

## The retirement pension system in Algeria: Parametric analysis and reform options.

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### Abstract:

*All over the world, these retirement systems, operate on a pay-as-you-go basis, have undertaken reforms of the imbalances observed: the first reforms put in place are the parametric reforms, that is to say, operating parameters of the system, such as the contribution rate, the starting age, the reference salary, etc., without modifying its mode of operation. The purpose of this article is to determine the parameters of the pension system disequilibrium in Algeria and to try to determine a possible path of parametric reform. This analysis is based on an econometric model, the overlapping generations model; this model determines the balanced points by using macroeconomic and demographic data from 2001 to 2018 in Algeria. This study shows that the imbalance is too great to be restored by parametric reforms alone, the equilibrium contribution rate of the pension branch, as it emerges from the model used is almost three times higher than the current global contribution rate of all social security branches in Algeria, a simultaneous structural reform (change in the operating mode of the system) should be considered, taking into account the career patterns in the sectors of activity as well as the wage disparities.*

**Keywords:** Pension system, Disequilibrium of pension system, Contribution rate, Parametric reforms, Overlapping generations model.

**JEL Classification:** C02, H53, H55, O17.

### نظام التقاعد في الجزائر: تحليل معياري و خيارات الإصلاح

ملخص :

عرفت أنظمة التقاعد في مختلف دول العالم إصلاحات كبيرة في معايير اشتغالها، ولا سيما الأنظمة التي تشتغل على أساس إعادة التوزيع والتضامن بين أجيال المجتمع. اختلالات في عمليات تمويل أنظمة التقاعد هي التي أملت هذه الإصلاحات. أول أنواع الإصلاحات المطبقة في هذه الحالة هي الإصلاحات على محددات أنظمة التقاعد أي تعديل معدل الاقتطاعات الاجتماعية، رفع سن الأدنى للخروج أو تعديل الأجور المرجعية دون تغيير أسس مبادئ وطبيعة اشتغاله. يهدف هذا المقال إلى التعرف على المحددات التي تُفقد لنظام التقاعد في الجزائر توازنه للكشف عن سبل التعديلات الممكنة. يقوم التحليل المقترح على أساس نموذج في الاقتصاد القياسي الذي يُعرف بـ "نموذج الأجيال المتداخلة". مكن هذا النموذج من تحديد نقطة التوازن لنظام التقاعد في الجزائر باستغلال معطيات اقتصادية وديموغرافية ما بين 2001 و2018. تُشير هذه الدراسة إلى أن اختلال توازن نظام التقاعد في الجزائر كبير، لا يُمكن استرجاع التوازن المالي باللجوء إلى تعديل المحددات فقط، بل يلزم النظر كذلك إلى تغيير طبيعة اشتغال النظام وذلك بأخذ بعين الاعتبار اختلاف المسارات المهنية في مختلف القطاعات واختلاف مستوى الأجور بين الفئات الاجتماعية والمهنية.

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الكلمات المفتاحية : نظام التقاعد، اختلال توازن نظام التقاعد، معدل الاقتطاعات، تعديل محددات نظام التقاعد، نموذج الأجيال المتداخلة.

تصنيف JEL : C02 ، H53 ، H55 ، O17.

## 1. Introduction :

The main objective of social protection and the pension system in Algeria is to provide a replacement after the loss of regular wages to maintain living conditions in line with the constant needs of individuals.

The current system of social protection in Algeria was founded during a period of political will for social and economic development that began in the mid-1980s. In this period, there has been a drive to broaden the benefits to guarantee the highest possible level of social security coverage. The State has gradually developed an institutional framework, composed of bodies covering all social fields and, as a result, very generous legislation.

The financing of the Algerian social protection system is based on workers' and employers' contributions with a threefold objective, the first is contributory, ensuring that workers' incomes are maintained; the second is distributive, which tends to extend some benefits to the majority, and the third is non-contributory and is a matter of national solidarity.

In addition to all the features discussed, it is necessary to stress the central role played by the State, whose main tasks are to subsidize and ensure the maintenance of this system and to absorb any deficits that may arise and jeopardize it.

In Algeria, the retirement pension system is the result of the same process of implementation of social protection, the pension scheme in Algeria is unique, general, and compulsory, it covers all employees who contribute to it. It operates on the principle of distribution and is a defined benefit scheme.

However, the Algerian pension system faces several problems: as a result of the pay-as-you-go operation, it is today's working people who, with their contributions, pay the benefits of current pensioners and thus acquire rights for their future retirement. This type of system can only work if the demographic and economic reality respects this order of reciprocity, i.e., as long as the number of contributors does not decrease with the number of beneficiaries.

Developments in both aspects, economic and demographic, point in the direction of a chronic financial imbalance in the retirement pension system in Algeria. Demographic changes through the widening of the older age group, combined with an economic situation characterized by a decline in employment in all sectors, pose the problem of reforming the retirement pension system in Algeria.

