrawal pension mode has particular features that unnecessarily complicate the analysis; (1) those pensioners with PBase < PBS have a guaranteed final pension benefit, (2) those with PBS < PBase < PMAS have a guaranteed supplement constant across years, and the government guarantees pension benefits at least equal to PBS, (3) the pension reform implemented in 2008 included an actuarially fair factor for pensioners under programmed withdrawal modality who access the solidarity pillar; this adjustment factor ensures that the present value of government supplements received in the programmed withdrawal modality is equal to those received under the life annuity pension mode, (4) the technical return rate is officially estimated and reported by the authority, with an estimation method that not necessarily generate a good predictor of the future profitability of the funds, and (5) all this has changed with Law 21,190, approved in December 2019, and that applies to all pensioners who have access to the pillar since January 2020. Under this law, everyone has access to a guaranteed final pension, but no longer exists a guaranteed subsidy and the actuarially fair factor. The person now finances with her own balance her pension benefits and the solidarity supplements until the balance is exhausted, and only after that, the government finances her pension benefits. In the case of life annuities, the supplement is calculated in the same way.

Data from the Chilean Superintendency of Pensions shows that from July 1, 2011, PBS beneficiaries have remained quite stable for both men and women, with PBS benefits on regime covering 60% of the population with low income. The number of PBS beneficiaries in July 2020 was 591,351, with 31.1% men and 68.9% women. In the same month, the number of APS beneficiaries was 1,066,102, made up of 42.7% men, and 57.3% women. These numbers evidence a sustained growth of the program since its inception, where this distributive tier has covered 58.4% of people with old-age pensions, supporting a total of 1,657,457 individuals up to July 2020. At the same time, fiscal expenditure on the distributive tier as a percentage of GDP has risen steadily from 0.58% in 2009 to 0.78% in 2019. Table A1 describes the real values of PBS and PMAS. PBS shows significant jumps in 2009, 2017, and at the end of 2019, while PMAS surge sharply in the first 3 years, after which it has remained relatively stable and rises again at the end of 2019.

Recent increases in government subsidies at the end of 2019 are explained by social discontent and massive protests that occurred around the country at the end of 2019 and lasted to a lesser extent until the COVID-19 pandemic. Income adequacy, continuing inequality, precarious access to public services, along with high profits of private companies in the social security sector has caught the attention of Chilean society and put more fiscal pressure on the

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50https://www.spensiones.cl/portal/compendio/596/w3-propertyvalue-3466.html
51https://www.spensiones.cl/portal/compendio/596/w3-propertyvalue-3429.html
52https://www.spensiones.cl/portal/institucional/594/articles-6102_libroReformaCompleto.pdf, pp 147–150.
53It was considered the values in UF units at implementation time and those values transform to US dollars with the exchange rate on July 30, 2020. USD 37.76 = 1 UF = CLP 28,668.36
54Chile’s crisis was decades in the making. Jennifer Pribble, October 28, 2019, Financial Times. https://www.ft.com/content/81801886-f650-11e9-bbe1-4db3476c5ff0
One of the main social demands has been a rise in pension benefits funded by general taxes. The Chilean government replied with the New Social Agenda to address social demands and people’s discontent. One of the main goals of this agenda is to increase public benefits PBS and PMAS by up to 50%, placing greater fiscal pressure with consequential effects on retirement age and labor market decisions.

### TABLE A1  Pensión Básica Solidaria (PBS) and Pensión Máxima con Aporte Solidario (PMAS) real values at implementation time (US Dollar at July 30, 2020)

| From       | Age (years)  | PBS   | PMAS  |
|------------|--------------|-------|-------|
| July 2008  | 65 and older | 111.08| 129.59|
| July 2009  | 65 and older | 135.29| 216.46|
| September 2009 | 65 and older | 135.67| 271.33|
| July 2010  | 65 and older | 134.93| 355.82|
| July 2011  | 65 and older | 135.11| 439.18|
| July 2012  | 65 and older | 134.49| 437.16|
| July 2013  | 65 and older | 135.37| 440.03|
| July 2014  | 65 and older | 134.98| 439.29|
| July 2015  | 65 and older | 135.82| 423.34|
| July 2016  | 65 and older | 135.37| 440.02|
| January 2017 | 65 and older | 147.50| 435.88|
| July 2017  | 65 and older | 148.31| 438.24|
| July 2018  | 65 and older | 149.03| 440.40|
| July 2019  | 65 and older | 148.90| 439.99|
| December 2019 | 65–74      | 183.87| 543.35|
| December 2019 | 75–79      | 191.23| 565.08|
| December 2019 | 80 and older | 220.65| 652.02|
| July 2020   | 65–74       | 186.12| 550.00|
| July 2020   | 75–79       | 193.57| 572.00|
| July 2020   | 80 and older | 223.35| 660.00|
| January 2021| 65–74       | 205.40| 606.96|
| January 2021| 75 and older| 220.07| 650.32|
| January 2022| 65 and older| 213.66| 631.38|

