

The Fitness of Assumptions and an Alternative Model for Funding the Public Sector Pension Scheme: The Case of Rio Grande do Sul*

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ABSTRACT

The research presented herein has two objectives. First, this study will test whether actuarial assumptions for public sector pension schemes in Brazil adhere to reality and whether changing these assumptions might affect the results, particularly with respect to life tables and wage growth assumptions. The paper shows that the best fit life table is AT 2000 for males aggregated by one year, which involves a longer life expectancy than the life table proposed under current legislation (IBGE 2009). The data also show that actual wage growth was 4.59% per year from 2002 to 2012, as opposed to the 1% wage increase proposed by the same legislation. Changing these two assumptions increases the actuarial imbalance for a representative individual by 18.17% after accounting for the adjusted life table or by 98.30% after revising the wage growth assumption. With respect to its second objective, this paper proposes alternative funding mechanisms in which the local pension scheme will provide the funded component of the benefit that would be complemented by local government in a pay-as-you-go manner. The database utilized was for the state of Rio Grande do Sul in the month of November 2011. The results are thus restricted to Rio Grande do Sul.

Keywords: Pensions for public employees. Pension funding. Rio Grande do Sul.

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1 INTRODUCTION

The objective of the present study is to discuss whether parameters commonly used in actuarial valuations adhere to reality and how adopting more realistic assumptions with respect to these parameters affects actuarial results and projections.

The study also proposes a mixed funding plan for new public employees as a solution for problems involving contributions to funds that may be experienced by the Pension Regimes for Government Workers (*Regimes Próprios de Previdência Social* - RPPSs). The rationale for this proposal emerged from the observation of the political context in which the RPPSs are inserted into states and municipalities and into the peculiarities of public sector pension schemes.

The analytical and mathematical system developed in this study includes mechanisms typically used in actuarial valuations. Based on the parameters chosen, this system should reflect the value of the mathematical reserve and of the projections for annual pension revenues and expenditures – both individual and collective – of the RPPS beneficiaries. These techniques can be observed in several studies, such as Vilanova (1969), Bowers, Gerber, Hickman, Jones and Nesbitt (1986), Jordan (1967) and Galé (1977). To perform these simulations, data regarding the RPPS beneficiaries in the state of Rio Grande do Sul, Brazil for the month of November 2011 were used. Accordingly, any and all results presented in this study are restricted to the pension reality of the state of Rio Grande do Sul and cannot be generalized to other federal entities in Brazil because the only database analyzed belonged to that state.

The Brazilian states are currently responsible for maintaining their own public pension systems that guarantee retirement and pension benefits to their public employees. A balanced pension system is vital for the fiscal sustainability of the federal units. Covering pension deficits leads to increasing budget commitments for these states and results in concurrent losses to other operating areas of the state.

Studies indicate that the pension system consumes a large portion of Brazilian public savings (Giambiagi, 2009; Giambiagi, Zylberstajn, Afonso, Souza, & Zylberstajn, 2007; Velloso, Freitas, Caetano, & Cândido, 2013). Caetano (2013) shows that the total expenditures of the pension system in Brazil account for 11% of the Gross Domestic Product (GDP) and that reforms are necessary with respect to establishing the minimum age, the formula for calculating death pension benefits and benefits indexation rules, particularly for the minimum wage policy and for the expansion of RPPS reforms, which is the focus of this study.

The effects of public employee pensions on the sustainability of public finances are also of concern internationally. Novy-Marx and Rauh (2014) indicate that it will be necessary to increase contributions to local and state pension funds in the U.S. by 2.5 times over the next 30 years for these pension plans to remain fully funded. Similarly, Brown, Clerk and Rauh (2011) argue that the liabilities held by local and state pension systems in the U.S. already exceed their assets.

The impact of pensions on public finances in Europe has been under discussion for some time, although this discussion has generally focused on the perspective of the general pension system and is not necessarily limited to the public employee pensions. For example, Feldstein and Siebert (2002) discuss how 10 European countries faced the conflict between generous pension promises and projected changes in demographic structure at the beginning of the 21st century.

The pension system in the Brazilian states is organized into RPPSs and managed by an agency that operates all the parts of the system, including the provision and maintenance of pension benefits and administration of financial resources.

