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Pension plans in public universities in Mexico[1]

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RESUMEN

Las pensiones privadas están diseñadas para complementar los ingresos de jubilación para cualquier empleado que cuente con este beneficio. Este trabajo muestra un ejemplo específico de un plan de pensiones de una universidad pública. Las características generales de los empleados, los pasivos actuariales totales, los flujos de efectivo anuales y la tasa de dependencia intergeneracional se muestran. Los resultados encontrados son que el plan de pensiones bajo estudio es generoso y que los pasivos actuariales representan en la actualidad más de $4,500 millones de pesos y van a aumentar a un máximo de $8,300 millones de pesos en 2027. También que el pago anual total máximo se alcanza en 2035 con $900 millones de pesos y que los flujos de efectivo se extinguen en el 2089. Por último, se ha encontrado que la insostenibilidad financiera de la universidad sería en 2027, si no existiera ningún recurso financiero adicional.

Palabras clave: pensiones, universidades públicas, pasivos actuariales, flujos de efectivo.

ABSTRACT

Private pensions are designed to complement the retirement income for any employee credited with this benefit. This work shows a specific example of a public university pension plan. The general average characteristics of the employees, the total actuarial liabilities, the annual cash flows and the dependency ratio are calculated. The results show that the pension plan under study is generous and that the actuarial liabilities represent at the moment more than $4,500 million of pesos and are going to increase to a maximum of $8,300 million of pesos in 2027. That the maximum total annual payment is reached in 2035 with 900 million pesos and that cash flows will be extinguished in 2089, as no other retirement will occur. Finally, it is found that the bankruptcy of the university will be in 2027, as the total annual budget is not sufficient to cover the cost.

Keywords: pensions, public universities, actuarial liabilities, cash flows.

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[1] This is an extension of the work “DB plans in Mexican universities” published at the “Global Vision Benefits” magazine, December 2015 issue.

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INTRODUCTION

In Mexico, the principal mandatory pension system started to operate as a Defined Benefit (DB) in 1973. However, since 1997 a switch from Defined Benefit to Defined Contribution (DC) with individual accounts managed by financial institutions, such as banks or insurance companies, was made. This DC system is still opened to new members, whereas the DB pension one is closed. As of today, the Mexican pension system consists mainly of 4 pillars: the non-contributory, the public mandatory, the private mandatory and the voluntary (CONSAR, June 2015, p. 15). The first pillar (called the pillar 0) consists on a universal basic pension financed by the government with a minimum pension guarantee, the second (pillar 1) consists on a compulsory plan financed exclusively by the government, financed with contributions or with both. This pillar is mandatory for the individuals working on the public sector with a pension plan. The third pillar (pillar 2) is also mandatory but financed by contributions, then it is considered a funded plan. The fourth pillar (pillar 3) is a voluntary one which consists on voluntary additional contributions or private pension plans bought to insurance companies.

The pillar 2 consists of two different pension schemes. That is, individuals entering to formal jobs in Mexico from July 1997 to date (referred to the current pensions law called IMSS-97), are automatically credited with an individual account managed by a financial institution, in order to save for retirement. In contrast, individuals who entered to formal jobs before July 1997, have the choice of a DB pension under the IMSS-73, which is of a DB kind and consists on a pension at retirement depending on the final salary of the worker or individual.

The chronology of the mandatory pension plans in Mexico is shown in figure 1. Summarizing, the first public mandatory system in Mexico started in 1960 with the Institute for Social Security and Services for State Workers (ISSSTE) operating under pillar 1. In 1973, the second public mandatory system started to operate also under pillar 1 with the Institute for the Mexican Social Security (IMSS). These two main institutions coexists in Mexico to provide for social security to all Mexican employees with the difference that ISSSTE relates to state workers while IMSS relates to workers in non-state institutions or private sector employees. In 1992, the system retirement savings (SAR) was created in order to regulate the new mandatory pension system in Mexico related to IMSS, also in 1994 the national commission for the retirement savings system (CONSAR) was created to regulate the SAR. In 1997, the pension system for private sector employees was amended from a pay-as-you-go scheme to a defined contribution structure based on individual accounts managed by private institutions called AFOREs (pension funds management companies). In 2007, new public sector employees affiliated to ISSSTE were incorporated to the individual accounts pension system.