**Note:** Real values at US dollars on July 30, 2020. USD 37.76 = 1 Unidad de Fomento = CLP 28,668.36.

**Source:** Author’s construction based on Chilean Pension Superintendency data.

state. One of the main social demands has been a rise in pension benefits funded by general taxes. The Chilean government replied with the New Social Agenda to address social demands and people’s discontent. One of the main goals of this agenda is to increase public benefits PBS and PMAS by up to 50%, placing greater fiscal pressure with consequential effects on retirement age and labor market decisions.

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55Chile Woke Up: Dictatorship’s Legacy of Inequality Triggers Mass Protests. Amanda Taub, November 3, 2019, *The New York Times*. https://www.nytimes.com/2019/11/03/world/americas/chile-protests.html

56https://www.gob.cl/agendasocial/
FIGURE B1  Labor variables and pension benefits by gender. Real values at US dollars on July 30, 2020. USD 37.76 = 1 Unidad de Fomento = CLP 28,668.36. Estimated values come from a Monte Carlo simulation with 500 replications under economic Scenario 2. Source: Author’s construction based on EPS and Chilean Pension Superintendency data.
### APPENDIX C: MACROECONOMIC AND LABOR VARIABLES

Table C1

#### Variable C1
Macroeconomic variables—Moderate economic growth (Scenario 2)

| Variable                                      | Since           | Value (%) |
|-----------------------------------------------|-----------------|-----------|
| Inflation, annual growth rate                 | August 2020     | 3         |
| Minimum wage, nominal growth rate             | March 2021      | 5         |
| Government pension benefits, nominal growth rate | January 2023    | 5         |
| Mandatory contribution rate (stable)          | –               | 10        |

| Variable                                      | Assumption      | Since       | Annual average (%) |
|-----------------------------------------------|-----------------|-------------|---------------------|
| GDP, real growth rate                         | Defined values  | August 2020 |                     |
| Unemployment rate                             | MAR(12)         | August 2020 | −6.01 4.52          | N(2.93, 2.02) |
| Real interest rate (life annuity)             | MAR(2)          | July 2020   | 1.69 2.27           | N(2.76, 0.91) |
| Portfolio A real return rate                  | SUR(3)          | July 2020   | 1.54 0.47           | N(5.75, 15.76) |
| Portfolio B real return rate                  | SUR(3)          | July 2020   | 2.51 4.39           | N(5.08, 11.33) |
| Portfolio C real return rate                  | SUR(2)          | July 2020   | 4.15 5.14           | N(4.49, 7.60)  |
| Portfolio D real return rate                  | SUR(2)          | July 2020   | 3.79 3.93           | N(4.02, 5.22)  |
| Portfolio E real return rate                  | SUR(3)          | July 2020   | 4.17 3.83           | N(3.21, 3.56)  |

**Note:** A multivariate autoregressive process of order “p” is denoted by “MAR(p)” and a seemingly unrelated regression of order “p” is denoted by “SUR(p).”

**Source:** Author’s construction. Mean and SD come from a Monte Carlo simulation with 500 replications.
FIGURE C1  Performance evaluation (Economic Scenario 2). Estimated values come from a Monte Carlo simulation with 500 replications. Source: Author’s construction based on EPS and Chilean Pension Superintendency data