The first major step toward standardizing and developing guidelines for the RPPSs was the passage of Act no. 9717 (1998). Until that time, the lack of regulation allowed the public sector pension system to be addressed in a personal and intuitive manner, with no minimum or mandatory technical evaluation that might illuminate the reality of pension commitments made by the entities that created their own RPPSs.

Shortly thereafter, Ordinance no. 4992 (1999) regulated Act no. 9717 (1998) by establishing minimum and maximum parameters to be used for the RPPS actuarial valuation process. To replace Ordinance no. 4992 (1999), the Brazilian Ministry of Social Security (*Ministério da Previdência Social* - MPS) issued Ordinance no. 403 (2008), which establishes new guidelines for parameters acceptable in performing actuarial valuations.

The regulatory premise established by Ordinance no. 403 (2008) with respect to maintaining a pension system with financial and actuarial balance in the RPPSs assumes that there will be a financial regime to fund the system; however, according to Nogueira (2012), this funding has not met the levels required to ensure long-term balance.

In a theoretical study on the regulatory policy of Brazilian RPPSs, Calazans and Caetano (2013) claim that the substantial number of RPPSs and the sheer size of the country hinder the regulation of state employee pensions. These authors thus propose alternatives – including self-regulation and social regulation – as complements to the current instruments of restraint and sanction. According to Avritzer (2008), beginning in the 20th century, Brazil has become a country with a high degree of participatory propensity, but the study does not refer to RPPSs. In turn, Silva, Jaccoud and Beghin (2005) point to the limitations of management councils as decision-making bodies.

The funding process established for the RPPSs through legislative guidelines has origins in the experience of the funding of private pension systems, which are called pension funds. However, there is a striking difference between funding part of some remuneration (complementary pension) structured under the strict rules of a private entity and funding the full benefits of public employees who have labor relations that are distinct from those of the private sector.

The funding of most of these pension funds began in the 1970s and 1980s at a time when the factors that influence this process seemed more favorable. For example, at that time, there was a smaller proportion of beneficiaries in relation to active worker and there was typically a larger return on financial investments (Pinheiro, 2007).

With the problems thus identified, the present study seeks to clarify that implementing and maintaining funding schemes similar to those of the private sector without proper conceptual adequacy for public sector pensions is not feasible. For these public sector pension plans, it is necessary to formulate alternatives that facilitate maintaining a funding system for the RPPSs based on the principle of

respecting the overall context in which all parties are involved: the federal entity, the public employees and the management agency.

This study is divided into four sections, including this introduction. Section 2 describes the actuarial methodology adopted. In section 3, tests are performed that measure whether the assumptions of the life table and wage growth adhere to the pension reality in the state of Rio Grande do Sul. Section 4 presents individual and collective simulations of the mixed plan in alternative scenarios. Finally, the conclusions are discussed in section 5. At the end of this article, an appendix describes the mathematical methodology adopted.¹

2 METHODOLOGY

This study was conducted in two phases: (1) the first phase features a study of the legally required minimum and maximum actuarial parameters and of the impact that more realistic parameters have on the actuarial results; (2) the second phase develops a mixed funding plan to perform individual and collective simulations based on the actual records of the RPPS beneficiaries in the state of Rio Grande do Sul.

First, the individual and combined effects of actuarial parameters were studied, including life tables and wage growth figures that were more closely fitted to reality. Furthermore, there was a discussion as to whether adopting the current minimum and maximum parameters established by Ordinance no. 403 (2008) reflects the reality of future RPPS commitments.

The mixed plan that was created in the second phase of this study was developed with the intention of solving a serious problem related to public pension funding schemes: adopting contribution rates that are below the percentage necessary to be fully funded. This practice compromises the solvency of the fund and affects the payment of future benefits.

This plan simulates a scenario in which the pension contribution rate of 11% (the minimum required) will be maintained for public employees and the corresponding entity.

At the time when the pension benefit is granted, the reserve formed by the sum of the employee's own contributions, the employer's contribution and the financial return obtained will be checked for each public employee. From this calculation, the value of the benefit that the fund will be able to pay out based on the amount that was actually funded for that public employee will be calculated. If the benefit that the public employee is entitled to exceeds the value of the benefit funded, the State Treasury will supplement the difference directly through a transfer to the RPPS; otherwise, the equating contribution shall be addressed as outlined in Ordinance no. 403 (2008).

