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Sustaining Algeria's Retirement System in the Population Aging Context: Could a Contribution Cap Strategy Work?

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Abstract: Previous research predicts an increasing financial deficit in Algeria's PAYG retirement system, mainly due to rapid population aging, and parametric adjustments will be insufficient to alleviate this imbalance. Mitigating the effects of population aging will necessitate further intervention. In this work, we analyze how capping contributed salaries can help to mitigate the effects of population aging on the retirement system. Under generous Pay-As-You-Go schemes, promised pension payouts far exceed contributions. Thus, restricting contributions is expected to reduce the burden of future benefits by accepting lower contributions today, while directing public subsidies to low-income individuals. We simulate the future evolution of the financial balance of Algeria's retirement system under various contributable salary caps versus various scenarios of environmental evolution and potential parametric reform actions. The results demonstrated that a 40% cap, along with major parametric reforms and an ideal environment, would help achieve a cumulatively balanced system in the long run.

Keywords: retirement; sustainability; aging; contribution cap; PAYG; Algeria

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1. Introduction

1.1. Context

Pension systems provide an efficient tool for reducing poverty among the elderly and allowing workers to smooth their incomes throughout their entire lives (Holzmann et al. 2008). Under any financing mechanism, it is important to maintain long-term financial sustainability to keep the underlying objectives on target. Unfortunately, demographic and socioeconomic mutations make such a challenge tough to achieve without major reforms and adaptations to country-specific circumstances.

For the case of Algeria, previous research has shown that it will be difficult, if not impossible, to maintain the financial sustainability of the retirement system of salaried workers in the coming decades without public intervention (Flici and Planchet 2020; Flici 2023). Algeria's population is undergoing profound structural changes as a result of increased life expectancy and lower fertility rates. Until 2021, there were always more than six people of working age for every one person of retirement age, but this ratio is expected to fall to less than three for one beginning in 2045 (Flici and Kouaouci 2021). Such a transformation will increase the system's financial deficit to up to 60% by 2050 (Flici and Planchet 2020). It was also demonstrated that even major parametric reforms of the system will not be sufficient to keep its sustainability in the most favorable environmental changes (i.e., activity, employment, social security enrollment, etc.) (Flici 2023).

Algeria's public pension system for salaried workers is a Pay-As-You-Go (PAYG)-defined benefits plan managed by the CNR ("Caisse Nationale des Retraites"). The regulatory retirement age is 60 years for men and 55 years for women. Contributions for retirement are paid as part of contributions to social security. The first pension benefit (FPB) is calculated

by multiplying the average salary of the five years prior to retirement (W*), or of the best five-year salary, by the replacement rate. This latter is calculated by applying an annuity rate of 2.5% for each year of the contribution period (n). A maximum replacement rate of 80% of the pre-retirement wage is provided against 32 years of contribution. Then, each year, pension benefits are increased by around 5% to offset inflation effects. While low pension benefits are subsidized to keep them up to 75% of the minimum wage, benefits are capped at 15 times the minimum wage. The contribution rate for retirement was only 7% in 1985.[1] The Algerian retirement system was still in an early stage of maturation at that time; hence, there were far more contributors than retirees. As the system progressed, the number of retirees grew faster than contributors. As a result, contribution rates had to be adjusted several times to bring total contributions in line with pension expenses. In 1991, the contribution rate for retirement was increased to 11% before undergoing a gradual increase starting in 1994 to reach 16% in 2000. It increased to 17.25% in 2006 and to 18.25% by the end of 2015. In parallel, a 1.5% specific contribution to early retirement was introduced in 1994 and was later on lowered to 0.5% in 2006. Meanwhile, the contribution rate for social security, which was at 29% in 1985, was gradually increased to 34.5% in 1999 and has remained at that level ever since.