All the contributions from authors in Algeria and abroad agree on the same observation about the imbalance of the pension system in Algeria and the need to implement reforms (Merouani & Hammouda, 2015), (El moudden & Hammouda, 2018).

Reforms of the pension system can be parametric or structural in nature (Palier, 2003). The first nature concerns the modification of the parameters for the acquisition of pension benefit rights, without changing the mode of operation, the modification of the departure age, the level of benefits, or the reference salary. Structural reforms concern the introduction of a system with a new mode of operation.

The problem of this work is: what is the importance of the parametric reform to be implemented to ensure the financial balance of the pension system in Algeria?

The question raised aims to determine the reforms to be introduced to guarantee the balance and maintenance of the pay-as-you-go pension system while ensuring a minimum social cost in Algeria.

The first reform path is likely to adjust the current system parameters, but will this be sufficient to maintain the social solidarity necessary to minimize the social costs of the reforms?

This epistemological approach gives rise to two assumptions:

- The lowering of the Starting Age and the increase in contributions are sufficient to balance the system.

- parametric reforms are not enough to restore the financial balance of the pension system in Algeria, the adoption of structural reforms is necessary.

To answer the question posed, this contribution proposes to analyze the parameters likely to be the subject of a parametric reform of the retirement pension system in Algeria. The analysis is carried out using an econometric model called “overlapping generation’s model” using macroeconomic and demographic data from 2001 to 2018 in Algeria.

The purpose of this work is to determine the probable ways of reforming the pension system in Algeria to maintain its main characteristics as a tool for income redistribution and solidarity between generations.

The importance of the subject appears in the construction of an effective social protection system, capable of protecting the most fragile social categories against the brutal changes in Algeria's economic orientations.

## **2. The main features of the retirement pension system in Algeria.**

Old age is one of the reasons for the termination of the employment relationship, which legally translates into retirement. To ensure a continuous income to these outgoing persons, the Algerian law set up conditions of access to retirement and defines the modalities of filiation to the National Retirement Fund (N.R.F), or “Caisse Nationale des Retraites”; the “C.N.R” is the social security fund which takes care of the old age risk.

The pension system has undertaken three major phases of development in Algeria:

- The pre-1983 phase: During this phase, the pension system in Algeria, inherited from the colonial era, operates in the form of different schemes covering different professional categories. These schemes are structured around multiple managing funds and organized by profession.

- The 1983 unification phase: It was within the framework of the new economic policy of the 1980s, which gave priority to the social aspect, that the social security review laws were to find their culmination in the laws of April 1983 (still in force). The corrective measures contained in these laws found designed to increase benefits, unify the schemes and modernize management. The fundamental principles on which the new system is based are as follows:

- The principle of generalization of the social security system.
- The principle of unification of schemes, benefits, and funding.
- The participation of workers' representatives in the management of social security bodies.

Developments during the structural adjustment plan to date: The retirement pension system in Algeria has undertaken a resizing of its size (from 1994 to 1997). During this period, it was used as a protection tool for dismissing employees after the closure of their public enterprises as part of the measure of the structural adjustment plan of the 1990s. The

cohorts of laid-off workers were covered by the retirement pension system in the context of the introduction of supplementary retirement schemes to facilitate the retirement.

**a. The vesting formulas.**

Since the last phase of development, it is possible to assert one's pension rights in Algeria according to four (4) formulas:

i. The general scheme or retirement at age 60: As its name suggests, the condition for liquidation is to be 60 years old, 55 for women, to have worked for at least 15 years, and to have paid contributions for a period equal to at least half of that time. The pension is liquidated at the rate of 2.5% of the monthly salary subject to social security contributions per working year.

The following formulas were introduced during the amendments launched during the period of application of the Structural Adjustment Plan; Amendment of the period 1994-1997.

- ii. **Age-neutral retirement:** This formula allowed all laid-off workers as a result of the closure of public enterprises to claim pension rights irrespective of their age, after 32 years of work, the number of years for which the maximum rate of 80% of salary as a retirement pension can be claimed.
- iii. **Proportionate retirement:** The formula that allows all workers to claim a pension right from the age of 50, 45 for women, and having worked for at least 20 years.
- iv. **Early retirement:** It is a formula that was introduced in 1997, the conditions of benefit are the same as the proportionate pension, but it is not the employee's choice; it is a means of absorbing redundancies for economic reasons. If the company is closing down, it is considered as a period of activity at the end of which the employee switches to one of the above-mentioned formulas as soon as his or her conditions are met.

It should be noted that Forms 2 and 3 were eliminated in 2016 to reduce pension fund expenditures and deficits.

