Pension Reform in Spain: A Computable OLG Approach

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September 6, 2023

Abstract

We use an overlapping generations model economy with endogenous retirement to study the 2022 and 2023 reforms of the Spanish public pension system. These reforms increase the payroll tax collections, reduce the contributivity of the system, and incentivate to workers to delay retirement. We find that these reforms do not solve the long run sustainability problems that plague the Spanish Pension System, so that we conjecture that further reforms lurk in the future of Spanish pensions.

Keywords: Computable general equilibrium, social security reform, sustainability

JEL classification: C68, H55, H23

1 Introduction

The projected reduction of the real value of Spanish pensions brought about by the 2011 and 2013 pension reforms made these reforms politically unsustainable. Thus, and between 2018 and 2021, the Spanish government eliminated both the Sustainability Factor and the Pension Revaluation Index, the two more effective measures introduced by these reforms to reduce the growth rate of the Spanish pension expenditure over the next decades. Put differently, the Spanish government decided to return to full Consumption Price Index indexation for all of the Spanish public pensions.

Subsequently, and between 2022 and 2023, the Spanish government has introduced a series of parametric changes in the pension system, a process that concluded last March, when it was announced that it had reached an agreement with the unions that also had the European Commission approval.[1] These parametric changes imply an increase in the payroll tax collections, a reduction of the contributivity of the system, and an increase in the incentives for workers to delay retirement.

In this paper we analyze the quantitative consequences of these reforms of the Spanish public pension system. We study these reforms one at time to explore which reform is quantitatively more important. To do so, we simulate an enhanced version of the general equilibrium, multiperiod, overlapping generations model economy populated by heterogeneous households described in Díaz-Giménez and Díaz-Saavedra (2017). The model economy that we study here differs from the one that we used in that article in two fundamental ways. First, by assuming that Spain is a relatively small open economy where interest rates and wages that households face are taken as given. Second, we have updated our calibration year to 2018.

Our findings are the following: First, after the policy reversal that took place between 2018 and 2021, we confirm that the Spanish Public Pension System was completely unsustainable. Specifically, we show that the pension system expenditures would increase by more than 4 percentage points of GDP between 2020 and 2050, while the pension system revenues would have remained virtually unchanged. The pension deficit would have reached 6.6 percent of GDP in 2050, and the consumption tax rate that would have been necessary to finance this deficit would have increased from 16.6 percent in 2020 to a startling 27.3 percent in 2050.

And second, between the pension changes approved in 2022 and 2023, we find that the increase in the payroll tax cap, jointly with a smaller increase in the cap of the Regulatory Base, is the parametric change quantitatively more important. It reduces the pension deficit by 0.5 percentage points of GDP in 2050, and the consumption rate by 0.5 percentage points that same year. Finally, and when we simulate all the parametric changes at once, we find that these numbers are in 2050, 0.3 percentage points of GDP and 2.0 percentage points, respectively. Put differently, unfortunately the changes approved between 2021 and 2022 do not improve substantially the sustainability problems

[1] These parametric changes are described in the Real Decreto-ley 13/2022 and the Real Decreto-ley 2/2023.

that plague the Spanish Public Pension System.

The paper is organized as follows: section 2 presents the model economy; section 3 briefly describes the calibration procedure; section 4 describes the simulations; section 5 describes the demographic and macroeconomic scenarios used in our simulations; section 6 presents the results; and, lastly, section 7 concludes

2 The model economy

This section presents the model economy. We study an overlapping generations econ- omy with heterogeneous households, a representative firm, and a government. We use the same model in related work in Díaz-Saavedra (2023).[2] Time is discrete and runs forever, and each time period represents one calendar year. All model quantities depend on calendar time t, but we omit this dependence during the presentation. We begin with a description of household heterogeneity.

2.1 The Households

Households in our baseline economy are heterogeneous and differ in their age, $j \in J$; in their education, $h \in H$; in their labor market status, $e \in \mathcal{E}$, in their pension rights, $b \in B$ in their pension, $p \in P$ and in their assets, $a \in A$. Sets J, H, $\mathcal{E}$, B, P, and A, are all finite sets and we use $\mu_{j,h,e,b,p,a}$ to denote the measure of households of type (j, h, e, b, p, a). We think of a household in our model as a single individual, even though we use the two terms interchangeably. To calibrate the model, we use individual data of persons older than 20 in the Spanish economy.

Age. Individuals enter the economy at age 20, the duration of their lifetimes is random, and they exit the economy at age 100 at the latest. Therefore $J = \{20, 21, ..., 100\}$. The parameter ψ_{jh} denotes the conditional probability of surviving from age j to age $j + 1$, for those households with educational level h.

Education. Households can either be high school dropouts with $h = 1$, high school graduates who have not completed college $h = 2$, or college graduates denoted $h = 3$. Therefore $H = \{1, 2, 3\}$. A household's education level is exogenous and determined forever at the age of 20.

Labor market status. Households in our economy are either employed, unemployed eligible for benefits, unemployed non-eligible, or retired. We denote workers by ω, eligible unemployed by ϖ, non-elegible unemployed by υ, and retirees by ρ. Consequently, $\mathcal{E} = \{\omega, \varpi, \upsilon, \rho\}$. Upon entering the economy, individuals draw a job opportunity. In subsequent years, the labor market status evolves according according to exogenous job separation and job finding rates, and also to the

[2]Differently from that version, this paper computes not only the steady states, but also the transitional dynamics among them.

optimal retirement decision

Workers. A worker provides labor services and receives a salary that depends on his endowment of efficiency labor units and his hours worked. This endowment has two components: a deterministic component, which we denote by ϵ_{jh}, and a stochastic component, which we denote by s.

The deterministic component depends on the household age and education, and we use it to characterize the life-cycle profiles of earnings. We model these profiles using the following quadratic functions:[3]

$$\epsilon_{jh} = a_{1h} + a_{2h} j + a_{3h} j^2 \tag{1}$$

We choose this functional form because it allows us to represent the life-cycle profiles of the productivity of workers in a very parsimonious way.