Given the future demographic prospects, maintaining retirement sustainability will require more than raising contribution rates. Usually, one of the main options recommended by the World Bank to face population aging consists of shifting to a multi-pillar system (Holzmann 1998, 2000). However, even with such an option, it remains necessary to redesign the existing PAYG pillar in a way to reduce its generosity and improve its sustainability in the long run. On the other hand, the possible reform options must be well investigated before implementation. Reforms, the systemic ones more specifically, have high implementation costs without being necessarily efficient in maintaining sustainability and adequate to socio-economic circumstances. Experience suggests that many countries went through reform reversals a few years after systemic reforms were implemented (Grech 2018), with reform reversal costs usually exceeding the cost of initial reforms (Baksa et al. 2020).

1.2. Contribution Caps: Literature Background

Despite the fact that various types of contribution ceilings exist in many countries around the world, their popularity as a parametric reform option in PAYG pension plans is not as widespread as the other reform actions, such as postponing retirement age, increasing contribution rates, or reducing benefit rates. Yet, imposing or lowering the pension contribution cap globally has the same effect as reducing contribution rates (Simonovits 2022) but with a side distributional effect (Whitman 2009). In relative terms, high earners will contribute a lesser fraction of their wages than lower earners, resulting in lower replacement rates after retirement.

Between the two extreme situations of flat contributions and proportional contributions with no cap, many intermediate cap levels are adopted worldwide, depending on country-specific characteristics and circumstances. Valdés-Prieto and Schwarzhaupt (2011) provided an overview of the contribution cap relative to the GDP per capita in 60 countries. According to the authors, many countries set the contribution cap below the GDP per capita (Egypt, Thailand, India, Ukraine, Pakistan, Kenya, and Taiwan), while for a huge number of countries, the cap is set from 1 to 3 times the GDP per capita (e.g., USA, Morocco, Brazil, Canada, France, Japan, Spain, and China). On the other hand, countries like Saudi Arabia, the Czech Republic, Germany, and Italy have a higher cap-to-GDP per capita ratio, while countries like Yemen, Indonesia, Iran, Nigeria, Belgium, Finland, Norway, and Portugal have no cap. Other countries, including Russia, the United Kingdom, Sweden, Ireland, Hungary, and the Netherlands, use reduced contribution rates beyond a given earning threshold.

Many studies have investigated the impacts of capping pension contributions on the contributors' behavior and the pension system's financial balance. The implications of adjusting contribution caps depend on the initial design of the system, principally, if it is mandatory or optional, how it compares to alternative private plans in terms of return/risk, and on the individual preferences of the contributors themselves. For instance, it is widely agreed that a cap, even a high one, is always more useful and socially desirable than no cap (Simonovits 2013; Bagchi 2017; Lee et al. 2022). Capping contributions to public pension systems aims essentially at limiting the impulsion of high earners (Barr and Diamond 2008), leaving more space for them to improve their savings in private pension plans (Simonovits 2012), if more advantageous, and eliminating excessive benefits (Reno and Lavery 2009; Simonovits 2018).

Despite the obvious fact that contribution caps are beneficial, it is challenging to find an optimal cap. Setting the contribution cap too high will discourage saving in private pension plans for high earners (Simonovits 2012). When the cap is too low, the system will fail to provide adequate pension benefits, especially to low earners (Feldstein 1982). Thus, the optimality of contribution caps has always been at the core of the literature (Feldstein 1982; Simonovits 2012, 2013; VanDerhei 2011a, 2011b). Previous experiences suggest that the effect of adjusting the contribution cap on the financial balance of the pension system depends mainly on the degree of its generosity, or more properly, the actuarial link between the contributions paid and the benefits promised. When the expected benefit to be paid for a retiree are—actuarially—much higher than the contributions paid during the working career, the system is generous; when the actuarial value of future benefits equalize that of the paid contribution, the system is fair; and when the actuarial value of the promised benefits is below the paid contributions, the system is not generous at all. In this latter case, raising or removing the cap will allow increasing contributions against less costly future benefits (Reno and Lavery 2009; Li 2021) and thus will help improve the sustainability of the system (Diamond and Orszag 2004; Bagchi 2017).