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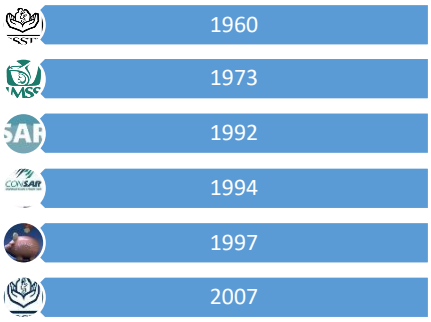
Figure 1. Chronology of mandatory pension plans in Mexico.



Source: Authors' contribution with data from OECD (2015)

As of today, AFORES are the institutions in charge of the management of the employees' mandatory pension savings who started to work after 1997 (IMSS) or 2007 (ISSSTE). These AFORES, through the SIEFORES, invest the funds with the investment regime defined by CONSAR. Another important date is 2008 in which the employees' pension funds from the Federal Commission of Electricity (CFE) started to operate under the AFORES. This kind of DC pension scheme has the advantage of making the financing of benefits explicit but leaves the cost of the benefits undefined, requiring that the falling of equity prices and declining annuity rates a larger DC fund to provide a decent retirement income (Foster, 2007).

The main objective of this work is then to give an example of a pension plan operating under pillar 1. Specifically, to give an overview of the general situation of a DB plan in a public university in Mexico and how these kind of plans are just about to extinguish due to the huge deficit these represent.

DB PLANS: EXAMPLE OF A PUBLIC UNIVERSITY

As mentioned before, under the Mexican pillar 1, individuals working on the public sector will benefit from a pension when the public institution offers them this. The pension can be of a DC, DB or a mixed type and can be a funded or an unfunded scheme. There is a specific case: the pension plans offered by the public universities, which in Mexico, the majority of them operate under a DB type. In a study made by a university in Queretaro, 12 pension plans from different public universities were compared and the results are shown in table 1.

Table 1. Pension plan characteristics from 12 public universities.

	%
Defined benefit financed with contributions	100
Lump sum at retirement	33
Replacement rate of 100% of the salary (when no entitlement to other pension exists)	42

Source: Authors' elaboration.

From this comparison, it is also found that the average compulsory retirement age is 63 with an average of 27 years of service. These pension plans are generous, in the sense that the actual mandatory pension plan in Mexico requires 65 years of age to retire and 40 years of service suggested to reach only a replacement rate of 50% (OECD, 2015, p. 4). That means, the individuals who are credited with this kind of pension plan need to work 13 years more only to obtain half of the pension than with a public university pension plan. Also, compared with occupational pensions in the UK, DB schemes typically operate with a maximum income of pension of 2/3 of final salary in retirement, which compared with the replacement rate of 100% is not high (Foster, 2007).

In order to give a specific example of a DB pension plan, the details are described in table 2. The plan is then, as mentioned before, considered a generous one compared with the actual mandatory pension system but also with others in the study. The plan was closed to new members in 2008, due to the high deficit it represents to the university and the public finances. Also, this plan was created to complement the pension received under the mandatory DB system. That is, the employees receiving a pension from the university also receive a pension from the current mandatory plan, so the university pension have to complement to receive in total 100% of the final salary. For example, if an employee receives a replacement rate of 70% under the mandatory plan, the university will complement the pension to receive in total 100%. That is the main objective of the majority of pension plans offered by public universities in Mexico. If we compare this situation with the one in the United States, Clark and Craig (2011) showed that teachers reach an average replacement rate of 60% with 30 years of service. Situation that is much less generous than our specific example in Mexico as the replacement rate reached is 100%.

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Table 2. An example of a DB pension plan: Mexican public university.

