

Evaluating the financial sustainability of pension systems: The case of Morocco's private sector pension scheme

Asmaa EL ANBARI¹, Saïd HANCHANE², Mariem LIOUAEDDINE³

¹ Faculty of Economics and Management/Laboratory of Economic and Public Policy Sciences, Ibn Tofail University, Kenitra, Morocco. ORCID: 0009-0005-7457-7683

² Africa Business School/Laboratory of Industrial Economics and the Emergence of Africa, University Mohammed VI Polytechnic, Rabat, Morocco.

³ Laboratory of Economic and Public Policy Sciences - Faculty of Economics and Management - Ibn Tofail University, Kenitra, Morocco. ORCID: 0000-0002-5824-1590

Abstract. The ageing of populations is one of the main factors contributing to financial unsustainability of pension schemes worldwide, particularly pay-as-you-go schemes. Morocco is not immune to these ageing trends, which have changed the shape of its age pyramid over time. This paper focuses on the pension system for salaried workers in the private sector in Morocco. It presents the results of actuarial modelling of this pension scheme using the "ILO-PENS" model. Developed by International Labour Organisation, this model relies on the cohort simulation method to estimate the future cost of financing pension benefits. The results of actuarial projections based on 2021 confirmed the scheme's short-term financial unsustainability. From 2027, the scheme's resources will no longer be sufficient to cover its expenditure. However, thanks to the accumulated reserve funds, the viability horizon extends to 2040. These results are close to the official ones published for the same year 2021[1], which validates the use of the model for assessing the impact of the reform options to be examined. In a context of pronounced ageing trends, reforming the national pension system is imperative, given that the rate of pension coverage for the elderly is among the lowest in the region, standing at 23.4%[2].

Keyword: Pension reform, Financial sustainability, Demographic ageing, ILO-PENS actuarial model.

1 Introduction

Debates concerning socioeconomic development, particularly the social protection component and its relationship with demographic changes, have been the focus of several research studies since the inception of political economy [3, 4, 5, 6]. This dynamic is currently being disrupted by demographic transition, which poses a threat to the structural balance of pension systems around the world.

The Moroccan pension system is currently facing financial fragility, a situation that has been exacerbated by many factors, especially the demographic transition because system's

constituent pension schemes are predominantly managed on a pay-as-you-go basis. Consequently, the sustainability of these schemes is directly impacted by demographic changes. Several demographic studies have highlighted the issue of demographic ageing and its consequences for the Moroccan pension system [7, 8], other studies have demonstrated the short-term horizon for its financial viability such as official reports [9, 10] and the recent study by El Anbari A. *and al.* 2025 [11]. In addition, national consultations are ongoing regarding the reform of the various schemes within the system.

The primary research questions guiding our study is as follows: what is the real financial issue of the pension scheme for salaried employees in the private sector in Morocco? And how this situation can be addressed? To answer these questions, it is appropriate to assess the long-term financial situation of the pension scheme and its ability to meet its commitments and pay pensions to current contributors. This analytical perspective involves the actuarial modelling of the studied scheme, which allows to evaluate how the scheme's financial position will develop in the future if no reform measures are adopted.

The actuarial modelling of the pension scheme studied is based on the ILO-PENS model developed by the Social Protection Department of the International Labour Organisation (ILO)¹. A meticulous protocol for adapting the model to the specific features of the scheme was necessary to produce credible results regarding certain particularities of the Moroccan situation. This model uses the cohort simulation method to estimate the future cost of financing pension benefits. It produces year-by-year projections of possible changes in the various populations covered according to their status and the various financial flows generated.

Before we proceed with the modelling and evaluating financial sustainability, we present the ILO-PENS model, its operating logic and its constituent modules. This is followed by a description of the data used to feed the model and project the main financial flows of the pension scheme under study.

Adapting the ILO-PENS model to the Moroccan macroeconomic context and to the pension scheme for private sector employees in 2021 confirms the scheme's short-term financial unsustainability, with a technical deficit appearing in 2027 when resources will no longer be sufficient to cover expenditure. However, the viability horizon extends to 2040 thanks to the accumulated reserve funds used until they are exhausted. These results align with those of the official studies conducted for this scheme based on 2021 financial data. This work therefore involves the initial step of preparing an actuarial tool that will enable to simulate the impact of the reform options to be defined on the viability of the modelled pension scheme.