APPENDIX D: ROBUSTNESS CHECK

Figure D1
Table D1
Table D2

FIGURE D1  Result according to the number of replications (Economic Scenario 2). Estimated values come from a Monte Carlo simulation with 500 replications. Source: Author’s construction based on EPS (Social Protection Survey) and Chilean Pension Superintendency data
| Variable                                      | Scenario 1 |          | Scenario 2 |          | Scenario 3 |          |
|-----------------------------------------------|------------|----------|------------|----------|------------|----------|
| Macroeconomic indicator                       | Mean       | SD       | Mean       | SD       | Mean       | SD       |
| Real GDP growth rate (%)                      | 2.00       | 2.00     | 2.93       | 2.02     | 3.85       | 2.07     |
| Unemployment rate (%)                         | 8.16       | 1.48     | 7.53       | 1.48     | 7.05       | 1.45     |
| Real interest rate (life annuity) (%)         | 2.66       | 0.89     | 2.76       | 0.91     | 2.77       | 0.90     |
| Portfolio A real return rate (%)              | 4.96       | 15.54    | 5.75       | 15.76    | 6.34       | 15.78    |
| Portfolio B real return rate (%)              | 4.18       | 11.20    | 5.08       | 11.33    | 6.16       | 11.39    |
| Portfolio C real return rate (%)              | 3.83       | 7.54     | 4.49       | 7.60     | 5.52       | 7.64     |
| Portfolio D real return rate (%)              | 3.42       | 5.17     | 4.02       | 5.22     | 4.98       | 5.23     |
| Portfolio E real return rate (%)              | 2.86       | 3.52     | 3.21       | 3.56     | 3.80       | 3.54     |
| Results                                       | Mean       | CI (95%) | Mean       | CI (95%) | Mean       | CI (95%) |
| Average withdrawal (USD)                      | 2,623      | [2,618, 2,631] | 2,623      | [2,618, 2,631] | 2,623      | [2,618, 2,633] |
| Average withdrawal (%)                        | 22.92      | [22.61, 23.16] | 22.92      | [22.62, 23.18] | 22.93      | [22.61, 23.20] |
| Aggregate withdrawal (%)                      | 8.00       | [7.95, 8.06] | 8.00       | [7.95, 8.06] | 8.00       | [7.95, 8.06] |
| Total cost ratio                              | −1.45      | [−2.07, −1.02] | −1.59      | [−2.33, −1.09] | −1.80      | [−2.74, −1.22] |
| PPB with release (USD)                        | 246.11     | [195.16, 313.92] | 262.34     | [206.03, 340.50] | 286.63     | [223.22, 373.49] |
| PPB no release (USD)                          | 265.26     | [209.85, 339.40] | 282.94     | [221.27, 368.75] | 309.46     | [239.54, 404.55] |
| Effect on PPB (USD)                           | −19.15     | [−25.73, −14.35] | −20.61     | [−28.31, −15.44] | −22.83     | [−31.56, −16.58] |
| Effect on PPB (Δ%)                            | −7.20      | [−7.68, −6.72] | −7.26      | [−7.80, −6.74] | −7.35      | [−8.02, −6.75] |
| Effect on FPB (USD)                           | −18.60     | [−24.95, −13.7] | −20.00     | [−27.70, −14.96] | −22.13     | [−30.84, −15.93] |
| Effect on gov. support (USD)                  | 5.66       | [4.40, 6.99] | 5.96       | [4.74, 7.42] | 6.35       | [5.00, 7.79] |
| Effect on gov. expenditure (Δ%)              | 4.04       | [2.61, 6.03] | 4.33       | [2.51, 6.23] | 4.87       | [2.97, 6.80] |

(Continues)
| Variable | Scenario 1 | Scenario 2 | Scenario 3 |
|----------|------------|------------|------------|
| Gini index $\times 100$, PPB with release | 53.64 [52.52, 55.32] | 53.58 [52.46, 55.22] | 53.61 [52.51, 55.19] |
| Gini index $\times 100$, PPB no release | 52.28 [51.18, 53.90] | 52.21 [51.10, 53.95] | 52.22 [51.16, 53.82] |
| Gini index $\times 100$, FPB with release | 53.62 [52.50, 55.29] | 53.56 [52.43, 55.19] | 53.58 [52.48, 55.16] |
| Gini index $\times 100$, FPB no release | 52.25 [51.16, 53.88] | 52.18 [51.07, 53.93] | 52.20 [51.14, 53.81] |

Note: Mean, SD, and CI come from a Monte Carlo simulation with 500 replication. Real values at US dollars on July 30, 2020. USD 37.76 = 1 UF = CLP 28,668.36.

Abbreviations: CI, confidence interval; FPB, final pension benefits; PPB, private pension benefits; UF, Unidad de Fomento.