Pension plan type	Defined benefit scheme (coexisting with the DB pension under the IMSS-73 law*)
Retirement age	60 years old~
Years of service	30 years
Total of monthly payments per year included in the pension	16+
Contributions to the pension fund	The university contributes twice the employee's contribution as a percentage of the salary^
Ancillary benefits	65% of the pension to the widow or widower and 30% to each child under 18 years old-

Notes:
*See section 1.
~As of 2015, the retirement age is 57 years old which is going to increase 6 months each year until 60 years old in 2021.
+The pension is calculated according to the total annual salary received by the employee, which consists of 12 monthly payments plus an annual bonus of 4 months as part of Christmas and vacations bonuses (in Spanish it is called "Aguinaldo" and "prima vacacional").
^There is a maximum percentage of 16%.
-Child under 25 if studying. Both percentages do not have to exceed 100%.
Source: Authors' elaboration with data from public university's pension plan.

Any pension plan has to be regulated by the government actual rules. In Mexico, private pension plans have to be registered at CONSAR. However, although pension plans from public universities are considered of a private type, such plans are not registered. These, instead, are regulated by the institution itself in which these are designed. Compared with the United States, as of 2011, there were 13 states whose teachers were outside the United States Social Security system: Alaska, California, Colorado, Connecticut, Illinois, Kentucky, Louisiana, Maine, Massachusetts, Missouri, Nevada, Ohio and Texas. These retirement plans for teachers not covered by Social Security are more generous than the plans covering teachers who are participating in Social Security (Clark and Craig, 2011). Also, defined benefit plans remain the dominant type of retirement plan for teachers with pension benefit formulas often rather complex, with the benefit varying by age, years of service, earnings, and coverage by Social Security (Clark and Craig, 2011, p.105).

In the next section, the actuarial liabilities that the pension plan described in table 2 represent are calculated to give an overview of the financial burden that these represent. It is worth to mention that the majority of the universities in Mexico have a similar situation, so it is a representative case of the general situation that is found in the country.

METHODOLOGY

Any pension plan of the defined benefit type represent liabilities for the institution holding the plan. In Mexico, for accounting purposes the pension plans represent an annual cost which is calculated using actuarial formulas. According to Blake (2006, p. 194), the majority of the defined benefit actuarial liabilities are calculated using a specific method called "the projected unit method". However, for the study presented in this work, a formula related with an actuarial present value of the pension amount is used. See formula (1) and (2).

$$AL_t^a = v^{r-x+t}{}_{r-x+t}p_x[S_x(1+i)^{r-x+t}]\ddot{a}_{r+t} \quad (1)$$

$AL_t^a =$ Actuarial liabilities for active members

$r =$ retirement age when the employee has reaching 30 years of service

$x =$ current age

$i =$ salary increment rate

$v^{r-x+t} = (1+j)^{x-r-t}$

$j =$ discount rate

${}_{r-x+t}p_x =$ probability of surviving till retirement age

$S_x =$ Salary at age x

$\ddot{a}_{r+t} =$ whole life annuity paid in advanced representing the payment for pension at age $r+t$

$$AL_t^b = v^t \ {}_tp_x[P_t\ddot{a}_{x+t}] \quad (2)$$

Where:

$AL_t^b =$ Actuarial liabilities from retirees

$P_t =$ Pension in payment at time t

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In order to calculate the actuarial liabilities for this particular pension plan example, the following assumptions are made:

- All employees retire with a 100% of their salary
- All employees retire immediately after 30 years of service
- An annual increase on salary of 4.5%
- 16 monthly salaries are considered annually to calculate the pension amount, according to the rules of the plan.
- Mexican mortality rates according to the National Commission on Insurance (CNSF) in Mexico.
- All employees are married and with no children. For female employees, it is assumed that they are married with a person 2 years older and for male employees with a person 2 years younger.

Annual cash flows are also calculated, in order to analyze the annual pension payments from the institution. These are calculated separately for active members who are entitled for a pension in that particular year t and for actual retirees. Formula (3) and (4) show the calculations to obtain cash flows for active members and retirees, respectively.

$$CF_t^a = {}_{r-x+t}p_x[S_x(1+i)^{r-x+t}] \quad (3)$$

$$CF_t^b = {}_tp_xP_t \quad (4)$$

Where:

CF_t^a = cash flow at time t of active members

CF_t^b = cash flow at time t of retirees

The assumptions to calculate cash flows are the same as previous ones with the following differences:

- No widow or widower is assumed, only payments to pensioner.
- All employees are entitled with a pension from IMSS. That is, the cash flows represent only complementary payments to reach 100% of the salary.