2 Method: adaptation of the ILO-PENS model for evaluating private-sector employees' pension scheme in Morocco

The approach adopted in this paper is to develop a macro model to assess the financial viability of the scheme in its current configuration, in a status quo scenario. This work is a preliminary step to evaluate the impact of possible reform options on its financial sustainability.

2.1. ILO-PENS actuarial valuation model

¹ It should be noted that the ILO-PENS model is the property of the ILO, which holds all copyright. However, its use, through its adaptation to the system studied and its input of data collected by the authors, as well as the results derived from it, are in no way binding on the ILO and are the sole responsibility of the authors of this paper

Our macro modelling of the scheme is based on the "ILO-PENS" actuarial pension model. As any actuarial model of social security pensions, the ILO-PENS model has two main objectives: to assess the financial viability of the scheme over the long term in order to anticipate any concerns about financial unsustainability, and to examine the financial impacts of reform options in order to help decision-makers design and make the best choices for reforming social security pension systems [12].

The ILO-PENS model estimates the future cost of financing pension benefits using the cohort simulation method; it enables "year-by-year" projections of the possible development trajectories of the various populations covered according to their status (active contributors, inactive, retired, disabled, deceased, etc.). ILO-PENS also assesses the associated financial profiles, in particular average salaries and the various benefits provided. To do this, the model uses demographic and financial assumptions based on the specific context of the scheme, as well as modelling of operating parameters and other assumptions specific to the scheme [13]. This model is adjustable and flexible, allowing its adaptation to several country contexts and different pension schemes.

The calculation of the annual benefits of the scheme is expressed as follows [13]:

$$DAP = C_{Ret} + C_{Rev} + C_{DC} + C_{Inv} \quad (1)$$

Where:

DAP Annual expenditure on benefits.

C_{Ret} Cost of retirement benefits.

C_{Rev} Cost of survivors' benefits.

C_{DC} Cost of death benefits.

C_{Inv} Cost of disability benefits.

Consequently, future expenditure is determined year by year, by applying to the expenditure for the current year (T) the survival rates of beneficiaries and the adjustment factors in the case of pension revaluations. In addition to this, the cost of new pensions projected to be paid in (T+1) is added. The formula can be expressed as follows:

$$D_{T+1} = (D_T * T_s * \alpha) + NvP_{T+1} \quad (2)$$

Where:

D_{T+1} Expenses for year T+1 ;

D_T Expenses for year T ;

T_s Survival rate: this is the probability of survival pensioners between year T and T+1 according to the mortality tables used.

α Pension adjustment factor: This generally refers to the systematic revaluation of pensions to consider inflation or any other mechanism for revaluing the amounts of pensions paid under the legislation of the scheme concerned.

NvP_{T+1} Cost of new pensions in year T+1.

Secondly, to estimate the scheme's resources, it is necessary to determine the annual contributions base. This estimate is determined by multiplying the number of contributors by the average insurable income and by the rate of contributions' collection according to the following equation:

$$Ass.Cot_T = Nb.Cot_T * RM_T * T_{Rec} \quad (3)$$

Where:

Ass.Cot_T The base of insurable income on which the rate of contribution is applied to calculate pension contributions.

Nb.Cot_T The number of active contributors covered by the scheme in year T.

RM_T The average insurable income in year T per active contributor to the scheme.

T_{Rec} Contributions’ collection rate: this is the proportion of active contributors who pay their contributions to the scheme in year T.

Finally, the three equations above represent the core of most actuarial pension models, particularly the ILO-PENS model. To apply them, we need to identify their various components.

Consequently, the actuarial projection of the scheme requires starting with the projection of the future macroeconomic environment. This is mainly related to the country's demographic context, the employment situation and economic growth. Then, the projection of the scheme's contribution bases is conducted by estimating the development of the insurable wages in the scheme under study. Finally, the model is adjusted to incorporate the specific features of the scheme, in particular conditions of eligibility for the various benefits provided and their calculation formulas.