On the other hand, generous pension schemes without targeted strategies benefit high earners significantly more than low earners. This would increase the burden on pension expenses while not necessarily addressing the basic purpose of pension systems, which is poverty alleviation. In such cases, setting a contribution cap or lowering an existing one will help improve the system's future sustainability. Additionally, the major loss from providing generous social security benefits consists of the resulting reduction in private savings (Feldstein 1982). Previous studies suggest that a generous public pension plan would distort private savings and encourage early retirement (Hurd et al. 2012). Thus, it is critical to set pension generosity just right: not too high to discourage private saving, and not too low to encourage evasion. Contribution caps are one of the pension criteria that can be adjusted to moderate pension generosity, reduce poverty, and ensure long-term sustainability.

1.3. Objectives

In the current circumstances of expected increasing deficit in the long run (Flici and Planchet 2020) and the inefficiency of the conventional parametric reforms to address population aging-related issues (Flici 2023), Algeria's public pension system for salaried workers is still highly generous (Flici 2022), similarly to north African countries (Ben Braham 2009) and MENA countries in general (Robalino et al. 2005).

Given the current system design, public subsidies allocated to offset the system deficit benefit higher-income earners more than lower-income ones. Because pension benefits are directly linked to pre-retirement wages, income inequalities during working age persist during retirement age. One way to reduce the future deficit further and make public subsidies more beneficial to low earners can be achieved by imposing a contribution cap.

In this paper, we investigate the effects of an eventual contribution ceiling strategy on reducing the future financial burden of pension benefits. Because of the system's high generosity, each additional monetary unit contributed today will result in additional future

benefits with a substantially larger actuarial value. Limiting the contributable salary will result in a focus on the lower range of salaries distribution and will allow a reduction in the public subsidies paid to high earners. The latter can contribute (for the higher range of their salaries) to a secondary fund with lower return rates. To assess the efficiency of capping contributions on financial sustainability, different cap levels will be evaluated and compared to determine the capping conditions to ensure future sustainability in a changing socio-economic environment. We simulate the future sustainability of the Algerian retirement system with various contributable salary caps versus various simplistic scenarios of environmental evolution and potential parametric reform actions.

2. Methods

In order to evaluate the financial sustainability of PAYG pension systems, it is necessary to compare the evolution of pension expenses and contributions for retirement over the long term. In the absence of microdata about the contribution history of salaried workers, which is our case, it will be difficult to accurately predict the number of retirees among people of retirement age as well as the corresponding amounts of pension benefits and to estimate the future evolution of pension expenses. For this, we follow the methodology used in Flici and Planchet (2020) and Flici (2023) to project retirement expenses and contributions in the future. The methodology consists of considering all people at working age as potential contributors with a specific probability and all people reaching retirement age as potential retirees with an expected duration of contribution, estimated based on the evolution of the probability to contribute to retirement over the duration of working age.

To predict the future evolution of the total contribution for retirement (TCR) paid by salaried workers, two pieces of information are needed: the evolution of the population of contributors $(PopC)$ and the evolution of the average yearly amount of contribution to retirement (CR). This can be written as follows: $TCR_t = \Sigma_x PopC_{xt} * CR_{xt}$. The population of contributors at age x in the year t is obtained by multiplying the global population by age (Pop_{xt}) by the age-specific probability of contribution to retirement as a salaried worker $(ASPC_{xt})$; this leads to $PopC_{xt} = Pop_{xt} * ASPC_{xt}$. This probability takes into consideration employment rates, salaried employment rates, and rates of affiliation to social security among salaried workers. On the other hand, the evolution of the average amount of the yearly contribution to retirement (CR) is estimated based on wage evolution in time and age (W_{xt}) and the contribution rate for retirement (CRR_t). We can write this as follows: $CR_{xt} = CRR_t * W_{xt}$.