The results for this study are presented in the next section. The data was obtained from the institution itself and the specific characteristics used in the analysis are: gender, actual age, faculty, total salary and years of service. Although this is a specific study case, the situation of most universities in the country is similar.

RESULTS

A general overview of the current situation of the 2204 employees credited with the pension described in table 2, is shown in table 3. Note that there is a high standard deviation between salaries, due to the difference between the minimum and the maximum annual salary. This is because of the difference on the employee contract within the institution, that is, some employees work one hour per day and others are full-time employees.

Table 3. Current situation of the employees at the university.

Gender	55% males, 45% females
Average age	47
Monthly average salary	$14,574
Minimum monthly salary	$329
Maximum monthly salary	$108,918

Source: Authors' elaboration with data from public university's employees.

The demographic situation of the university's employees is shown in figure 2. The orange bars represent total number of women and the grey bars total number of men. The y-axis represents the age and the x-axis the number of employees. When looking at the results, it can be seen that the average age is 47 and that at this age there are more men than women. Also that the minimum age found is 22 and the maximum 79. The maximum number of women are found at age 46 and for men 48. The population at this university is relatively young.

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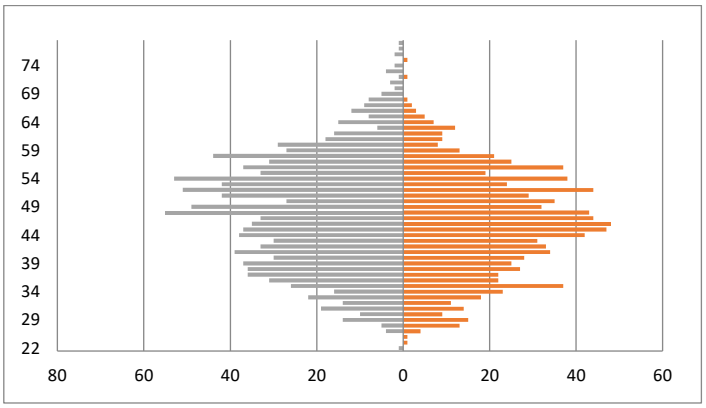
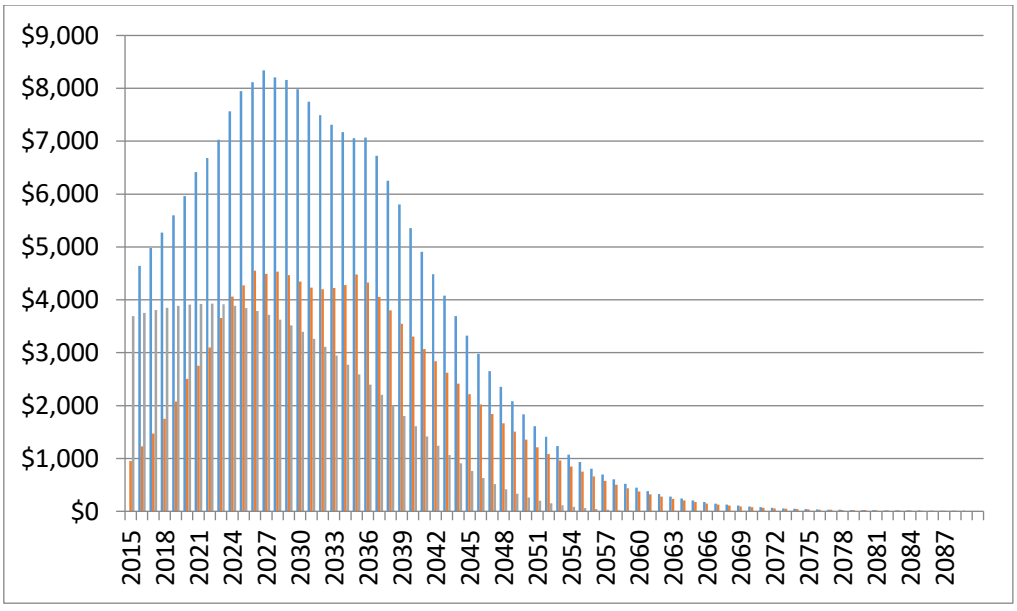
Figure 2. Population pyramid of the university's employees.