**b. Social security contributions, the main source of funding.**

The financing of the pension system in Algeria is based on a professional insurance system, i.e. conditioned by the exercise of a salaried activity. It operates on a pay-as-you-go basis, with the active (those who work) contributing to pay the benefits of pensioners. Old-age insurance contributions paid by working people are collected by the retirement fund and immediately used to pay the pensions of pensioners. This system is therefore based on strong intergenerational solidarity, an intergenerational dimension.

The "pay-as-you-go" system can be defined as "operating based on an at least implicit contract between generations (which would stipulate): I agree to pay today because I know that you will agree to pay for me tomorrow". (Clerc, 2008). To respect the social and moral contract of intergenerational solidarity, it is necessary to preserve the sustainability of the pay-as-you-go pension system; this ensures that the cohorts of active contributors are guaranteed future care. Conversely, high-income inequalities can cause social exclusion of an entire generation of pensioners who have agreed beforehand to make the effort to pay their contributions.

In most countries, such as Algeria, pension systems are based on a pay-as-you-go financing. The contributions levied in each year are used to finance the pensions paid out in

that year; it is therefore a mode of operation that calls for solidarity between generations and is also characterized by a high rate of redistribution.

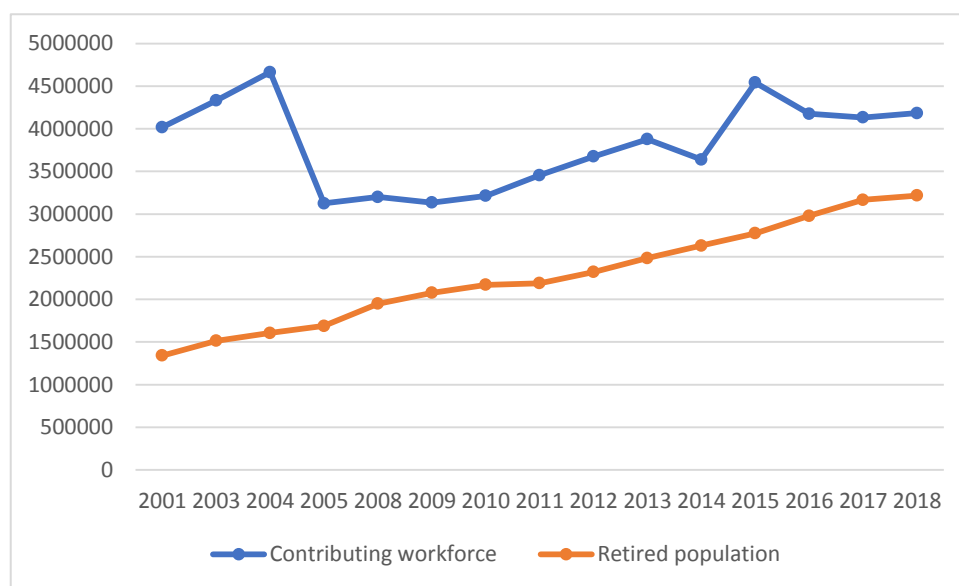
The pension system in Algeria is general and compulsory, it is unique to all employees and contributory, which means that each individual contributes to the system obligatorily throughout his or her career; it operates on a pay-as-you-go basis and has a defined benefit, i.e., the benefit is conventionally fixed in advance and is conditional on the number of years the employee has worked.

### 3. A financial imbalance noted.

There are two sources of financing of the pension system in Algeria: first, social contributions with their employee and employer shares, and second, state contributions. What is interesting to discover is the proportion of these two sources in the financing of retirement pensions in Algeria; Since the 2000s, the proportion of state funding has grown steadily and currently stands at 40% of the pension benefits distributed. The social security contributions paid by the Algerian pension system are not sufficient to ensure its long-term and sustainable operation.

#### a. An ever-increasing load.

Since the end of the 1990s, the number of pensioners in the national pension fund has been steadily increasing (see Figure 1), with the largest proportion liquidating their pension entitlements through the facilitating arrangements put in place, proportional and age-neutral retirement (see Figure 2).



**Source:** According to the data of the national office of statistics & national pension fund.

The observed period can be divided into two parts, the first one (2001-2010) and the second (2010-2018).