The stochastic component is independently and identically distributed across the households, and we calibrate it to match moments of the Spanish earnings and wealth distribution, following Castañeda et al. (2003). This component does not depend on the age or the education of the households, and we assume that it follows a first order, finite state, Markov chain, with invariant distribution given by $\pi(s)$, and with conditional transition probabilities given by Γ:

$$\Gamma\left[s'|s\right] = \Pr\left\{s_{t+1} = s'|s_t = s\right\}, \text{ with } s, s' \in S. \tag{2}$$

We assume that the process on s takes three values and, consequently, that $s \in S = s_1, s_2, s_3$. We make this assumption because it turns our that three states are sufficient to account for the Lorenz curves of the Spanish distributions of income and labor earnings in enough detail, and because we want to keep this process as simple as possible.

Every period agents receive a new realization of s. His labor productivity is then given by $\epsilon_{jh}s$. A worker with education h and age j who supplies l hours of labor has gross labor earnings y^l given by:

$$y^l = w\epsilon_{jh} s l \tag{3}$$

where the economy-wide wage rate w.

Workers face a probability of losing their job at the end of the period, denoted φ_{jh}. This probability is education and age dependent, and we use it to generate the observed labor market flows between employment and non-employment states within age cohorts. We model these profiles using the following functions:

$$\varphi_{jh} = a_{4h} + a_{5h} j + a_{6h} j^2 + a_{7h} j^3 \tag{4}$$

[3] In the expressions that follow the letters a denote parameters.

Unemployed. Eligibility for unemployment benefits is conditional on having lost a job during the previous two years and not having started a new job yet. Eligibility expires when one the conditions is not met. An eligible agent with education h receive unemployment benefits given $y^u = \vartheta y_h^{\bar{l}}$, where $y_h^{\bar{l}}$ is the average labor earnings of those workers with education h, and where $\vartheta < 1$ is a replacement rate.

At the end of each period, an unemployed receives a job offer with probability ξ_{jh}. This probability is also education and age dependent, and we use it to generate the observed labor market flows between unemployment and employment. The offer is the productivity shocks. Therefore, its amount is either s_1, s_2, or s_3. Conditional on receiving an offer, the probability of receiving each one of the productivity shocks is the unconditional probability of each realization of that shock. Once a household is re-employed, the future values of s are determined by the process on s.

We model the probabilities to receive a job offer as:

$$\xi_{jh} = a_{8h} + a_{9h}j + a_{10h}j^2 + a_{11h}j^3 \tag{5}$$

Retirees. Workers who are R_0 years old or older decide whether to to retire and collect the retirement pension. They take this decision after observing their current labor productivity. If they decide to retire, they loose the endowment of labor efficiency units for ever and exit the labor market. Unemployed households who are R_0 years or older are forced to retire.

Pension rights. Workers and unemployed also differ in the pension rights. These rights are used to determine the value of their pensions when they retire. The rules of the pension system, which we describe below, include the rules that govern the accumulation of pension rights, and the rules that determine the mapping from pension rights into pensions. In our model economy households take this mapping into account when they decide how much to work and when to retire. We assume that pension rights belong to the discrete set $B = \{b_0, b_1, \ldots, b_m\}$, that $m = 9$, and that the spacing between points in set B is increasing. We also assume that $b_0 = 0$, and that $b_m = a_{12}y$, where $a_{12} > 1$, y is the model economy per capita output, measured at market prices, and $a_{12}y$ is the maximum covered earnings, following the Spanish Public Pension System.

Pensions. Retirees differ in their retirement pensions. We assume that retirement pensions belong to the set $P = \{p_0, p_1, \ldots, p_m\}$. Since this mapping is single valued, and the cardinality of the set of pension rights, B, is 10, we let $m = 9$ also for P. We also assume that $p_0 = a_{13}y$, and that $p_m = a_{14}y$, where p_0 and p_m are the minimum and maximum retirement pensions, in accordance with the Spanish Public Pension System. Finally, we also assume that the distances between any two consecutive points in P are increasing. We make this assumption because minimum pensions play a large role in the Spanish system and this suggests that we should have a tight grid in the low end of P.

Assets. Households in our model economy differ in their asset holdings, which are constrained to being non-negative. The absence of insurance markets give the households a precautionary motive to save. They do so by accumulating real assets which take the form of productive capital, denoted $a \in A$.[4]

Preferences. Households derive utility from consumption, c, and disutility from labor effort, l, where labor is decided both at the extensive and intensive margins. The period utility is described by a utility flow from consumption and leisure, $u(c, 1-l)$. Unemployed and retired agents dedicate all the time endowment to leisure consumption. Accordingly, lifetime utility is given by

$$\mathbb{E}\sum_{j=20}^{100} \beta^{j-20}\psi_{jh}\Big[log\ (c) + \chi\frac{(1-l)^{1-\gamma}}{1-\gamma}\Big] \tag{6}$$

where β is a time discount factor, c is consumption, χ is the relative utility weight on leisure, and γ is the labor elasticity.

2.2 The Representative Firm

In our model economy there is a representative firm. Aggregate output, Y, is obtained combining aggregate capital, K, with the aggregate labor input, L, through a Cobb-Douglas, aggregate production function which we denote by $Y = K^{\theta}L_t^{1-\theta}$. We assume that factor and product markets are perfectly competitive and that the capital stock depreciates geometrically at a constant rate, which we denote by δ.

2.3 The Government

The government in our model economy taxes capital income, household income, and consumption, and it confiscates unintentional bequests. It uses its revenues to consume, and to make transfers to households other than pensions. In addition, the government runs a pay-as-you-go pension system. The consolidated government and pension system budget constraint is

$$G + Z + P + U = T_k + T_y + T_c + T_s + E \tag{7}$$

On the expenditure side, G denotes government consumption, Z denotes government transfers other than pensions, P denotes pensions, and U denotes unemployment benefits, And, in the revenue side, T_k, T_y, and T_c, denote the revenues collected by the capital income tax, the household income tax, and the consumption tax, T_s denotes the revenues collected by the payroll tax, and E denotes unintentional bequests. Finally, we assume that the government uses the consumption tax rate to clear the government budget.[5]

[4] An important feature of the model is that there are no insurance markets for the stochastic component of the endowment shock nor for unemployment risk.