Source: Authors' elaboration with data from public university's employees.

The total actuarial liabilities for this pension plan are calculated under the previous assumptions and using formula (1) and (2). The results are shown in figure 3. All values in millions of Mexican pesos, the blue bars represent the total actuarial liabilities (current employees and retirees), the red bars represent the actuarial liabilities for current employees and the grey bars for retirees. From the results, in 2027 the actuarial liabilities reach its maximum value with 8,341 millions of Mexican pesos and these will be extinguished in 2087 because no more retirees will exist. Also, in 2026 a maximum total actuarial liability reaches 4,500 million of pesos for current employees and 4,000 millions of Mexican pesos in 2021.

Figure 3. Total actuarial liabilities.



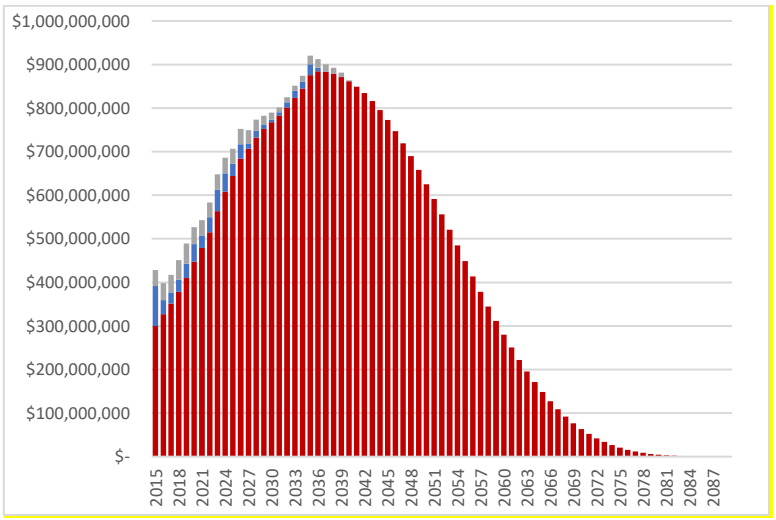
Note: The blue bars represent the total actuarial liabilities for all current employees and retirees. The red bars represent the total actuarial liabilities for only the current employees and the grey bars for retirees.

Source: Authors' elaboration.

The university has a total financial budget of $1,500 million of pesos per year, which is not sufficient to cover for the pension expenses shown in figure 3. Then, it is estimated that when the maximum is reached in 2027 the university will have no sufficient funds to operate, which can be seen as the bankruptcy of the institution.

The annual pension cash flows are also calculated and shown in figure 4. The red bars represent the cash flows for total pensions paid at that particular year, the blue bars represent the lump sum received by all employees that retire at that particular year (seen as an ancillary benefit) and the grey bars represent the university payments at IMSS for the total employees entitled to retirement because of years of service but that have not reached the mandatory retirement age.

Figure 4. Cash flows as a total of actuarial liabilities (current employees and retirees)



2047

Source: Authors' elaboration.

From the results, in 2027 the cash flows for the retirees reach its maximum with 300 million of pesos. In 2035, the active members' annual payments reach its maximum with 600 million of pesos. Finally, the maximum total annual payment is reached in 2035 with 900 million pesos. It is also found that cash flows will be extinguished in 2089, as no other retirement will occur. A similar situation is found at most of the public universities in Mexico that designed pension plans in the past. Some of them, have already closed their plans to new members because of the high financial cost this represents. The total actuarial liabilities for public universities in Mexico represent 1,000,000 million pesos.