**Figure (1): Load by number of people in the paying-in employee population and the retired population at the expense of the national pension fund from 2001 to 2018.**

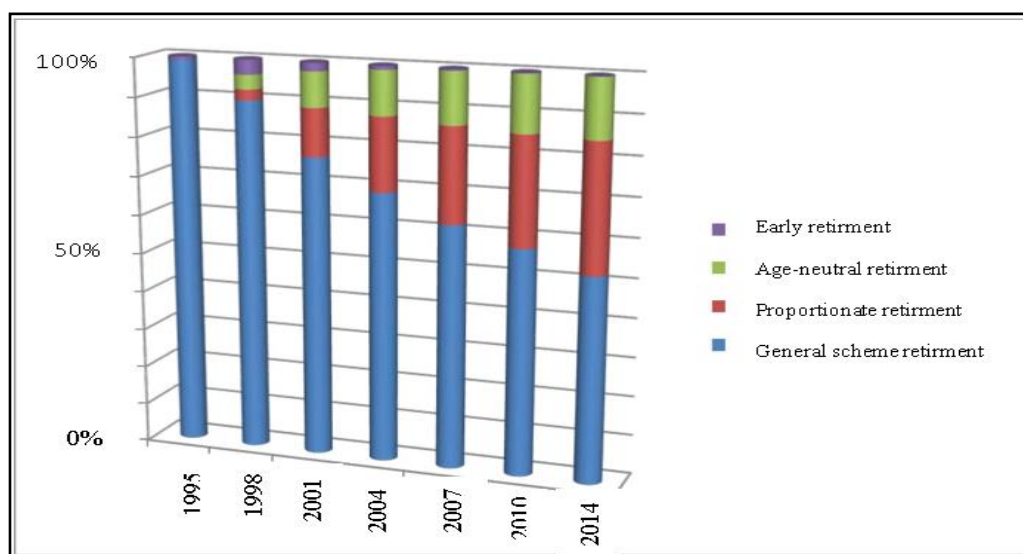
In the first period (2001-2010), the employed population contributing to the national pension fund decreased by more than 20%, it increases only in the second part of the period (2010- 2018); over the whole period (2001-2018) the increase of contributing employees is

barely 4%; while the increase in the number of pensioners paid by the pension fund, over the period (2001-2018), shows steady growth with a rate of 60%.

This divergence between the number of contributing employees and the number of pensioners dependent on the fund is the primary cause of the chronic financial imbalance of the pension fund.

The small increase in contributing employees can be explained by two main factors: First, the inadequacy of recruiting companies. Second, the under-reporting or non-registration of the real workforce of enterprises, which is the illegal behavior of concealed work (Gaulier, 2002).

The increase in the number of pensioners paid by the fund is characterized by the increase in retirements due to the facilitation formulas introduced at the time of the structural adjustment plan; proportionate retirement, the most important, and the age-neutral retirement (see figure 2). These formulas are the least financially advantageous for the pension fund. They provide generous benefits for employees who liquidate their rights prematurely, thus losing their ability to contribute to the system while providing benefits for a longer period.



**Source:** According to the data of the national pension fund.

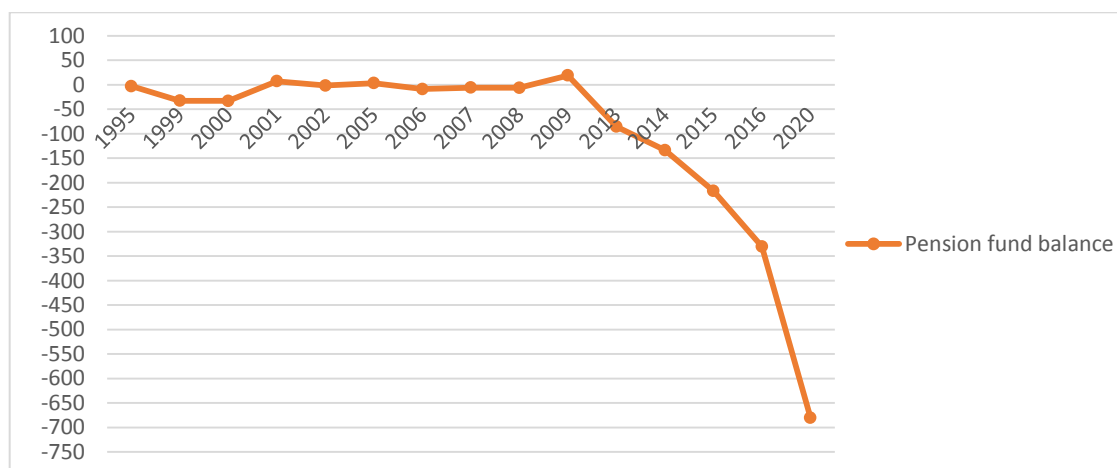
**Figure (2): Proportion of pension distribution by type.**

Since their introduction in the mid-1990s and until their abolition in 2016, there has been a significant increase in retirements under the facilitation formulas. These formulas, which have been a heavy burden on pension expenditure, are the second reason for the financial imbalance of the pension fund in Algeria.

#### **b. A chronic financial imbalance.**

Due to the cross effect of the drop in the number of contributing workers and the increase in retirements in formulas that are expensive, the pension fund in Algeria is in a situation of chronic financial imbalance.

It is the large gap between the rapid evolution of expenditure and the fall in employee contributions that have created an imbalance in the cash flow of the Algerian pension fund. To maintain its existence, the state covers the deficit through public finance.