[5] We also assume that there is no Pension Reserve Fund. This is because the stock of assets of this fund only represented 0.4 percent of GDP at the end of 2018., which is our calibration target year.

2.3.1 The Fiscal Policy

Expenditures. We assume that the amount of government consumption is given by $G = a_{15}Y^*$, where Y^* is the model economy output at market prices. Transfers other than pensions are delivered to those households whose income is below a minimum income level, $\underline{y} = a_{16}y$. In this case, these households receive a transfer from the government, denoted by $t_r = \underline{y}$. We already defined unemployment benefits, and we describe pension expenditures in the next section.

Revenues. We assume that the proportional capital income and consumption tax rates are given by τ_k, and τ_c. Moreover, we assume that the assets that belong to the households that exit the economy are confiscated by the government. To model the household income tax, we use the following function:

$$\tau_y(y_t^b) = a_{17}\left\{ y_t^b - \left[a_{18} + (y_t^b)^{-a_{19}}\right]^{-1/a_{19}} \right\} \tag{8}$$

where y_t^b is the income tax base. This expression, where a_{17}, a_{18}, and a_{19} are parameters, is the function chosen by Gouveia and Strauss (1994) to model effective personal income taxes in the United States, and it is also the functional form chosen by Calonge and Conesa (2003) to model effective personal income taxes in Spain.[6] Finally, we describe payroll taxes in the next section.

2.3.2 The Pension System

In our benchmark model economy we choose the payroll tax and the pension system rules so that they replicate as closely as possible the *Régimen General de la Seguridad Social* of the Spanish pay-as-you-go pension system in 2018, which is our calibration target year. See Díaz-Saavedra (2020) for a description of the Spanish Public Pension System.

Payroll Taxes. In our model economy, as in Spain, the payroll tax is capped and workers older than the full entitlement retirement age, which we denote by R_1, are exempt from paying payroll taxes. Specifically, the payroll tax function is the following:

$$t_s(y^l) = \begin{cases} 0 & \text{if } j > R_1 \\ \text{otherwise} & \begin{cases} \tau_{ss}y^l & \text{if } y^l < \overline{y}^l \\ \tau_{ss}\overline{y}^l & \text{otherwise} \end{cases} \end{cases} \tag{9}$$

where parameter τ_{ss} is the payroll tax rate and $\overline{y}^l = b_m = a_{12}y$ is the maximum covered earnings. Finally, we also assume that eligible unemployed also pay social security contributions, so that the payroll tax function becomes $t_s(y^u) = \tau_{ss}y^u$.

[6] Additionally, Guner et al. (2014) conclude that this functional form generates a better statistical fit for average tax rates, in comparisons to other alternatives.

Retirement Ages. In our model economy the early retirement age is R_0. Workers who choose to retire early pay a penalty, λ_j, which is determined by the following function

$$\lambda_j = \begin{cases} a_{20} - a_{21}(j - R_0) & \text{if } j < R_1 \\ 0 & \text{if } j \geq R_1 \end{cases} \tag{10}$$

where a_{20} and a_{21} are parameters which we choose to replicate the Spanish early retirement penalties.

Retirement pensions. A household of age $j \geq R_0$, that chooses to retire, receives a retirement pension, $p(b)$, which we compute following the Spanish pension system rules. The main component of the retirement pension is its *Regulatory Base*, RB, which averages labor earnings up to the maximum covered earnings, during the last $N_b = 21$ years prior retirement. If a household has not reached the full entitlement retirement age, its pension is subject to an early retirement penalty. If the household is older than R_1, its pension claims are increased by 3 percent for each year worked after this age. The Regulatory Base is multiplied by a pension replacement rate, ϕ, which we use to replicate the pension expenditures to output ratio. Finally, retirement pensions are bounded by a minimum and a maximum pension.

Note that the Regulatory Base takes into account a long period of time. Consequently, it can be relatively frequent that contribution gaps occur; that is, periods to be taken into account to determine the amount of the pension in which the household does not credit any contribution. This is the case, for instance, of non-eligible unemployed. In order to mitigate the negative effects of these gaps, the Spanish pension rules establishes that these unlisted periods will be integrated with fictitious quotes. In our model economy, we assume that these fictitious quotes are $y^{fq} = a_{22}y$.

In our benchmark model economy we calculate the retirement pensions using the following formula:

$$p(b) = \phi(1.03)^v(1 - \lambda_j)RB \tag{11}$$

where ϕ denotes the replacement rate, and v denotes the number of years that the worker remains in the labor force after reaching the full entitlement retirement age. The Regulatory Base, RB, is exactly equal to the pension rights at the time of retirement. Consequently, it is defined as:

$$RB = \frac{1}{N_b} \sum_{s=j-N_b}^{j-1} min\{y_s^l, \overline{y}^l\} \tag{12}$$

Note that labor earnings, y_s^l, is replaced by y_s^u or y_s^{fq} in the case of eligible or non-eligible unemployed households (see below). Expressions (11) and (12) replicates most of the features of Spanish retirement pensions. The main difference is that in our model economy the pension replacement rate is independent of the number of years of contributions. We abstract from this feature of Spanish pensions because it requires an additional state variable. Finally, we require that $p_0 \leq p(b) \leq p_m$.