Individualized simulations were also performed to check the value actually funded during the public employee's work period.

Finally, the study used data from the beneficiaries in the state of Rio Grande do Sul for the reference period of November 2011 to collectively examine the assumptions adopted for the individual projections.

The simulations were performed on an actuarial system in which the pension policy governing the provision of benefits – and the methods used to verify adherence to the biometric and financial assumptions used in the projections – was observed.

3 ACTUARIAL PARAMETERS

The actuarial parameters can be divided into financial and biometric parameters, such as interest rates and life tables, respectively. The use of these parameters is indispensable in the actuarial valuation processes of pension entities because they provide the basic probabilistic tools required to generate the valuation process (Vilanova, 1969).

The choice of appropriate actuarial parameters is crucial given that the results observed by actuarial valuations in funding schemes express the status of the entity and guide corrective actions if future financial shortfalls are identified.

Through Ordinance no. 172 (2005), the MPS began requiring the Certificate of Pension Compliance (*Certificado de Regularidade Previdenciária* - CRP), which is, in summary, a document that attests the entity's practice of routine procedures that are indispensable to pension issues of its RPPS.

Currently, Ordinance No. 403 (2008) establishes the minimum and maximum parameters to be used in actuarial valuations of RPPSs. Table 1 presents some of the key parameters provided in the ordinance.

¹ If the reader wants the full version of the technical note presented in the appendix, please contact the authors.

Table 1 Actuarial parameters set forth in Ordinance no. 403 (2008)

ITEM	DESCRIPTION	PARAMETER	LEVEL
A	General Life Table	IBGE-09	Minimum
B	Actual Annual Wage Growth	1.0%	Minimum

Source: Ministry of the Social Security. Prepared by the authors.

Next, the actuarial parameters required by law will be analyzed, in addition to their adequacy for the RPPSs in the specific case of the state of Rio Grande do Sul.

3.1 General Life Table.

The general life table, according to Rodrigues (2008), represents the effects of the lifespans of beneficiaries on the calculations of costs in public or private pension plans. Rodrigues (2008) also indicates that the life table is an efficient tool to measure these costs.

According to a note about the 2010 Census released by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* - IBGE, 2010a), in 50 years (1960-2010), the life expectancy of Brazilians increased 25.4 years, from 48.0 to 73.4 years. By contrast, the mean number of children per woman decreased from 6.3 to 1.9 during this period, which is below the replacement level of the population. These changes altered the age pyramid, narrowing the base and widening the top, pointing toward an aging population structure that is characteristic of more developed countries (IBGE, 2010a).

3.1.1 Comparison between Life Tables.

The use of the minimum life table (IBGE-09) is justified by the difficulty of performing adherence tests to choose the life table most appropriate for the RPPS beneficiary population, which is mainly due to the difficulty in obtaining consistent records.

The IBGE life table is designed by considering the general population (IBGE, 2010b) of all Brazilian states and municipalities, including parts of the population that are unemployed and are unable to access adequate health care or even basic sanitation in their homes.

Longevity conditions specific to public employees from entities with some social structure are assumed to be better than the average for the general Brazilian population. These public employees, in principle, have higher income, better hygiene information, better access to healthcare and higher levels of nutrition than the average person. Consequently, it is natural to assume that this increased access to well-being will yield higher life expectancy for this specific group (Beltrão, Pinheiro, & Silva, 2010).

According to Rodrigues (2008), the use of life tables with risks that do not represent the real behavior of the covered population may reduce or increase mathematical reserves and costs of benefit plans, which may cause structural imbalances that are difficult to cover in the short term.

Similarly, RPPS beneficiaries, particularly in large cities, likely have general characteristics closer to the population participating in private pension plans, i.e., pension funds.