Source: According to the data of the national pension fund.

**Figure (3): Changes in pension fund balances (1995-2020) (x10³ DA)**

The balances observed in Figure 3 are the result of the reconciliation of the expenditure of the national pension fund with its income, which is already made up of public endowments, i.e., despite the State's intervention in the financing of the fund, negative balances continue to appear and continually increase the State's contribution. Faced with this situation of imbalance which threatens the existence of the pension system in Algeria, minor reform measures have been put in places such as an increase in the contribution rate or the abolition of measures to facilitate retirement.

**Table (1): Breakdown of the contribution rate by the branch of social risks**

Branch	Employer	Employee	Social works	Total
Social Security	11,50%	1,50		13,00%
Work accident	1,25%	-		1,25%
Retirement	11%	6,75%		17,75%
Early retirement	0,25%	0,25%		0,50%
Unemployment insurance	1%	0,50%		1,50%
Public housing			0,50%	0,50%
Total	25 %	9%	0,50%	34,50%

Source: Algerian ministry of labor.

Social security contributions are 34.50% on salaries subject to social security contributions. This contribution finances social insurance and is divided between both the employer's and the employee's share; social security contributions make up the replacement income in the event of a stoppage caused by a social risk. These contributions are spread over the various social risks as shown in Table 1. The pension insurance scheme obtains the highest spread rate with 17.75% of the salary subject to social contributions. It is this rate that must be gradually increased to cover the deficit of the pension fund.

**Table (2): Changes in the retirement contribution rate (%).**

<b>Year</b>	<b>1983</b>	<b>1994</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2006</b>	<b>To 01/2018</b>
Contribution rate	07,00	11,00	11,50	12,00	12,50	14,00	16,00	17,25	17,75

**Source:** Algerian ministry of labor.

A comparison of the evolution of the retirement contribution rates in Algeria and the balances of the pension fund, for the period studied (1995-2020), clearly shows the inefficiency of the increase in rates in restoring financial balance.

#### **4. Analysis of the parameters of a reform.**

Retirement pension systems are required to offer the following two qualities, to be comprehensible to the insured and to guarantee rights or commitments in the future. Technical management methods reduce long-term risks, but economic and demographic changes may call into question the future of pensions in a systemic way.

The environment and context of pension systems, particularly pay-as-you-go pensions, are constantly changing; economic developments play a determining role in the short and medium-term. Indeed, changes in unemployment and the labor market, in general, have a direct effect on the number of contributors, while changes in wages and the contribution base have a major impact on the level of revenue collected by the retirement pension system (Blanchet & Brousse, 1994).

Demographic changes also play a crucial role and have an impact, in the long term, on the financial balance of the system. These population changes have a direct effect on the level of expenditure. An aging population, through the effect of longer life expectancy and/or lower birth rates, will increase expenditure at the expense of revenue. These changes have their origin in social behavior in the organization of life cycles, the average age of marriage, birth rate, or trade-offs between lengthening the period of study and starting a professional career (DUPONT & STERDYNIK, 2000).

To adapt to economic and demographic changes, parametric reforms envisage the correction of certain parameters of the retirement system without changing the operating way. These corrections may concern, on the one hand, the parameters of entitlement to retirements, such as the retirement age, or the years of contributions required, or, on the other hand, the parameters for the payment of the retirement pension, such as the income taken into consideration, the contribution base or the level of the retirement pension (the replacement rate) (Holzmann, 2013).

##### **a. Economic dependency rate.**

The pension system in Algeria, as previously described, is a defined benefit system operating on a pay-as-you-go basis.

In a defined-benefit system, the commitment relates to the ability to provide pensions capable of guaranteeing pensioners an income proportional to the income of working people; this proportion is called the "instantaneous replacement rate".

When the number of contributors is not sufficient to meet the commitments in terms of pension level through an increase in expenditure, by increasing the number of retirees; the adjustment is made by raising the contribution rate to increase revenue. The ratio of the number of contributors to the number of retirees is called the "economic dependency rate". The increase in this rate means that the number of contributing employees is falling, with



the consequence that the contribution rate may have to be increased to maintain pension levels.