The specification of the model's entire system of equations involves other actuarial sub-models designed and developed by the ILO [13]. These include the ILO-POP demographic projections model, which is based on assumptions relating to mortality, fertility and population migration flows [14]. Similarly, the ILO-LAB employment projections model is used to project the working population and the employed labour force, based on assumptions about the unemployment rate. The ILO-ECO model is used for purely economic projections. This simulates the trajectory of certain key variables, such as GDP, inflation, etc. Finally, the ILO-SAL model is used to project insurable wages based on demographic assumptions, employment and other economic variables [15]. The outputs of all these sub-models interact with each other and are used to feed the ILO-PENS model.

In addition to projecting the various demographic and financial flows by age, gender and type of benefit provided, ILO-PENS project also the scheme's income and expenditure account over the projection period and calculate several indicators to assess financial sustainability of the scheme under study.

2.2. Data used

In seeking to adapt the ILO-PENS actuarial model to the CNSS pension scheme, the effort consists of mobilising a considerable amount of data at a very fine granularity, since most of the data used must be disaggregated by age and sex.

For this reason, data was collected from several national and international sources, to guarantee the reliability of the model's inputs and provide a solid basis for the projections (see table 1).

Table1 : Data collected by authors and their sources

Data collected	Data Sources
Demographic data: Population, Mortality, Life expectancy, Migration	- Office of the High Commissioner for Planning - Demographic data from the United Nations Population Division
Employment data	- Office of the High Commissioner for Planning - ILO statistical data (ILOSTAT)
Macro-economic and financial data: GDP, inflation & interest rates	- Office of the High Commissioner for Planning - Central Bank: Bank Al Maghrib -Trading Economics
Data specific to the pension scheme: Covered population, Contributions, Benefits, Reserves, Administrative costs....	- Statistical and demographic reports, National Social Security Fund - Annual reports of the social security sector: Insurance and Social Protection Supervisory Authority

In order to determine the future macro-economic environment in which the pension scheme for private sector employees is evolving, several demographic and economic assumptions had to be formulated. All the assumptions used were formulated primarily by calibrating demographic and economic data based on our statistical sources. In addition, specific data covering more than 10 years was used to formulate assumptions regarding the future evolution of the pension scheme under study.

The time horizon chosen is 100 years, as this is an actuarial study of a long-term benefits branch. This projection horizon is usually used in actuarial models and is well suited to long-term simulation exercises on the development of pension schemes. However, it poses a whole series of problems, particularly among economists and econometricians. This is because assumptions about very long-term trends in economic and financial variables may turn out to be unrealistic. Even over a medium-term or even short-term horizon, it is well known that forecasting models can be subject to considerable margin of error, particularly in the event of various shocks (the 2008 financial crisis, pandemics and climate changes, etc.). The reliability of the long-term projections made by actuarial models can be contested despite their frequent utilisation due to the nature of pension provision, involving long-term commitments [16].

Finally, it should be noted that the base year chosen for the projections is 2021. This is the most recent year from which the data required for the scheme studied to feed the ILO-PENS model is available.

3. Results: Analysis and discussion

3.1. Demographic and macro-economic projections

According to the adopted assumptions for the evolution of the country's demographic context, the results of the projections obtained by the ILO-POP sub-model confirm the overall trends of those emanating from national (HCP) and international (UN) institutions [17]. They predict a continuation of population ageing trends, with an increase in the proportion of the population aged 60 and over and a fall in the proportion of children, due to lower fertility rates.

In addition, based on the economic calibrations of the model and the base year data feeding the ILO-PENS sub-models, the main projections of the macro-economic environment regarding employment, in particular the labour force and the employed persons, are broadly similar. They show a continuous upward trend until the middle of the projection period, when growth stabilises and then adopts a downward trend. This trend is a consequence of the demographic transition characterized by the ageing population, which has an impact on the labour market, with a decline in the active population over the long term.

3.2. Projections of the scheme's covered populations

By adjusting the ILO-PENS model to the specific characteristics of the scheme studied, the projection of the scheme's active contributors and pensioners was conducted. The results show that the population covered by the scheme is ageing, since the growth rate of the number of pensioners receiving benefits from the scheme exceeds that of contributors. In addition, the number of active contributors will stagnate over the next two decades, while the number of pensioners will continue to rise over this period.