According to this perspective, the minimum parameter used in the actuarial valuation of these funds is the American life table, AT-83, a parameter provided by the Supplemental Pension Plan Management Council (*Conselho de Gestão da Previdência Complementar* - CGPC) Resolution no. 18 (2006). The National Supplemental Pension Superintendence (*Superintendência Nacional de Previdência Complementar* - PREVIC) considers this parameter insufficient and is planning to adopt a more conservative update, as described by Mr. Edevaldo Fernandes da Silva, director of actuarial accounting and economic affairs of PREVIC:

PREVIC wants to adopt a more conservative life table, i.e., one that assumes greater longevity of retirees and pensioners, present and future. Currently, the recommended table is the AT 83, according to which the median survival at age 60 is 22.6 years. (Izaguirre, 2012).

The use of a more conservative table than the AT-83 by pension funds is already provided for in review cases of benefit plans because of surplus. For these cases, MPS/CGPC Resolution no. 26 (2008) requires the American table, AT-2000, as a minimum parameter.

In accordance with another perspective, it can be assumed that the life expectancy of public employees is proportional to the population covered by Brazilian insurance companies. Based on this assumption, the Superintendence of Private Insurance (*Superintendência de Seguros Privados* - SUSEP), by means of Circular Letter no. 402 (2010), published a life table with the experience of the Brazilian insurance market, the BR-EMSmt; this table also has a higher survival rate than that predicted by the IBGE-09 table.

The comparison of the life expectancy at age 55 between the life tables discussed above is presented in Table 2.

Tabela 2 Comparison between biometric tables

AGE	BIOMETRIC TABLE ²	LIFE EXPECTANCY
55	IBGE-09, MF	25.0
55	BR-EMSmt	27.1
55	AT-83, M	26.8
55	AT-2000, M	28.9

Source: MPS, SUSEP, Society of Actuaries (SOA). Prepared by the authors.

The life expectancy at age 55 in the Brazilian table, BR-EMSmt, exceeds that of the AT-83, which justifies the PREVIC concern regarding the use of a table that projects a higher survival rate than the current rate.

3.1.2 Adherence Test for RPPS-RS.

From the databases of active and retired public employees of the state of Rio Grande do Sul (RS), annual tests were performed between 2006 and 2011 to identify which life table was more statistically appropriate for use in the actuarial projections related to the RPPS of this state.

² Only male life tables were selected, except for the IBGE-09 table, which includes both genders.

Some life tables more common in actuarial studies were chosen to test the adherence of these tables with the database available for this study. By applying the distribution of mortality rates per age in each of the tables to the group of living beneficiaries, the expected mean death rate per year can be projected and compared with actual deaths to determine which tables have expected mean death rates that are closer to the observed rate. Table 3 presents the expected number of deaths according to the life tables and the actual number of deaths between 2006 and 2011.

Table 3 Expected and actual number of deaths per year

LIFE TABLE	YEAR					
	2006	2007	2008	2009	2010	2011
AT-49, M	3898	4081	4277	4477	4645	4876
GAM-83, M	2862	3006	3164	3326	3465	3652
AT-83, M	2395	2509	2632	2758	2865	3011
AT-2000, M	1892	1984	2084	2185	2273	2391
UP-94-M	2620	2756	2904	3057	3188	3364
GAM-94, M	2436	2563	2701	2843	2965	3129
RP-2000, M	2400	2529	2671	2819	2947	3117
GKM-95, M	3308	3469	3645	3823	3979	4187
IBGE-09, MF	3116	3243	3376	3509	3621	3778
BR-EMSmt	2362	2469	2584	2701	2801	2936
ACTUAL	1909	2370	2283	2455	2518	2660