2.4 The Households' Decision Problem

Individuals with education h are heterogeneous in five dimensions $x = \{j, e, b, p, a\}$, where j is age, e is employment status, b is pension rights, p is pensions, and a is private savings. The households' problem is described recursively. Let $V_h(x)$ be the value function of an individual with education h in state x.[7]

Workers. We start with employed individuals that are younger than the minimum retirement age, specifically $j < R_0$. In this way we can abstract, for now, from the retirement decision. An individual of education level h, with age j, stochastic productivity s, pension rights b, and private savings a, faces the following optimization problem:

$$\begin{aligned} V_h(j,s,b,a) = \quad & \max_{(c,l,a')} \Big\{ \text{u(c,1-l)} + \beta E\Big[(1-\varphi_{jh}) \textstyle\sum_{s' \in S} \Gamma(s'|s) V_h(j+1, s', b', a') \\ & \qquad + \varphi_{jh} V_h(j+1, \varpi, b', a')\Big]\Big\} \end{aligned} \tag{13}$$

subject to

$$(1+\tau_c)c + a' = y^l + (1 + r(1-\tau_k))a - t_s(y^l) - \tau_y y^b + I_{t_r}$$

where $y^b = (1-\tau_k)ra + y^l - t_s(y^l)$ is the income base of the personal income tax, and I_{t_r} is an indicator function that takes value 1 if households are eligible for public transfers other than pensions. In addition, the law of motion of pension rights is:

$$b' = \begin{cases} 0 & \text{if} \quad j < R_0 - N_b \\ b + (\min\{y^l, \overline{y}^l\}/N_b) & \text{if} \quad R_0 - N_b \leq j < R_0, \\ [b(N_b - 1) + \min\{y^l, y^{\bar{l}}\}]/N_b & \text{if} \quad j \geq R_0, \end{cases} \tag{14}$$

Eligible unemployed. A household currently unemployed and eligible for unemployment benefits, aged $j < R_0$, solves the following problem:

$$V_h(j,\varpi,b,a) = \max_{(c,a')} \Big\{ \text{u(c,1)} \beta E\Big[\xi_{jh} \textstyle\sum_{s \in S} \pi(s) V_h(j+1, s, b', a') + (1-\xi_{jh}) V_h(j+1, u', b', a')\Big]\Big\} \tag{15}$$

[7] When the household is not a retiree, we drop the variable describing retirement pensions, p. Conversely, when the household is a retiree, with drop the variable describing pension rights, b.

subject to

$$(1+\tau_c)c + a' = y^u + (1 + r(1-\tau_k))a - \tau_s(y^u) - \tau_y y^b$$

where $y^b = (1-\tau_k)ra$ and u' is ϖ if the current period is the first period that the unemployed collects unemployment benefits, and u' is υ if it is the second period. Note that eligible unemployed households do not receive public transfers other than pensions, since we assume that unemployment benefits are well above the minimum income level $\underline{y}$, which entitles families to receive these public transfers.

The law of motion for pension rights is in this case:

$$b' = \begin{cases} 0 & \text{if} \quad j < R_0 - N_b \\ b + (y^u/N_b) & \text{if} \quad R_0 - N_b \leq j < R_0, \end{cases} \tag{16}$$

Non-eligible unemployed. A household currently unemployed and non-eligible for unemployment benefits, aged $j < R_0$, solves the following problem:

$$V_h(j,\upsilon,b,a) = \max_{(c,a')} \left\{ \text{u(c,1)} + \beta E \left[\xi_{jh} \textstyle\sum_{s \in S} \pi(s) V_h(j+1,s,b',a') + (1-\xi_{jh}) V_h(j+1,\upsilon,b',a') \right] \right\} \tag{17}$$

subject to

$$(1+\tau_c)c + a' = (1 + r(1-\tau_k))a - \tau_y y^b + I_{t_r}$$

where $y^b = (1-\tau_k)ra$ and the law of motion for pension rights is:

$$b' = \begin{cases} 0 & \text{if} \quad j < R_0 - N_b \\ b + (y^{fq}/N_b) & \text{if} \quad R_0 - N_b \leq j < R_0, \end{cases} \tag{18}$$

Retired. Retired individuals do not receive labor income. They finance consumption with past private savings and pension payments. The problem is a standard consumption-savings decision, with survival risk and a certain maximum attainable age, assumed to be $J = 100$. At age $j = 99$, the continuation value is zero because the agent exist the economy next period with probability one. Before that, the retired household solves:

$$V_h(j,\rho,p,a) = \max_{(c,a')} \left\{ \text{u(c,1)} + \beta \psi_j \left[V_h(j+1,\rho,p,a') \right] \right\} \tag{19}$$

subject to

$$(1+\tau_c)c + a' = p + (1 + r(1-\tau_k))a - \tau_y y^b$$

where $y^b = p + (1-\tau_k)ra$. Retired households, similarly to eligible unemployed, are not eligible in any case to receive public transfers other than pensions, since we assume that the minimum retirement pension is well above the minimum income level.

Retirement decision. Recall that we assume that unemployed households who are R_0 years or older are forced to retire. On the other hand, a worker aged $j \geq R_0$ must decide if to retire or not from the labor market. In this case, she chooses the optimal plan after solving problems 13 and 19.

2.5 Equilibrium

A detailed description of the equilibrium process of this model economy can be found at Díaz-Saavedra (2022).

3 Calibration

To calibrate our model economy, we choose 2018 as our calibration year. Then we choose the initial conditions and the parameter values that allow our model economy to replicate as closely as possible selected macroeconomic aggregates and ratios, distributional statistics, and institutional details of Spain in 2018.

More specifically, to characterize our model economy fully, we must choose the values of a total of 70 parameters. Of these 70 parameters, 20 describe the government policy, 21 describe the endowment of efficiency labor units profiles, 24 describe the employment and unemployment risk functions, 2 describe the production technology, and the remaining 3 describe the household preferences. To choose the values of these 70 parameters, we need 70 equations which formalize our calibration targets.