The contribution rate to ensure financial equilibrium is written as follows (formula (1)) (Dupuis & El Moudden, 2002).

$$\text{Contribution rate} = \text{instant replacement rate} \times \text{economic dependency rate}$$

**Table (3): Changes in the retirement dependency rate (%).**

Year	2001	2005	2010	2011	2012
Salaried population	4 017 573	3 125 524	3 212 550	3 456 000	3 675 000
Retired population	1 341 161	1 688 055	2 169 892	2 189 702	2 319 531
Dépend. Rate	33,38%	54,01%	67,54%	63,36%	63,12%
Year	2013	2014	2016	2017	2018
Salaried population	3 878 000	3 640 000	4 176 000	4 132 000	4 184 000
Retired population	2 482 454	2 630 362	2 978 557	3 166 903	3 217 503
Dépend. Rate	64,01%	72,26%	71,33%	76,64%	76,90%

**Source:** Data of Algerian national office of statistics & Algerian national pension fund.

**b. Instant replacement rate.**

On the one hand, the instant replacement rate expresses the proportionality of the income provided by the pension system to that of workers in the same socio-professional category. On the other hand, the instant net replacement rate relates the average pensions paid by the pension fund to the average wages of the working population.

To measure the standard of living of retirees, i.e., their capacity to consume, the replacement rate must be calculated "net", after deduction of the compulsory levy deducted from wages and pensions.

The technical replacement rate of the retirement system in Algeria is defined as 80%. It is calculated based on elements of the salary that are subject to social contributions. However, the net salary may include other elements not subject to this social contribution. In this case, the instant replacement rate is lower than the technical replacement rate depending on the size of the components of remuneration not subject to contribution.

Work (MENDIL, 2014) shows the following instant replacement rates in the Algerian retirement system. Table 4, below, shows the instant replacement rate "RR", compared to the proportion of retirees "Proportion" who benefit from it according to the different retirement formulas.

Table (4): Changes in the retirement contribution rate.

Retirement RR Proportion	Proportional 61.1 28.24%	Age-neutral 90.8 12.98%	Early 45.1 0.08%	Attribution 17.6 9.34%	At 60 64.7 49.36%
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Source: Mendil, 2014.

It is possible to determine an average replacement rate for the retirement system in Algeria. The geometric average, weighted by the number of employees benefiting from it shows an average instant replacement rate of **63.50%** of the working wage.

The following table calculates the financial equilibrium contribution rate of the pension system based on the formula (1).

Table (5): Calculation of the equilibrium contribution rate using the formula (1).

Year	2001	2005	2008	2009	2010	2011	2012
Dependency rate	33,38%	54,01%	60,86%	66,20%	67,54%	63,36%	63,12%
Instant replacement,	63,50%	63,50%	63,50%	63,50%	63,50%	63,50%	63,50%
<b>Balance contribution</b>	21,20%	34,30%	38,65%	42,04%	42,89%	40,23%	40,08%
Year	2013	2017	2014	2015	2016	2017	2018
Dependency rate	64,01%	76,64%	72,26%	61,07%	71,33%	76,64%	76,90%
Instant replacement	63,50%	63,50%	63,50%	63,50%	63,50%	63,50%	63,50%
<b>Balance contribution</b>	40,65%	48,67%	45,89%	38,78%	45,29%	48,67%	48,83%

Source: constructed with data from Tables 3 &amp; 4.

The results in Table 5 illustrate what contribution rates to the pension system should be to maintain the financial equilibrium of the operation to ensure the sustainability of the retirement system in Algeria.

The main observation is that these pension contribution rates are higher than the currently applicable rate (17.75%), they are higher, since 2005 than the overall rate for all social security, with all these branches of social risks (34.50%) (see Table 1&2).

The first conclusion is that a reform of the pension system in Algeria could not be achieved by increasing contribution rates alone. It would be necessary to modify the determinants of the economic dependency rate as well as the determinants of the replacement rate.

### c. The balance parameters of a defined benefit pension system.

The parameters of the instant replacement rate and those of the economic dependency ratio can be highlighted by the development of formula (1), the formula (1A).

$$c = P/w * R/S_n$$

$c$ : contribution rate = ( $P$ : pensions /  $w$ : wage) X ( $R$ : retiree /  $S_n$ : salaried employees).

«  $p/w$  »: The instant replacement rate parameters are the relationships between the income of retirees and the income of employees. It reflects the commitment to guarantee retirees a standard of living close to that of working people.

«  $R/S_n$  »: The parameters of the economic dependency ratio are of a demographic nature; they express the number of pensioners (old age persons) dependent on contributing employees, thus expressing the demographic constraint imposed on the retirement scheme.

A linear approach would suggest that to lower the contribution rate to the retirement system and improve financial balance, it would be necessary to lower the economic dependency ratio or lower the instant replacement rate. In reality, the analysis of the implications is more complex.

- i. **Lower the economic dependency ratio:** The variables in the parameters are exogenous, of an unpredictable demographic nature, linked to the social and family policies put in place by the government. The other parameter is equally exogenous, linked to economic and employment policies. The increase in the number of employees requires measures to encourage the creation of businesses, recruitment, and policies aimed at full employment.
- ii. **The drop in the instantaneous replacement rate:** These variables are more manageable, but may have negative social implications. The main tool used by defined-benefit pension systems to reduce the replacement rate is the increase in the number of wages considered in calculating the amount of the pension. Thus, in the most likely hypothesis of an upward career, this may lead to a low replacement rate. The impact may be even sharper on strongly ascending careers, of a high socio-professional category, which may find themselves in economic difficulty after retirement (the effect may be reduced by using previous savings, for example through a supplementary system).