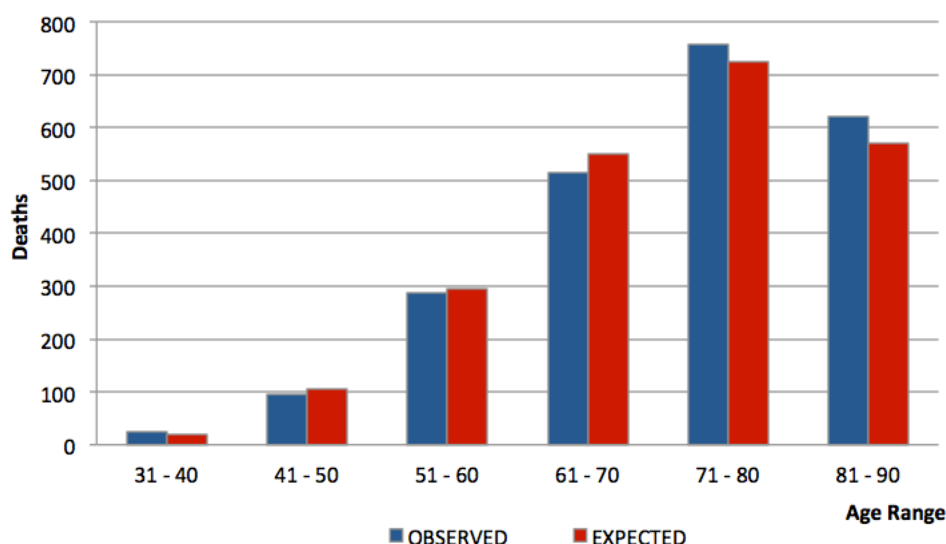
Source: MPS, SUSEP, SOA. Prepared by the authors.

This initial process is basically a filter to determine which life tables are adequate to test adherence. Table 4 presents the percent deviation of each of the mortality tables from actual deaths.

Table 4 Percent deviation from actual deaths

LIFE TABLE	YEAR						
	2006	2007	2008	2009	2010	2011	MEAN
AT-49, M	104%	72%	87%	82%	84%	83%	86%
GAM-83, M	50%	27%	39%	35%	38%	37%	38%
AT-83, M	25%	6%	15%	12%	14%	13%	14%
AT-2000, M	-1%	-16%	-9%	-11%	-10%	-10%	-9%
UP-94-M	37%	16%	27%	25%	27%	26%	26%
GAM-94, M	28%	8%	18%	16%	18%	18%	18%
RP-2000, M	26%	7%	17%	15%	17%	17%	16%
GKM-95, M	73%	46%	60%	56%	58%	57%	58%
IBGE-09, MF	63%	37%	48%	43%	44%	42%	46%
BR-EMSmt	24%	4%	13%	10%	11%	10%	12%

Source: MPS, SUSEP, SOA. Prepared by the authors.



Prepared by the authors.

Figure 1 Adherence Test – table AT-2000, M (+1) (2010)

According to Tables 3 and 4, life tables AT-2000, M, BR-EMSmt, AT-83, M and RP-2000, M were selected to perform the final adherence test because they had the four smallest deviations from the mean.

The chi-square test was chosen to determine which of the four previously selected tables were significant at the 5% level. The null hypothesis is that the life table chosen represents the true occurrence of deaths in the group of beneficiaries and the alternative hypothesis rejects the table, *i.e.*, the table chosen does not represent the occurrence of deaths. The hypothesis test consists of the observation of Type I error, *i.e.*, rejecting the null hypothesis when it is true.

The chi-square test (Bussab & Morettin, 2002) tests whether the frequency with which a particular event observed empirically deviates significantly or not from the frequency at which it is expected.

Typically, the chi-square test becomes stricter as the number of studied classes increases; thus, the process was only accepted with a small number of age ranges, and extreme ages were eliminated because they did not fit any of the predefined life tables.

At the end of the tests, six age ranges were used, each covering a 10-year span, discarding extreme ages, beginning from the range between 31 and 40 years and ending with the range between 81 and 90 years, regardless of the gender of the beneficiaries. This distribution, with six age ranges, provides an adherence test with five degrees of freedom.

The final result of the test indicated that only life table AT-2000, M(+1) was adherent, *i.e.*, aggregated over a year at a significance level of 5%. Aggregating a life table means aggregating mortality rates and, consequently, reducing the projected life expectancy. Figure 1 shows the adherence test of life table AT-2000, males, aggregated for one year.

Even with the conditions imposed on the adherence test, the method rejected years 2006 and 2008, and in the other years, for acceptance, aggregating table AT-2000, M was necessary, as Table 5 shows.

Table 5 Test results on life table AT-2000, M

YEAR	RESULT	COMPOUNDING
2006	Rejected	-
2007	Accepted	2 years
2008	Rejected	-
2009	Accepted	1 year
2010	Accepted	1 year
2011	Accepted	1 year

Prepared by the authors.