To determine the values of the 70 parameters that identify our model economy, we do the following. First, we assign values to 51 parameters that can be estimated directly using equations that involve either one parameter only, or one parameter and our guesses for (K, L). These include, for instance, the deterministic productivity profiles and the probabilities governing employment transitions. Second, we use the model and a system of 19 non-linear equations to calibrate the 19 remaining parameters. Most of these equations require various statistics in our model economy to replicate the values of the corresponding Spanish statistics in 2018.

We describe these steps and our computational procedure at Díaz-Saavedra (2022).[8] In that paper we show that our model economy succeeds in replicating most of the aggregate and distributional statistics that we target, and that it also replicates the retirement behavior of Spanish workers very accurately. This last result is particularly remarkable, since we intentionally exclude the statistics that describe retirement from our set of calibration targets.

4 The Simulations

In this paper, we will study the consequences of the reforms of the Spanish social security.

The Benchmark Economy (BEN). Our Benchmark Economy is the economy that we modelled and calibrated to approximate the Spanish economy in 2018. Specifically, the early retirement age is $R_0 = 62$, the normal retirement age is $R_1 = 66$, and pension rights are computed taking into account the last 21 years of contributions previous to retirement. We then delay the early and the normal retirement ages to $R_0 = 63$ and $R_1 = 67$ in 2024, and we also extend the number of years of earnings that we use to compute the pensions, from the 21 years previous to retirement in 2018 to 25 in 2022, at a rate of one year every year. These changes are in line with what is happening in Spain as a result of regulatory changes enacted before 2018. We also revaluate the minimum and the maximum pensions so that their share of output per person remains constant at is 2018 value, and we assume that the real value of all other pensions does not change.

The Reformed Model Economies. The pension reforms included in our simulations correspond to most of those approved by the Spanish government between 2021 and 2023. These reforms affect both pension expenditures and pension revenues, and we study these reforms one at time to explore which reform is quantitatively more important. We described these parametric changes below:

- The *Intergenerational Equity Mechanism (IEM)*, increases the payroll tax rate. The increase goes from 0.6 percentage points in 2023, to 1.2 percentage points in 2029, the year from which it will remain constant at that level. These additional revenues will be accumulated in a Reserve Fund to compensate mismatches between income and tax expenses. From 2033 to 2052, the Spanish Government can make withdrawals from this fund in order to partially reduce the imbalance between payroll tax revenues and pension expenditures (see Panel A of Figure 1).

  In our model economy, we assume that the pension reserve fund evolves between 2023 and

[8] The current version of the model is an enhanced version of that model economy. Specifically, this version assumes that Spain is a relatively small open economy, and it also improves the measurement of key macroeconomic aggregates and ratios, such as the Pension Payments to GDP ratio. Additionately, this version includes as pension revenues the direct transfers from the Spanish Central Government, which will be 1.4 percentage points of GDP in 2023.

2032 according to

$$F^{'} = (1 + r^{*})F + T_s \tag{20}$$

where $F^{'}$ is the value of the pension reserve fund at the beginning of the next period, and T_{s+} are the payroll tax revenues collected by the increase of the payroll tax rate. After 2032, the law of motion of this fund is given by

$$F^{'} = \begin{cases} (1 + r^{*})F - x_t\, Y, & \text{if } T_s - P < 0. \\ (1 + r^{*})F, & \text{otherwise.} \end{cases} \tag{21}$$

where r^{*} is the rate of return for the pension fund and x_t is the withdrawal rate of pension assets. We assume that $r^{*} = 1\%$, and that x_t is given by time serie plotted in panel A of Figure 1. Finally, we require the pension reserve fund to be non-negative, so that when the pension fund assets ran out, the government changes removes this fund.

- Under the current Spanish public pension system, the *annual pension reward (APR)* for every year worked after the full entitlement retirement age depend of the number of years worked during the working lifetime, and it varies between 2 and 3 percent. The last Spanish pension reform increases this number until 4 percent, regardless of the number of worked years.

- The reform also increases both the *real cap of the regulatory base and the real maximum pension (CAPS).* The cap of the regulatory base will increase 1.2 percentage points per year between 2024 and 2050, while the maximum retirement pension will increase 0.1115 percentage points per year that same period. From 2051, and until 2065, the maximum retirement pension will increase an additional 20 percent in order to reduce the gap with the cap of the regulatory base (see Panel B of Figure 1).

- The 2023 reform also includes the so-called *solidarity quota (QUOTA)*, an additional contribution on earnings from work that exceed the cap of the regulatory base. The contribution will be 5.5 percent on the part of the remuneration between the cap of the regulatory base and 10 percent higher than that cap, 6 percent on the part of the remuneration between that 10 and 50 percent higher than the cap, and 7 percent on earnings that exceed the cap by more than 50 percent. These additional contribution rates will gradually increase between 2025 and 2045 (see Panel C of Figure 1).

- Finally, we simulated a final reform where we introduce *all previous parametric changes (ALL).*

We do not simulate two additional changes. First, there is a change in the payroll taxes payed by the self-employees that implies that these workers will pay payroll taxes according to their declared earnings. According to AIReF, this change coul increase payroll tax revenues in 0.5 percentage points of GDP in 2070. Additionately, the reform will increase in 2043 the number of years used to compute the pension to the last 29 years of working life, from which the 24 worst months will be excluded. Between 2026 and 2040, a dual system will be in force in which new pensioners will access the regulatory base that is more favorable between the new system and the previous regime, where the regulatory base is computed from the last 25 years of working life. Also, and according to AIRef, this parametric change will reduce pension expenditure by 0.1 percent of GDP in 2070.[9]

5 The Scenarios

In the next section, we will study the aggregate and welfare consequences of some policy experiments aimed to improve both the future financial situation and the pension design of the Spanish public pension system. All model economies have exactly the same initial conditions and share the demographic, educational, growth, and fiscal policy scenarios that we describe below.