To move from the contribution phase to the pension payment phase, Flici and Planchet (2020) adapted the concept of the 'expected duration of contribution (EDC)', which can be obtained by summing up the age-specific probabilities to contribute to retirement as a salaried worker over the duration of the working career. For a retirement age r in year t, the expected duration of contribution can be calculated as follows: $EDC_{rt} = \sum_{x=18,k=t-r+18}^{r-1,t-1} ASPC_{x,k}$. The EDC was used to replace the duration of contribution in calculating the first pension benefit (PB_{rt}), combined with the final wage $(W*)$ and the annuitization factor a. We could write the following: $PB_{rt} = W * EDC * a$. Then, pension benefits (PB) are augmented yearly to fit inflation. Usually, a rate of $c = 5\%$ is used. This leads to $PB_{r+1,t+1} = PB_{r,t} * (1 + c)$. The total direct pension benefits paid for retirees during the year t, which we denote as $TDPB_t$, is calculated by summing up the pension benefits paid for all the generations of retirees; with this latter being equal to the average pension benefit paid in the year t for retirees aged x multiplied by the corresponding population Pop_{xt}, with x going from age r to the ultimate age of survival w. We can write $TDPB_t = \sum PB_{xt} * Pop_{xt}$. In addition to direct benefits, survivors' benefits are provided to parents, spouses, and orphans of the main retiree after their death. In our case, the total survivors' pension benefits are calculated as a constant share of the $TDPB$. According to recent observed values, this share was estimated at 20% (Flici 2023). Hence, the total pension benefits TPB were calculated as follows: $TPB_t = 1.2 * TDPB_t$. By adding 1.5% of administration fees, we obtained the total retirement expenditures (TRE). We write $TRE_t = 1.015 * TPB_t$.

On the other hand, the multi-scenario analysis was performed considering all the variables assumed to have a direct effect on the financial balance of the retirement system. These variables can be arranged into two different sets of variables: environmental variables and possible reform actions (Table 1).

Table 1. Environmental and reform scenarios.

Environment Variables		**Reform Options**	
Population	15 scenarios combining 5 scenarios about Fertility and 3 about Life Expectancy.	Age of Retirement[2]	1—60 and 57 years 2—63 and 60 years 3—65 and 62 years (for men and women, respectively)
Employment Rates	1—61% and 14.8% 2—50% and 10% 3—80% and 40% (for men and women, respectively)	Annuitization Rate	1—2.5% 2—2.25% 3—2%
Salaried Employment Rates	1—65.8% and 79.6% 2—50% and 65% 3—80% and 85% (for men and women, respectively)	Reference Wage Duration	1—5 years 2—10 years 3—12 years
Affiliation Rates of Salaried Employees	1—65.1% and 91.9% 2—60% and 70% 3—80% and 95% (for men and women, respectively)	Contribution Rate for Retirement	1—18.75% 2—20% 3—22%
Salaries Annual Growth	1—5% 2—9% 3—3%	Pensions Annual Revaluation Rates (real rate instead of the official rate)	Same as the Salaries Annual Growth Rate.
Collection Factor	1—87.9% 2—80% 3—95%		

Source: Flici (2023).

Environment variables include population growth, employment, salaried employment, affiliation to social security as a salaried worker, wage evolution, and contribution collection factor. This set of variables was considered with three simplistic evolution scenarios (a central scenario inspired by current levels or recent trend, a high scenario, and a low scenario), except population growth, which was considered with fifteen scenarios. Environmental variables are assumed to vary according to simple scenarios of smooth and consistent progression along the projection horizon, with the values displayed in Table 1 being those expected to be attained in 2070. The limitations of such a hypothesis are obvious, but it allows for an initial assessment of the effectiveness of contribution caps as a reform alternative. More sophisticated methods can be employed subsequently for a more in-depth and realistic analysis.

The possible reform actions, which are assumed to have an immediate effect, include raising the age of retirement, increasing the rates of contribution to retirement, reducing the annuitization rate, expanding the salary period base, and reducing pensions' annual revaluation rate. Reform actions were considered with three options: 'no change', 'minor reform', and 'major reform'.