Thus, the modulation by the parameters of the replacement rate can have unexpected and negative social effects, depending on the existing career profiles.

#### d. Evaluation of the parameters by two overlapped generation model.

Building on the previous formulation (1A), it is possible to develop a simple model that will be used systematically to study the economic and demographic impacts on the pension system.

To maintain the sustainability of the defined-benefit pay-as-you-go pension system, the aim is to achieve financial balance by simultaneously adjusting the level of benefits and contributions.

Based on the previous relationships, the overlapping generations model makes it possible to study the impact of economic and demographic changes on the pension system by introducing the concept of time. The same reasoning will be applied, but on variables that come under two exercises. That will leads to the period being noted as an index.

For the period "t", the equilibrium contribution rate is written in the wording (1A). The model variables are:

for the period « t-1 »:

$w_{t-1}$ : The average wage for the period "t-1".

$A_{t-1}$ : Active population of the period "t-1"

for the period « t »:

$c_t$ : Contribution rate.

$p_t$ : Pension.

$w_t$ : Average wage.

$R_t$ : Number of retirees.

$S_t$ : Salaried employee.

$A_t$ : Active population.

$\theta$ : Probability of survival after retirement.

$\mu$  : Replacement rate.

$u$  : Unemployment rate.

$g$  : Wage growth rate.

$n$  : Active population growth rate .

The principle of interweaving is as follows, let us consider that a person lives two periods in his life, the first period of activity at "t-1", where the individual carries out an income-generating professional activity, and the second period of retirement at "t", during which it is replaced by the pension system, are returned in the form of a pension. The wage in period "t" is expressed as a function of the previous period "t-1", with "g" being the rate of wage growth between the two periods. The replacement rate " $\mu$ " is equal to the pension of "t" about the career wage of "t-1"; the instantaneous replacement rate relates the pension of "t" to the wages of workers in the same period.

The following formula expresses the wage of « t ».

$$\boxed{w_t = w_{t-1} * (1 + g)}, \text{ it involves: } (1 + g) = \frac{w_t}{w_{t-1}}, \text{ with } \mu = \frac{p_t}{w_{t-1}}$$

By replacing the terms:  $\frac{p_t}{w_t} = \frac{p_t}{w_{t-1} * (1 + g)} = \mu * \frac{1}{(1 + g)} = \frac{\mu}{(1 + g)}$ .

In the same way, demographic changes can be introduced by linking the populations of one period to those of the previous period. Retirees in period "t" were active in period "t-1", a period in which mortality is assumed to be zero. On the other hand, in period "t", the probability of survival of the working people of "t-1" is " $\theta$ " which takes a value of less than 1. During period "t" two generations coexist, " $A_t$ ": the working people of the moment and " $R_t$ ": the retirees of the moment who are only survivors of the employees of the previous period. that can be formulated:  $\boxed{R_t = \theta * A_{t-1}}$ .

The number of contributors is equal to the active population "A" minus the unemployed population "u"; the active population of a period is determined by the population growth "n" which applies to the active population of the previous period. The formulation is as follows:

$$\boxed{S_t = A_{t-1} * (1 + n) * (1 - u)}$$

Taking the last three relationships into account, the contribution rate formula is expressed

as follows:  $c_t = \mu / (1 + g) * \left\{ (\theta * A_{t-1}) / A_{t-1} * ((1 + n) * (1 - u)) \right\}$ .

This gives:  $\boxed{c_t = \mu / (1 + g) * \left[ \theta / ((1 + n) * (1 - u)) \right]}$

**Formula (2): Two-generation overlapped model.**

This means that the balancing contribution rate in a pay-as-you-go and defined-benefit pension system must vary over two periods depending on the desired replacement rate (maintain, increase or decrease) for a change in the net contributory population of the unemployed and non-survivors.

i. Evaluation of model parameters in Algeria: period (2006-2011) and (2011-2016).

For this evaluation, we assume that the replacement rate is maintained over the second period; i.e., that the average instantaneous replacement rate of the retirement pension in

Algeria is maintained at 63.5% of wages. This hypothesis is based on two assumptions: the first is that the components of wages subject to social security contributions have not changed during this period. The second is that equity, particularly between generations, is respected as an objective of the pension system.

The data published by the national statistics office on wage surveys in Algerian enterprises show the average wage growth rates in the private and public sectors as follows: for the periods between 2006 and 2011 there is an average growth rate of 5.50% and for the period 2011 and 2016 the rate is 8.75%, which can be explained, among other things, by the increase in public sector wages.