The Demographic Scenario. The demographic scenario replicates the demographic projections for Spain for the period 2018–2072 estimated by the *Instituto Nacional de Estadística* (INE) in 2022.[10] In Panel A of Figure 2 we plot the changes in the 65+ to 20–64 dependency ratio that result from this scenario. This ratio increases from 32.2 in 2018 to 52.8 in 2070.[11]

The Educational Scenario. The initial educational distribution of our model economies replicates the educational distribution of the Spanish population in 2018, as reported by the INE.[12] After 2018, we assume that the educational shares for the 20-year old entrants are 7.33 percent, 62.62, and 30.05 percent forever for drop-outs, high school graduates, and college graduates. Those shares are the educational shares of the most educated cohort ever in Spain, which corresponds to the 1980 to 1984 cohort.[13] In Panel B of Figure 2 we plot the changes in the distribution of education shared by all model economies. The shares of high school drop-outs, high school graduates, and college graduates change from from 27.9, 53.0, and 19.1 percent in 2014 to 7.1, 64.7, and 28.2 percent in 2070.

The Growth Scenario. We assume that the labor productivity growth rate is 1 percent after 2018. The rationale for this choice is because the Spanish average annual labor productivity growth rate between 1995 and 2012 was 0.9 percent, according to the OECD.

The Fiscal Policy Scenario. Recall that the consolidated government and pension system budget

[9]We do not simulate the change in the numbers of years used to compute the pension, since it would involve to introduce and additional state variable in the model.

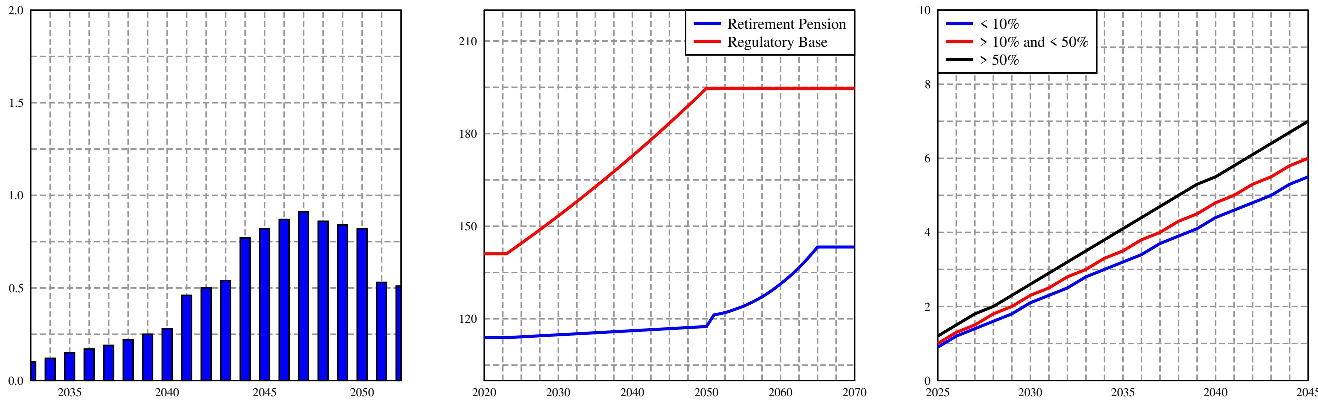
[10]These projections can be found at $https://ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_Ccid=1254736176953menu=resultadosidp=1254735572981$.

[11]We assume that the age distribution remains constant after 2072.

[12]The INE reports the educational distribution of the population by five-year age groups. We smooth this distribution through the estimation of polynomial curves.

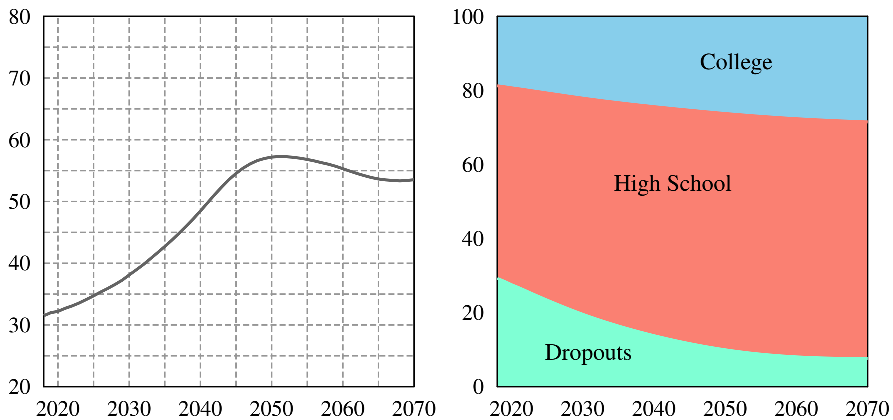
[13]Conde-Ruiz and González (2013) also use this educational scenario.

Figure 1: The Fund, the Caps and the Solidarity Quote



Panel A: Withdrawals from Fund (% GDP) Panel B: Caps (% GDP per capita) Panel C: Solidarity Quote (%)

Figure 2: The Simulation Scenarios in All Model Economies



Panel A: Dependency Rate (%)[a] Panel B: The Distribution of Education[b]

[a]This is the ratio between the number of households in the 65+ age cohort and those in the 20–64 age cohort.
[b]This is the distribution of education of the households in the 20–64 age cohort.

constraint in our model economy is given in Expression (7) In that expression G_t is exogenous and the remaining variables are endogenous. In all model economies the capital income tax rates and the parameters that determine the household income tax function are identical and they remain unchanged at their 2018 values. The consumption tax rates differ across the economies because we adjust them to finance the pensions once the pension reserve fund is exhausted. Every other variable in Expression (7) varies with time and differs across both economies because they are all endogenous.

Reform Announcement. We assume that all the reforms of Spanish pensions are announced and implemented at the beginning of 2023.

6 Results

We simulate these two model economies using the demographic, educational, and economic scenarios that we have described in Section 5 and we illustrate the main results of our simulations in Table 1 and Figure 3.