In order to assess the effect of capping the contributed salaries on enhancing the financial sustainability of Algeria's retirement system, we consider four different cap

levels: i. "No cap", ii. 80%, iii. 60%, and iv. 40%. Under each capping level, we assess a total of 295,245 scenarios, crossing 3645 scenarios about the environment and 81 possible combinations of reform actions concerning the retirement parameters, all considered with 3 scenarios of no reforms, minor reforms, and major reforms. The detailed methodology of the multi-scenario analysis is explained in Flici (2023). By considering the four scenarios of capping levels, we had to assess a total of 1,180,980 scenarios.

Due to a lack of data about salaries, the distribution of wages is not made available in official statistics or in academic publications. What we do have is the evolution of salaries by large age intervals. In order to set up an easily understandable framework for our calculations, we assume all workers aged x in year t receive the same wage; the latter is assumed to grow with time and age. Setting age 20 to be the age of first entrance to the labor market in the year (t), an average worker is expected to receive a salary of $W_{x=20,t}$, which corresponds to the minimum salary an average worker could receive during their entire working career. We assume, implicitly, an increasing salary evolution during a working career. Thus, the maximum wage is received during the last year before retirement. The range of salary evolution corresponds to the gap between early and late working career salary.

The evolution of salary by large age intervals is retrieved from the data of the household revenues survey administered by the Algerian Office of National Statistics [ONS] in 2011 (ONS 2014). Then, a polynomial interpolation was used to estimate the evolution of the average salary at single ages. A similar methodology was used in Flici and Planchet (2020).

Considering the range of salary evolution during a working career, the contributed salary cap is set as a fraction of the minimum–maximum average salary range and is defined to be the limit above which a salary is not subject to contribution to social security (See Figure 1). A contributed salary cap of 40%, for example, means that the cap is set at 40% from the range between minimum and maximum wages. The range from the minimum wage up to the cap is contributable, while the remaining range (i.e., from the cap to the maximum wage) is not.

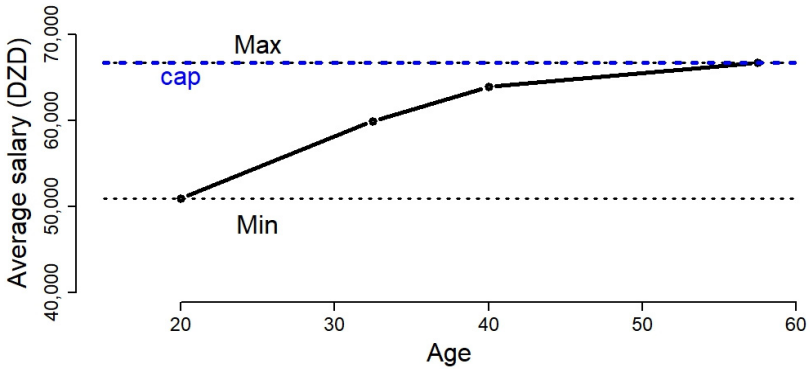

Figure 1. Defining the contributed salary cap.

For our analysis, we compare different capping levels (i.e., 100%, 80%, 60%, and 40%) and we analyze their impact on the financial balance of the Algerian retirement system up to 2070. The assessment methodology is similar to that proposed by Flici and Planchet (2020) and adapted later by Flici (2023).

The financial sustainability of retirement systems refers to future incomes being higher, or at least equal, to future expenses. Here, we use the incomes-to-expenses ratio (IER) as an indicator to assess sustainability. A value of 1 implies total income equalizing total expenses; a value of 0.5 means that retirement incomes cover half of the retirement expenses only; and so on.

Note that due to the unavailability of official statistics about employment, social security, salaries, and demography in Algeria after 2019, we use 2020 as the base-year for all projections.

3. Results

Figure 2 shows the obtained results. The left column displays the capping level, while the right-hand one displays the corresponding incomes-to-expenses ratio. The latter shows three layers of color starting from the light gray, which corresponds to major changes made to retirement parameters, namely retirement age, contribution rate, years of contribution used as a reference, and annuitization rate. The second layer, represented in dark gray, corresponds to minor changes made on the previously mentioned parameters combined with different combinations of the environmental variables. The third layer shown in gray reflects the "no reform" situation combined with all the possible environmental changes.