Source: Author's calculation based on EPS (Social Protection Survey) and Chilean Pension Superintendency data.
| Economic scenarios and mitigation policy effects—Robustness check |
|---------------------------------------------------------------|
| **Scenario 1** | **Scenario 2** | **Scenario 3** |
|-----------------|----------------|----------------|
| **Private pension benefits (Δ%)** & **Mean** | **CI (95%)** | **Mean** | **CI (95%)** | **Mean** | **CI (95%)** |
| 50% less contributions avoidance | 3.85 | [2.57, 5.42] | 3.94 | [2.76, 5.79] | 4.12 | [2.72, 5.83] |
| Full contribution enforcement | 7.70 | [5.05, 10.93] | 7.86 | [5.54, 11.41] | 8.23 | [5.47, 11.84] |
| 50% less tax evasion | 6.08 | [4.53, 8.13] | 6.18 | [4.60, 8.20] | 6.34 | [4.72, 8.68] |
| No tax evasion | 12.15 | [9.06, 16.27] | 12.37 | [9.20, 16.40] | 12.68 | [9.43, 17.36] |
| 50% workers delay retirement | 3.03 | [2.19, 3.85] | 3.17 | [2.37, 3.98] | 3.43 | [2.64, 4.27] |
| 100% workers delay retirement | 6.08 | [4.51, 7.61] | 6.36 | [4.79, 8.07] | 6.88 | [5.29, 8.52] |
| Solidarity fund—No behavioral response | 8.55 | [6.61, 11.12] | 8.66 | [6.64, 11.14] | 8.79 | [6.67, 11.44] |
| Solidarity fund—With behavioral response | 13.87 | [10.71, 17.46] | 14.10 | [11.09, 18.51] | 14.48 | [11.41, 18.78] |
| **Gini index × 100** | & **With release and no mitigation policy** | **53.64** | **[52.52, 55.32]** | **53.58** | **[52.46, 55.22]** | **53.61** | **[52.51, 55.19]** |
| 50% less contributions avoidance | **52.28** | **[51.31, 53.93]** | **52.29** | **[51.28, 54.04]** | **52.37** | **[51.30, 54.24]** |
| Full contribution enforcement | **51.28** | **[50.29, 52.98]** | **51.37** | **[50.33, 53.26]** | **51.49** | **[50.34, 53.75]** |
| 50% less tax evasion | **53.24** | **[52.18, 54.82]** | **53.29** | **[52.17, 55.12]** | **53.46** | **[52.27, 55.62]** |
| No tax evasion | **53.08** | **[52.00, 54.57]** | **53.23** | **[52.04, 55.16]** | **53.52** | **[52.12, 56.22]** |
| 50% workers delay retirement | **53.60** | **[52.49, 55.29]** | **53.54** | **[52.42, 55.22]** | **53.57** | **[52.42, 55.15]** |
| 100% workers delay retirement | **53.57** | **[52.47, 55.23]** | **53.51** | **[52.38, 55.27]** | **53.53** | **[52.39, 55.10]** |
| Solidarity fund—No behavioral response | **52.79** | **[51.70, 54.40]** | **52.87** | **[51.70, 54.80]** | **53.08** | **[51.79, 55.31]** |
| Solidarity fund—With behavioral response | **51.12** | **[50.07, 52.58]** | **51.29** | **[50.22, 53.29]** | **51.57** | **[50.28, 54.16]** |
| **Government Expenditure (Δ%)** | & **50% less contributions avoidance** | **−2.55** | **[−3.78, −1.58]** | **−2.73** | **[−3.96, −1.69]** | **−3.12** | **[−4.39, −2.18]** |
| (Continues) | | | | | | | |
| Scenario                                      | Scenario 1 | Scenario 2       | Scenario 3       |
|----------------------------------------------|------------|------------------|------------------|
| Full contribution enforcement                | −4.91      | −5.31            | −5.99            |
| 50% less tax evasion                         | −2.98      | [−6.67, −3.25]   | [−7.18, −3.50]   | [−7.84, −4.26] |
| No tax evasion                               | −5.71      | [−7.46, −4.37]   | [−7.63, −4.54]   | [−7.84, −4.83] |
| 50% workers delay retirement                 | −1.34      | [−2.13, −0.77]   | [−2.25, −0.89]   | [−2.46, −1.09] |
| 100% workers delay retirement                | −2.63      | [−3.99, −1.60]   | [−4.23, −1.79]   | [−4.69, −2.19] |
| Solidarity fund—No behavioral response       | −4.58      | [−6.11, −3.42]   | [−6.28, −3.63]   | [−6.31, −3.96] |
| Solidarity fund—With behavioral response     | −7.96      | [−10.12, −6.20]  | [−10.56, −6.30]  | [−11.20, −7.20] |

**Note:** Mean and confidence intervals (CI) come from a Monte Carlo simulation with 500 replications. Real values at US dollars on July 30, 2020. USD 37.76 = 1 Unidad de Fomento = CLP 28,668.36.

**Source:** Author’s construction based on EPS (Social Protection Survey) and Chilean Pension Superintendency data.