The Sustainability of the pre-Reform Pension System (Benchmark Economy). Our simulations show that the pay-as-you-go, defined benefit pension system that prevailed in Spain before the aforesaid reforms was completely unsustainable. We find that the pension system deficit in the Benchmark Model Economy would have reached 6.3 percent of GDP by 2050 (see second block of Table 1 and Panel C of Figure 3), and that the accumulated pension system debt, would have reached 100 percent of GDP that same year. In 2050, the consumption tax rate that would have been necessary to finance Spanish pensions would have been 27.3 percent, 12 percentage points higher than the value observed in 2020 (see Panel D of Figure 3).

This sustained increase in the pension deficit is mainly structural. Specifically, we find that the pension system expenditures increase by more than 4 percentage points of GDP during the next decades, from 12.3 percent of GDP in 2020 to 16.6 percent in 2050 (see Panel B of Figure 3). However, there is not significant variation in the pension system revenues since payroll tax revenues are 11.1 percent of GDP in 2020 and 10.3 percent in 2050 (see Panel B of Figure 3).[14]

The Sustainability of the Reformed Pension System. We begin by analyzing the reform introduced by the Intergenerational Equity Mechanism (IEM). Our results show that the additional payroll tax revenues collected by the Government whit this mechanism account until 0.5 percent of GDP.[15] However, we also find no significant differences between this reform and the Benchmark Model

[14] In the pension system revenues we include the government's transfers to the system which account 1.4 percentage points of GDP.

[15] This number is in line with the findings reported by Airef (2023), De la Fuente (2023), and Ministerio de Inclusión, Seguridad Social y Migraciones (2023).

Economy. If we look at the fine print, this reform reduces the consumption tax needed to finance the deficit of the pension system in the long run. Specifically, the consumption tax rate is 27.3 percent in the Benchmark Model Economy in 2050, but this number is 25.9 percent in after this reform that same year. This is because in this economy, the government can sell a limited amount of assets from the fund accumulated with the additional payroll tax revenues, in order to cover part of the deficit of the pension system. Consequently, and because the lower taxation, output is slightly higher in this reformed economy. As a conclusion, the Intergenerational Equity Mechanism (IEM) helps very little to cope with the sustainability problems that plague the Spanish Public Pension System.

We obtain a similar result when we simulate the increase in the annual pension reward (APR), and this is mainly because there are two effects that cancel each other out. First, the increase in the annual premiun induces to workers to delay retirement, since the average retirement age is 69.1 years in 2050, but only 68.2 years in the Benchmark Model Economy that same year. Note that the increase in the average retirement age increases payroll tax collections and also reduces pension expenditure. On the other hand, however, the increase in the annual premiun also increases the average retirement pension by 4.9 percent in 2050. Consequently, the overall effect is a no significant variation in the pension system deficit that same year, since it is 6.3 and 6.4 percent of GDP in the Benchmark and the reformed model economies, respectively. Our results are also in line with those reported by the De la Fuente (2023), who find that the additional revenues brought about by this measure are 0.4 percent of GDP in 2050, and that the cost of higher retirement pensions account until 0.5 percent of the GDP that same year.

Recall that another parametric change is the increase in both the real cap of the regulatory base and the real maximum pension (CAPS). The cap of the regulatory base increases 1.2 percentage points per year between 2024 and 2050, while the maximum retirement pension increases 0.1115 percentage points per year that same period. As expected, these increases in the caps reduce the long run pension deficit. Specifically, the pension deficit decreases from 6.3 percent of GDP to 5.9 percent of GDP that same year. Consequently, this change reduces the consumption tax rate needed to finance the pension deficit by 0.5 percentage points in 2050, from 27.3 percent to 26.8 percent. Similarly, the implicit debt of the pension system decreases in almost 5 percentage points of that year GDP, from 100.1 to 95.7 percent. Not surprisingly, then, this parametric change is the one that has the greatest impact on the reduction of the deficit of the pension system in the long term, although it does not solve its sustainability problem. Additionately, this type of change reduces the contributivity of the system, because the increasing gap between the maximum Regulatory Base and the maximum Retirement Pension.

Finally, the we also simulate the introduction of the solidarity quota (QUOTA), an additional contribution on those earnings that exceed the cap of the Regulatory Base. As in most of our previous results, we continue to find that this parametric change brings no significant variation on