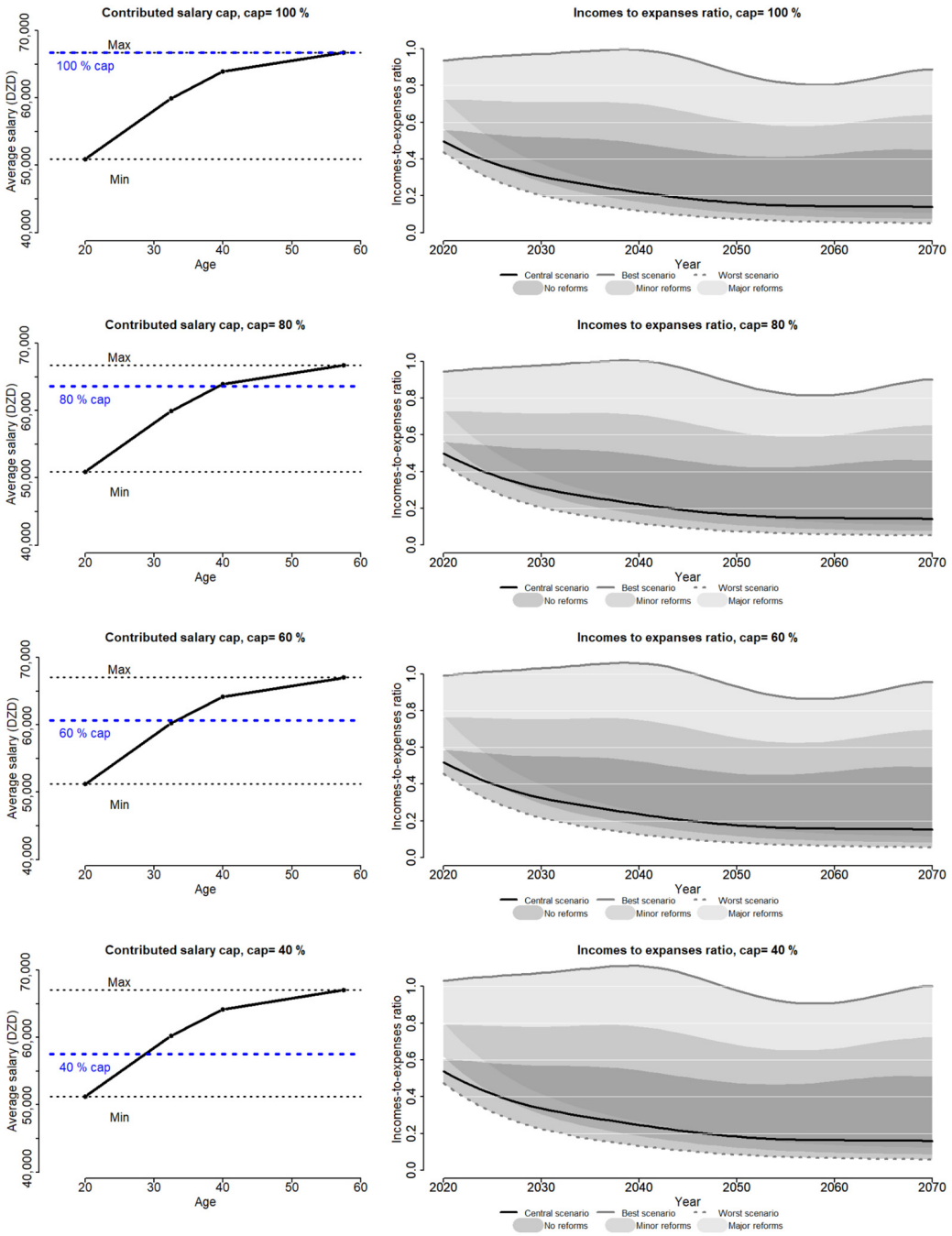

Figure 2. Comparison of different contribution capping levels on the financial sustainability of the Algerian retirement system.