As the scheme is financed on a partially funded basis, the demographic factor is important to monitor, particularly the demographic ratio. This indicator, defined as the ratio

of the number of active contributors to the number of pensioners, enables the monitoring of changes in the number of contributors who finance each pension paid by the scheme. As the following graph shows (figure 1), the projections for the scheme studied show that its demographic ratio is declining sharply. It falls from 5 contributors/pensioner in the base year to around 1 contributor for each pension paid over the projection horizon. This trend indicates a serious demographic problem that poses a major risk to the financial sustainability of the scheme.

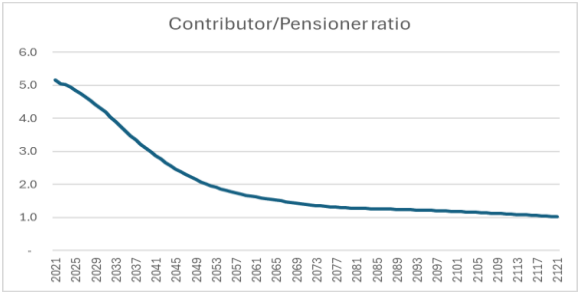


Figure 1: Projected demographic ratio for the scheme under study by ILO-PENS Model

The demographic projection for the populations covered by the scheme confirms the ageing trends in Morocco's population. The deterioration in the demographic ratio is a consequence of the population ageing over the coming decades. Also, the results of the projection of the evolution of the demographic ratio of the CNSS salaried workers' scheme according to the ILO-PENS model are aligned with the official actuarial study carried out by the ACAPS model [1].

3.3. Cash-flow projections

The model was adjusted to the context of the scheme studied to consider the eligibility conditions for the various benefits and the formulas used for calculation. Projection of the various financial flows representing the scheme's resources are composed of employers' and employees' contributions and the financial income generated by the investment of the scheme's reserve funds, net of investment expenses. As for the scheme's expenditure, it includes the various pension benefits paid out, as well as administrative costs. The results of all these financial flow projections (figure 2), show that benefit expenditure is increasing at a higher pace than the scheme's resources.

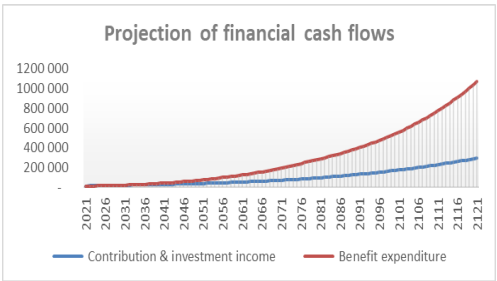


Figure 2: Projected resources and expenditure for the CNSS scheme for employees by ILO-PENS model

This situation is a direct consequence of the population ageing, which is leading to an increase in the number of elderly people receiving pensions, with a slower growth in the population of active contributors. As a result, if no corrective measures are taken in the future, the scheme's resources will no longer be sufficient to cover its expenditure.

The results of the actuarial projections in the central scenario forecast a technical deficit by 2027, when the scheme's resources will no longer be sufficient to cover its expenditure. However, the scheme's viability horizon is extended to 2040, where the accumulated reserves, supposed to cover the deficit generated, are exhausted. These results are aligned with those of the actuarial study carried out by ACAPS for the same base year of 2021 for the CNSS scheme, which estimates that the deficit will occur by 2026 and that reserves will be exhausted in 2038 [1].

Also, some sensitivity tests were carried out by applying shocks to demographic, economic and financial variables. The purpose of these tests is to check the robustness and consistency of the model's results, subject to changes in these variables. The results of these tests are consistent in terms of changes in the scheme's financial viability indicators.

3.4. Main limitations of the model

The modelling of the system studied in ILO-PENS encountered several constraints which can be considered as limitations of the version of the model used. For example, the validity of long-term projections for several economic variables, such as inflation, may be subject to considerable margin of error due to their volatility and the difficulty of predicting their long-term evolution.