Table 1: Simulation Results

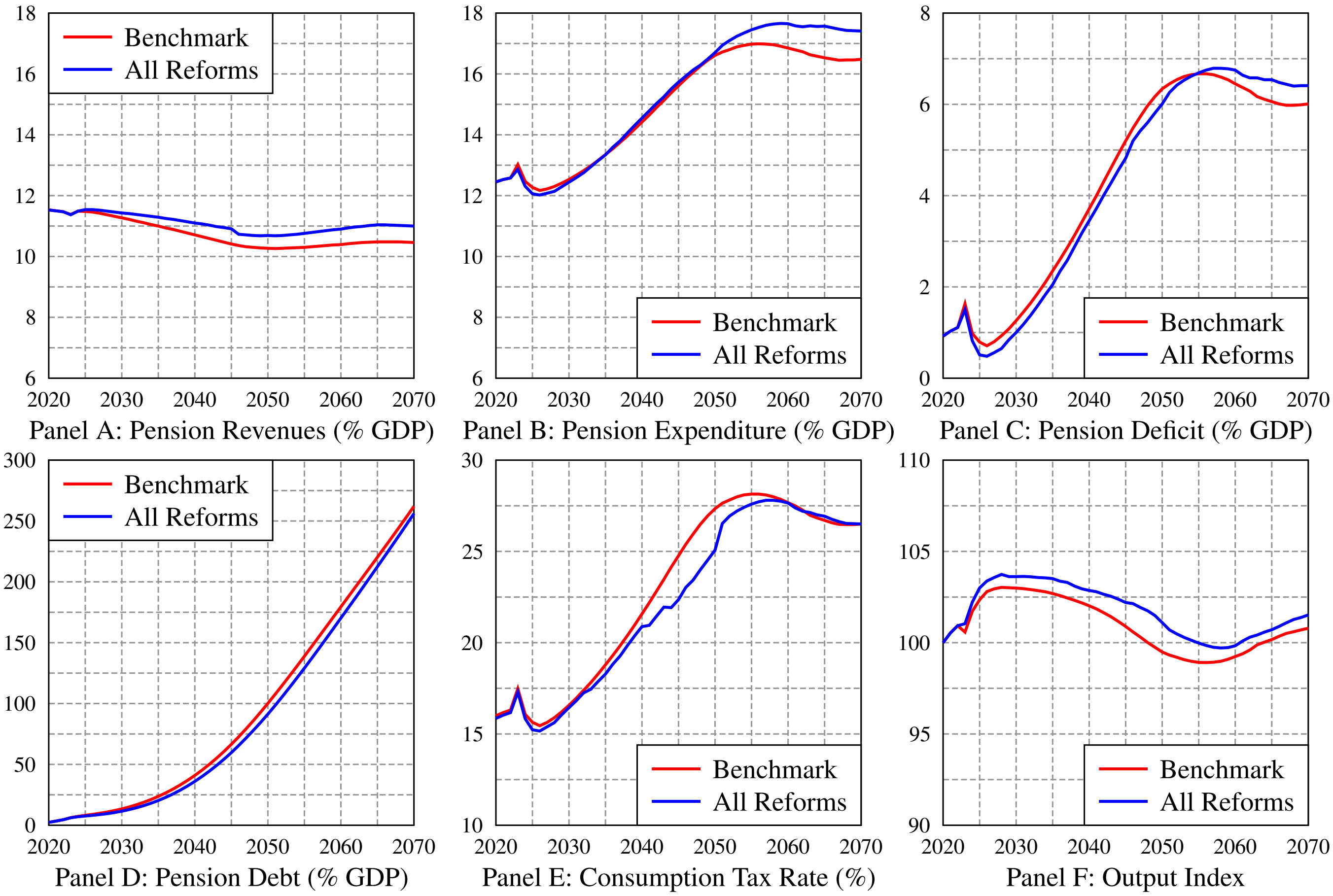
Model	Rev	Exp	Def	Deb	τ_c	AvP	AvA	Y
				2030				
BEN	11.27	12.53	1.26	13.43	16.56	101.38	66.30	102.98
IEM	11.20	12.49	1.29	13.68	16.99	101.41	66.29	103.20
APR	11.22	12.22	1.00	11.74	15.98	102.38	66.56	103.75
CAPS	11.44	12.71	1.26	13.22	16.55	101.98	66.18	102.74
QUOTA	11.39	12.53	1.14	12.92	16.33	101.36	66.30	102.99
ALL	11.43	12.43	1.00	11.54	16.43	103.31	66.41	103.61
				2050				
BEN	10.26	16.60	6.34	100.13	27.33	108.54	68.23	99.49
IEM	10.21	16.66	6.45	101.99	25.93	108.56	68.25	99.74
APR	10.18	16.55	6.37	95.77	27.35	113.81	69.11	100.61
CAPS	10.81	16.67	5.86	95.57	26.88	109.10	68.35	99.72
QUOTA	10.25	16.58	6.32	96.07	27.52	108.54	68.23	99.59
ALL	10.69	16.69	6.00	91.27	25.06	114.32	69.15	101.10
				2070				
BEN	10.46	16.47	6.01	262.03	26.50	110.96	67.88	100.78
IEM	10.40	16.51	6.11	266.44	25.87	111.11	67.87	101.03
APR	10.39	16.60	6.21	261.24	26.68	116.70	68.57	101.67
CAPS	11.11	17.22	6.11	254.51	26.85	115.57	67.82	100.40
QUOTA	10.46	16.47	6.01	256.82	26.56	110.98	67.88	100.80
ALL	11.00	17.41	6.41	256.09	26.50	121.71	68.49	101.52

Rev: Pension revenues (%GDP); Exp: Pension expenditures (%GDP); Def: Pension system deficit (%GDP); Deb: Accumulated pension debt (%GDP, 2018=0); τ_c: Consumption tax rate needed to finance the pension system (%); AvP: Average pension (2020=100); AvA: Average retirement age; Y: Output index (2020=100).

the long run financial situation of the Spanish Pension System, results that are also in line with those reported by De la Fuente (2023), and Ministerio de Inclusión, Seguridad Social y Migraciones (2023).

Overall assessment. Our previous results show that the quantitative effects of all parametric changes on the Spanish Pension System are rather limited, when they are simulated once at time. When we then simulate all these changes simultaneously (ALL), we continue to find a small variation in the long run pension deficit, since it decreases from 6.3 to 6.0 percent of GDP in 2050. Put differently, the long run sustainability problems that plague the Spanish Public Pension System remains. However, and looking at the fine print, this reform reduces the consumption tax rate needed to finance the pension deficit by more than two percentage points, from 27.3 to 25.1 percent in 2050. And output is 1.6 percetn higher in the reformed economy that same year.

Figure 3: The Benchmark and the Reformed Model Economies



7 Conclusions

In this paper we use an overlapping generations model economy calibrated to the Spanish economy to study the 2022 and 2023 Spanish pension reforms. These reforms increase the payroll tax collections, reduce the contributivity of the system, and increase the incentives of workers to delay retirement. Our main result is that these reforms do not solve the long run sustainability problems that plague the Spanish Pension System.

We conclude then that further reforms lurk in the future of Spanish pensions. Moreover, we think that the current Spanish pension system should be overhauled and replaced by a system that combines fully contributive pay-as-you-go pensions with mandatory individual retirement accounts. Naturally, the government should compensate the initial cohorts who are entitled to the current PAYG promises, because their probable looses, specially to thos workers who are near of their retirement when this reform is introduced.

In a companion paper, we compare the effect of the Spanish ageing transition under these different pension systems, and we show how a fast transition, from the current to the aforementioned reformed PAYG system can be Pareto improving, while minimizing the risk of political reversal.

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