The results obtained with "no-cap" are similar to those obtained by Flici (2023) and suggest that in the most favorable environmental conditions combined with major parametric reforms, retirement incomes will not be enough to cover retirement expenses during the period up to 2070. Under the most favorable conditions, the ratio of incomes to expenses is expected to reach its peak in 2038–2039 with a value of 99.6%. Then, it decreases to around 80% during the 2057–2060 period, before increasing again and reaching 89% in 2070.

Essentially, introducing a contributed salary cap is supposed to help minimize the deficit; the lower the cap, the smaller the deficit. The primary objective of comparing various cap levels is to determine an adequate cap to alleviate the system's long-term financial deficit. Compared to the no-cap situation, introducing a cap of 80% on the contributed salaries may allow an increase in the incomes-to-expenses ratio. Indeed, this later increased to slightly higher than 1 during the 2036–2040 period. Then, it decreased to around 81.5% in 2057–2059, and increased again to 90% in 2070.

The incomes-to-expenses ratio stands above 100% up to the year 2045, when a cap of 60% is applied to contributed salaries, but when the best environment conditions meet major parametric reforms. Afterward, this ratio is expected to decrease to 86% in 2057–2059 and increase again to 95.6% in 2070.

Lowering the cap further (i.e., 40%) results in positive balance for a longer time period, but if a very favorable environment happens and major parametric reforms are introduced, i.e., a retirement age of 65 and 62 years for men and women, respectively, an annuitization factor of 2% only, a salary base period of 12 years, and a contribution rate of 22%. The incomes-to-expenses ratio can reach a value of 111% during the 2038–2040 period. The lowest value that it can record is 91% in 2055–2060, while it is expected to rise back to 1 in 2069.

4. Discussion

Population aging is the most significant threat to the future sustainability of PAYG pension schemes. The rising share of the elderly in national populations forced many governments to implement substantial pension reforms. The experience of the last half-century has demonstrated that there are a few if any reform options that are—at the same time—economically feasible, efficient in ensuring long-term sustainability, and socially acceptable. The most recommended reform measures to save PAYG plans were the implementation of a multi-pillar system or the transition to a fully funded plan. Despite the fact that such reforms have encountered strong societal resistance in several countries, their effectiveness is not always guaranteed. Many reforms were followed by other reforms, or even reform reversals. Parametric reforms are another option that is more silent and less likely to draw social attention. The latter, when well-studied, can help achieve or improve financial sustainability while remaining socially acceptable.

Algeria is one of the countries that has already begun to experience the effects of population aging on pension plan sustainability (Flici and Planchet 2020), with traditional parametric reforms failing to address the expanding deficit (Flici 2023). Maintaining long-term sustainability will require more than simply delaying retirement, increasing contribution rates, or lowering replacement rates. Additional and stronger reform measures will be required.

One further action that can help reduce future deficits in the current circumstances of population aging and better target low earners is capping the share of the salary subject to contribution, also called the "contribution cap". Our main idea was that accepting lower contributions from employees today will imply paying much lower benefits for them when they retire. This paper aimed to assess the feasibility of such an action as well as its efficiency in alleviating the deficit in Algeria's pension system. We evaluated and compared different contribution caps, combined with different possible combinations of reform actions and environmental changes. Reform actions concerned postponing retirement age, increasing contribution rates, reducing the benefit conversion rates (replacement rate), and expanding the salary base period used in calculating benefits.

The proposed methodology allowed us to assess the effectiveness of the contribution cap as a supplement to traditional parametric adjustments in improving the long-term sustainability of Algeria's pension plan in a changing socioeconomic environment. It also allowed us to assess whether a contribution cap may be used to substitute or supplement parametric reforms as a solution to population aging implications. The benefit of crossing multiple caps with multiple reform actions, all paired with multiple environmental scenarios, is that it allows for the assessment of sustainability conditions and the determination of whether a specific contribution cap level will help to ensure the system's future sustainability, as well as the combination of parametric reforms and socioeconomic conditions.