The mortality tables of the national statistics office determine the probability of survival at the age of 60 for the period between 2006 and 2011, a rate of 94.63% and for the period between 2011-2016 a rate of 95.27%.

Finally, the demographic data concerning the evolution of the contributing salaried population as well as the unemployment rates in Algeria are also extracted from the data published by the national statistics office and cross-checked with data from the World Bank, in particular the WDI databases.

The following table groups the data from the model and determines the balanced contribution rate calculated by Formula 2.

**Table (6): Balanced contribution rate of Algerian retirement system parameters (2006-2011) (2011-2016) with the formula (2).**

	Period 1 (2006-2011)	Period 2 (2011-2016)
$\theta$	0,9463	0,9527
$\mu$	0,635	0,635
$u$	0,2258	0,12
$g$	0,055	0,0875
$n$	-0,05834	0,009421
$\mu/(1+g)$	0,601895735	0,583908046
$\theta/(1+n)*(1-u)$	0,778014846	0,830551375
<b>Ct</b>	<b>46,83%</b>	<b>48,50%</b>

**Source:** Established by the author.

The results show, for the first period, that the financial balance of the pension system is reached for a contribution rate of 46.83%. The observations to be noted during this period are: first, the decline in the contributing population; over the period, on average, contributing employees decrease since the variable "n" is expressed in negative. Second, the relatively high unemployment rate "u" of 22.58% is likely to harm the system, i.e. potential employees who do not contribute.

The adverse demographic and economic trend effect, combined with a high replacement rate requires a contribution of more than 17.75%, instead of 46,83%; the revenue differential is offset by the national pension reserve fund financed by the public treasury.

For the second period the contribution rate increases for two reasons: the first is that, due to the effect of the increase in average wages and to maintain a constant replacement rate, the fund's expenses increase. The second is the decreasing number of

contributing employees. The fact that the increased pension fund burden is absorbed by a declining number of contributors increases the break-even contribution rate.

## 5. Conclusion.

The pension system in Algeria is in total imbalance. Its expenditures are much higher than its revenues. This imbalance is likely to threaten its existence. It continues to exist thanks to the significant contribution of public finances to cover deficits.

the main results that emerge from this contribution are:

1- In view of the significant imbalance of the pension system in Algeria, a parametric reform will not be sufficient, too great a correction of the parameters will cause a disastrous social transition cost.

2- Simultaneous structural reform is needed, taking into account the specificity of career profiles between the different sectors and wage disparities between socio-professional groups.

3- Demographic and economic developments are too important to maintain a single general and compulsory pensions system.

In fact, and view of its operating parameters, the correction should involve, simultaneously, aspects linked to economics, demographic and social policies. It is obvious, then, that a reform of the exclusively parametric aspects of the system will be too restrictive and will generate significant social costs.

In recent years, the only correction granted by the government is the increase in the contribution rate at retirement through a system of equalization of the rates between the various social security funds. But even if it seems necessary, it is not enough and to settle for it to achieve balance is a foolish idea.

As observed, the contribution levels necessary for balance exceed 45%, and this only concerns the retirement branch of the social security system, whereas the overall contribution rate for all social risks in the application in Algeria is 34.5%.

Increasing the pension contribution rate would be counterproductive and would have a disastrous impact on the labor costs of Algerian companies and their competitiveness. The first consequence would be a sharp slowdown in recruiting and business creation in the Algerian economy, which is already suffering from the symptom of the inadequacy of companies that recruit and contribute to the pension system in particular and the social security system in general.

Even if the reflection on the contribution rates to be implemented is important, it is also vital to think about other possible ways of reform in the retirement system in Algeria. The alternative path to the sustainability of the current system is the consideration of a total reform, on several aspects of its operating mode, not only of its parameters, but also of the system of taking care of the risk of old age and retirement.

The socio-economic evolution in Algeria seems to advocate for a diversification of the management of retirement. The diversity of career profiles in the public and private sectors, the disparity in income levels, and the improvement of living standards suggests a need for a diversification of management methods around a central system.

These proposed reforms must respond to the need to safeguard the social gains, by preserving the principle of intra- and intergenerational solidarity to minimize the social costs of the pivotal generations that will live the reforms. for that purpose, it would be wise to consider the implementation of a differentiated and multi-pillar system as proposed by the World Bank:

- A first pillar granting benefits, after examination of the level of resources, financed by taxes, under a public scheme operating according to the principle of national solidarity, this is a minimum support.

- The second pillar would comprise a compulsory pension programme, consisting of pay-as-you-go and/or funded pension schemes, financed by compulsory savings entrusted to private insurance, regulated by the state or by professional bodies.

- The third pillar consists of a voluntary and/or compulsory scheme, directed towards high incomes, operating on a funded basis, where the contribution would be progressive according to the level of these resources.

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