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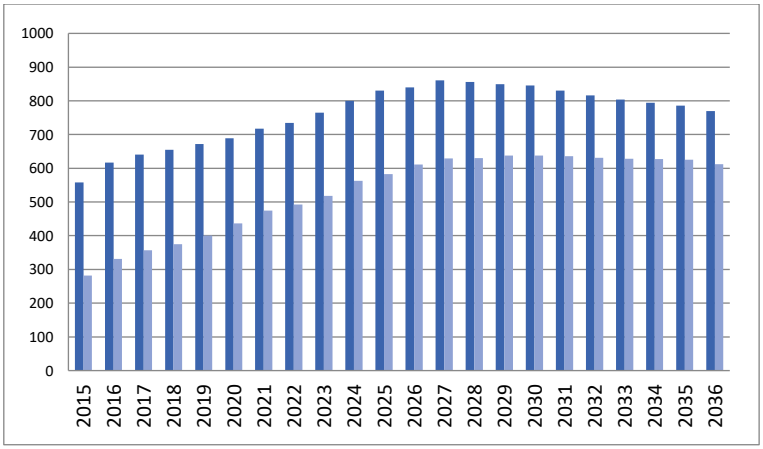
Another interesting figure from this study is the so called "dependency ratio" defined as "*The dependency ratio of an unfunded scheme is the ratio of the number of beneficiaries to the number of contributors; this is usually approximately the same as the ratio of the number of pensioners to the number of active members (Z. Khorasanee, class notes, March, 2004)"*. Then, if we assume that this university's pension plan is unfunded, the active members would have to pay the total pensions of the retirees. The previous mandatory pension plan in Mexico, currently closed to new members, operated as of this type. The dependency ratio is calculated under formula (5).

$$Dependency\ Ratio\ = \frac{number\ of\ pensioners}{number\ of\ active\ members} \tag{5}$$

As of 2015, the university dependency ratio was 0.7 but by 2036 it is projected to be 86. That is, at the moment there is 1 active member per 0.7 pensioner and in 2036 there will be 1 active member per 86 pensioners. Under this scenario, in order to finance the pension amount, in 2015 the active members would have to contribute 70% of their salaries and in 2036 would have to be 8600%. This means that the sole contributions are not sufficient to cover the expenses of this plan. It is necessary to find other sources to finance these deficit.

The projected number of retirees is also calculated and shown in figure 5 for this particular case. The dark blue bars show the number of males retiring and the light blue bars the number of women. The results show that by 2027 the majority of the active members will retire (860 males and 629 females). This is consistent with our previous result where it was found that by this date the bankruptcy of the institution will occur.

Figure 5. Projected number of retirees per year



Source: Authors' elaboration.

We can also see from these results that the number of pensioners is increasing until 2027 and after 2036 no more retirements will occur. This is for both males and females. It is worth to remember that until 2089 the pensions in payment for these retirees will be extinguished.

CONCLUSIONS AND DISCUSSION

The 12 pension plans from public universities analyzed in this work showed to be generous as the average retirement age is 63 with an average of 27 years of service, compared with the actual mandatory pension plan in Mexico which requires 65 years of age to retire. Also, that under the actual mandatory service 40 years of service are suggested to reach only a replacement rate of 50%, which is much lower than 100% under the public universities pension plans analyzed.

A specific case of public university pension plan was analyzed and some characteristics from this are a mandatory retirement age of 60 years old, 30 years of service, 16 monthly salaries to calculate the annual pension, a maximum contribution of 16% to the fund, 65% of pension to the widow or widower and 30% to each child under 18 years old (without exceeding 100%). There are 2204 employees in total, 55% males and 45% females, 47 is the average age and a monthly average salary of $14,574 pesos. By using the formulae and the assumptions mentioned in previous sections, it was found that the actuarial liabilities for this plan represent at the moment more than $4,500 million of pesos and are going to increase to a maximum of $8,300 million of pesos in 2027. Considering that the university expects to have a total budget of $1,500 million of pesos each year, the university will fail to cover the costs by 2027.