Also, several adjustments were made to adapt the available data to the requirements of the model used, or in the expression of formulas for calculating benefits provided and eligibility conditions. In some specific cases, adjustment required simplifications which resulted in the loss of certain information and the non-inclusion of certain specific features. However, the impact of these specific cases is relatively limited in the global context

4. Conclusion and prospects

In the context of the country's demographic situation, which is characterised by increasingly pronounced ageing trends and the many limitations of the national pension system, reform is becoming imperative. In addition, the pension coverage rate for the elderly is one of the lowest in the region. In fact, only 23.4% of people in retirement age have pension benefits in Morocco [2]. Therefore, this situation calls for appropriate reform to facilitate the extension of pension coverage in the country.

Modelling the pension scheme for private sector employees in Morocco under ILO-PENS has produced results that are broadly consistent with those of official studies of this scheme. Projections of the central scenario confirm that the scheme is facing significant financial sustainability issues. The main factors contributing to the scheme's financial fragility are the demographic ageing of the covered population and the way the pay-as-you-go scheme operates.

The actuarial modelling discussed in this paper, while providing a useful framework for analysis, has limitations that should be highlighted. These issues mainly emerge at two levels: the adaptation of the model to the country's macroeconomic context and its capacity to fully integrate the specific features of the scheme under study. Regarding the initial aspect, the calibration of the model is based on assumptions that could be the subject of

discussion and criticism. Moreover, it is imperative to acknowledge the necessity of simplification to capture the fundamental characteristics of the scheme under study. These methodological choices, which are inherent in all modelling, represent areas for improvement in future research.

Indeed, this version of the model represents a preliminary step in our future research on the issue under study. This model is designed to provide a macro-level assessment of the present situation of the pension scheme in the absence of reform measures, confirming the issue of its financial unsustainability in the short-term. Its purpose is to serve as a means of subsequently carrying out simulations to assess the impact of possible reform scenarios on the scheme's financial equilibrium and to provide a basis for comparison with the results of the central scenario.

References

- [1] Autorité de Contrôle des Assurances et de la Prévoyance Sociale, Rapport annuel - secteur de la Prévoyance Sociale 2021, (2022).
- [2] International Labour Office, World Social Protection Report 2024-2026, Universal social protection for climate action and a just transition, (2024).
- [3] S. Kuznets, Modern Economic Growth: Findings and reflections, American Economic Review, Vol. 63, pp 247–258, (1973).
- [4] R. Lee, The Demographic Transition: Three Centuries of Fundamental Change, Journal of Economic Perspectives, vol. 17, pp 167–190 (2003).
- [5] P. Trainar, Démographie, Assurance et Croissance, Revue d'Économie Financière, numéro 122, pp 161–180, (2016).
- [6] T. Malthus, An essay on the principle of population. Oxford University Press, (1998).
- [7] Centre d'Etudes Démographiques et de Recherches, Rapport national sur la politique de population, Personnes âgées au Maroc : Situation Et Perspectives, (2006).
- [8] Centre d'Etudes Démographiques et de Recherches, Projections de la population et des ménages 2014-2050, (2017).
- [9] Actuarial, Commission Technique sur la Réforme des Retraites : Etude du statu Quo, (2009).
- [10] Cour des Comptes, Rapport sur le système de retraite au Maroc : Diagnostic et proposition de réformes, (2013).
- [11] A. El Anbari, S. Hanchane, M. Liouaeddine, and M. Amrani, Généralisation de la couverture retraite au Maroc : Évaluation des enjeux et des contraintes et perspectives d'évolution, Cahiers du Plan HCP, (2025).
- [12] P. Plamondon, A. Drouin, G. Binet, M. Cichon, W. McGillivray, M. Bedard, and H. Perez-Montas, Actuarial practice in social security, International Labour Office/International Social Security Association, (2002).
- [13] International Labour Office, The ILO pension model: A technical guide, (2018).
- [14] International Labour Office, The ILO population projection model: A technical guide, (2002).
- [15] International Labour Office, ILO-dist: The ILO wage distribution model, Technical Guide, (1996).
- [16] International Labour Organization and International Social Security Association, Guidelines: Actuarial work for social security (2022).
- [17] Department of Economic and Social Affairs, United Nations, World population prospects 2024, n° 9, (2024).