Results showed that, globally, setting (or lowering) a contributable salary cap positively affects the evolution of the financial balance of the Algerian retirement system in the long-term. However, it was shown that, in the most favorable socio-economic environment changes (improvement in employment rates up 80% for men and 40% for women by 2070, more than 80% of salaried employment, enrollment rates higher than 80%, a collection factor of 95%, and 3% annual wage growth rate) and with the heaviest possible parametric reforms (a retirement age of 65 years for men and 62 for women, an annuity rate of 2%, a contribution rate of 22%, and a salary base period of 12 years), it will be challenging to completely eradicate the deficit from 2045 onwards. On the other hand, starting from a 60% cap, total contributions will significantly exceed total benefits from now to 2045, and for a 40% cap, in a good environment and with major parametric reforms, the projected excess from now to 2045 will be able to cover the deficit of the period from 2045 onwards. However, it will be necessary to find ways to save the excess of the first period to finance the deficit of the second period.

Such a result cannot be expected without major parametric reforms and favorable socio-economic conditions. Still, whatever the socio-economic environment is, setting a contributable salary cap will help improve the situation. However, such a kind of reform is not as silent as we imagine it to be. The workers who have already paid high contributions, especially those at the end of their working career, and who expect to receive high benefits at retirement will experience the largest losses and need to be compensated. This is a prerequisite to reduce social resistance and improve intergenerational equity (Conde-Ruíz and González 2012), which is primordial for a successful reform.

The implementation of a contributable salary cap will leave an exploited saving effort for high earners (Simonovits 2012) that will need to be addressed. To allow high earners to make more savings and increase their retirement income, a second pillar needs to be created, either under private or public management, PAYG or fully funded, and more importantly, less generous and actuarially more fair than the current system. One other solution can consist of introducing a threshold-based contribution system with different generosity degrees depending on salary slices. The bottom slice of salaries will—for example—benefit from high conversion rates; the second slice will be given moderate benefit rates; while the high salary range will receive less generous benefits. A simulation analysis can be performed to define the optimal salary thresholds with regard to the effect on the financial sustainability of the whole system.

One major limit of this work consists of assuming a smooth and steady evolution of the different variables affecting the sustainability of the pension system. Such an assumption seems to be unrealistic, because in the real world, demographic and economic variables can show ups and downs depending on many factors. We are aware of the impacts of such assumptions on sustainability assessment, but this can represent a first step towards more sophisticated scenario-based analyses. One other limit consists of not considering the interactive effect between the different variables involved in the financial sustainability of the pension system. It was simply assumed that all the variables are fully independent. For example, it was not considered that the reform actions will impact individuals' behavior regarding social security enrollment or saving efforts. It was also not considered whether there was an interaction between the different environmental variables. For example, in the real world, increasing contribution rates is very likely to result in decreasing the rates

of enrollment to social security; postponing the retirement age is likely to increase the workforce offer and lead to lower salary growth rates. Thus, the results presented here should be interpreted with caution. One other issue in this work relates to data availability, especially regarding salary distribution. To deal with such a data shortage, we used the evolution of the average salary by age instead of using the salary distribution to evaluate the implication of a contributable salary cap. This assumes that all workers at the same age, of any sex, receive the same salary in the same year, with this average salary increasing over age and time.

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Conflicts of Interest: The authors declare no conflicts of interest.

Notes

[1] Flici and Planchet (2020) reported, mistakenly, a rate of 5% in 1985.

[2] The reform scenarios of the average retirement age were defined with a three-year difference between men and women under all scenarios. Although women's retirement ages can be set to be equal to men's as in many countries, Algeria's low employment rate (roughly 15% vs. over 60% for men) suggests that equal retirement ages for men and women may not be a priority at this time or in the near future.

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