A similar situation is found at 65% of the public universities in Mexico, where in some cases the actuarial liabilities represent the 536% of their total income (Muñoz, 2015). That is, the costs associated with pensions in public universities in Mexico vary from 0.5% and 536% of the total income. Shared risk schemes will offer employers, who cannot afford or are unwilling to take on the long-term risks associated with a balance of cost defined benefit scheme, a new kind of shared-risk scheme or a total transfer of the risk to the participant of the pension plan.

On the other hand, in 2027 the cash flows for the retirees reach its maximum with 300 million of pesos. In 2035, the active members' annual payments reach its maximum with 600 million of pesos. It was also found that cash flows will be extinguished in 2089, as no other retirement will occur. A similar situation is found at most of the public universities in Mexico that designed pension plans in the past. Some of them, have already closed their plans to new members because of the high financial

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cost this represents. The total actuarial liabilities for public universities in Mexico represent 1,000,000 million pesos ("Pensiones Universitarias", 2014).

Also, the dependency ratio was analyzed. The results showed that there is an extremely high dependency between pensioners and active members. Then, if we assume that the pension plan is of a defined benefit type and unfunded, in 2015 an active member will have to contribute 70% of his or her salary in order to finance the pension of one retiree. In 2036 gets worse as this increases to 8600%. If we compare this situation with public universities pensions in the United States, it is found that the U.S. active member to beneficiary ratio was 1.5 to 1 in 2015 (U.S. Census Bureau, 2016). Situation that is nothing compared with the situation of the majority of the public universities in Mexico. Also, we found that Government contributions for state- and locally-administered pension systems increased 8.3%, earnings on investments for state- and locally-administered pension systems decreased 68.4% and that total payments for state- and locally-administered pension systems increased 5.1% from 2014 to 2015.

Then, the shift from Defined Benefit (DB) schemes to Defined Contribution (DC) provision is now extremely common among the private sector companies, which do provide pension benefits. This means also further closures of DB funds to new members, and an increasing trend of closure of funds to new accruals for existing members. An example of this is the pension plan that was described in this article. The main reasons for this rapid change in provision are because employers have felt unable to finance the cost of current levels of defined benefits.

These current costs have increased mainly due to the increase on the number of pensioners with respect to the number of workers, and the increase on the life expectancy among the population. Shared risk schemes offer employers the ability to control costs into the future by way of the ability to increase normal pension age or to hold back targeted indexation of benefits until the scheme could safely pay such benefits, as has happened in the last years with public pension systems worldwide.

REFERENCES

Blake, D. (2006). *Pension Finance*. London: John Wiley & Sons.

Clark, R. L. & Craig, L. A. (2011). Determinants of the generosity of pension plans for public school teachers, 1982–2006. *Journal of Pension Economics and Finance*, 10(01), 99 – 118.

CONSAR (June, 2015) *Diagnóstico del sistema de pensiones*. Secretaría de Hacienda y Crédito Público. Retrieved August 19, 2016: http://www.consar.gob.mx/otra_informacion/pdf/transparencia/informes/Diagnostico_del_Sistema_de_Pensiones.pdf

Foster, L. (2007). Do Women Teachers Get a Fair Deal? An Assessment of Teachers' Pensions. *Social Policy and Society,* 7(1), 41 – 52.

Muñoz (2015, November 5) *Estados Mexicanos Enfrentan Presión por Pensiones no Fondeadas de Universidades* [Press release]. Moody's Investors Service.

OECD (2015). *Reviews of Pension Systems, Mexico*. Retrieved August 19, 2016: https://www.consar.gob.mx/otra_informacion/pdf/OECD-Mexico-Pension-System-Review-2015.pdf

Pensiones Universitarias: el pasivo laboral de un billón de pesos. (2014, August 27). *Arena Pública*. Retrieved August 8, 2016, from http://www.arenapublica.com/articulo/2014/08/27/2102

U.S. Census Bureau. (2016). *Annual Survey of Public Pensions: State- and LocallyAdministered Defined Benefit Data Summary Brief: 2015*. Retrieved August 19, 2016, from https://www.census.gov/content/dam/Census/library/publications/2016/econ/g15-aspp-sl.pdf

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