The technical tests on the available records suggest that mortality table AT-2000, M aggregated in a year best represents the survival rate of the beneficiaries of the RPPS in the state of Rio Grande do Sul.

3.2 Actual Wage Growth.

According to Ordinance no. 403 (2008), the minimum actual growth rate of the wage of public employees throughout their career that can be adopted by the RPPS is 1% annually. However, the bylaws of some entities set forth timely benefits, such as three-year and five-year premiums for their employees, and the granting of these rights may lead to higher growth than the minimum parameter required by the Ministry.

It is worth clarifying a common conceptual error about the effects that wage growth may have on the funding scheme. It is natural to think that because the contribution level is proportional to the gains of a public employee, that employee would have no practical effect on the funding process because if the employee increases the base and the commitment, then the income would also increase. However, as demonstrated below, this effect is not null. The wage variation during the activity period will produce significant effects on the funding process, implying an increase of the RPPS commitment.

In addition to the increase in remuneration obtained during the career plan progress of public employees (timely benefits and promotions), they receive pay raises resulting from collective labor agreements that frequently outweigh inflationary adjustments, *i.e.*, that represent a real gain.

The Brazilian democratic electoral process provides a singular aspect to entities with respect to human resources management that does not include predictability. Unlike the private sector, the public sector cyclically elects a new director who may not uphold the human resources policy of their predecessor. The results of this process can be observed in the contract cycles of public employees and wage adjustments.

The RPPSs, in turn, will suffer the consequences of this volatility in the accounts. Sometimes, the benefit projected during the activity period differs greatly in value from the benefit actually paid at the time of retirement.

These distortions are caused by class gains provided for several reasons. The following news regarding the employees of the municipality of Curitiba is an example:

The City Council of Curitiba yesterday granted a raise of 8.6% to municipal teachers. Added to the raise of 10% granted to public employees last week, these teachers will have, overall, a pay raise of approximately 19%. This raise shall be paid on this month's payroll (Boreki, 2012).

These advances, adjustments or readjustments, as discussed in the news, can be politically and legally reproduced in other federal entities. Without making judgments as to their fairness, the fact to be noted is the disproportionate gap that a public employee benefiting from advances adds to the RPPS pension commitments. In the situation described by the news, a teacher who is close to retirement will have their benefits increased by 19%, without any possibility that contributions made while they were active – by the employee and by the entity – will have been sufficient according to the new commitment.

The increase of the commitment made by the RPPS is even more complicated in relation to beneficiaries entitled to parity; in such cases, the benefit increase directly impacts pension charges, making contributions necessary to afford the new commitment.

With parity, any adjustment or restructuring granted to active public employees is immediately reflected in equal proportion for RPPS retirees and pensioners. It is important to note that Constitutional Amendment no. 41 (2003) eliminated parity for employees who entered public service after the date of its promulgation.

Regarding public employees who will not be entitled to parity when they retire, there would be, in theory, a greater predictability of the value of their benefits because the benefits would only undergo inflation adjustment, and this procedure is common in pension fund regulations.

In practice, this situation may not occur, given the possibility that the entity grants parity to the active public employee, even after the advent of Constitutional Amendment no. 41 (2003), which constitutionally obligates them to grant only the adjustment of benefits to preserve their actual value, *i.e.*, grant the adjustment in the same proportion to retirees and pensioner as a discretionary matter.

Other factors at times change even the shortfalls of public employee retirement funds, such as with teachers who assume the roles of principals, administrators or course coordinators who, by means of Act no. 11.301 (2006), acquire the rights to special retirement with corresponding reductions in the contribution period.

Considering that there is likely to be suppressed demand and a favorable economic momentum at the national level in this context, the occurrence at any time of events similar to those discussed herein may nevertheless compromise the funding of the RPPSs to a large extent.

3.2.1 Wage Growth of Rio Grande do Sul Public Employees.

To estimate the actual growth rate of the wage of active public employees throughout their working lives, and therefore to determine whether the use of the minimum parameter requi-

red by law is suitable to the reality of the RPPS of the state of Rio Grande do Sul, data on public employees in the state of Rio Grande do Sul were analyzed.

Only public employees were considered in the calculation because military employees have their own specific pension fund. The main employment categories of the state were chosen and represent 88.5% of the active public employees: teachers, general staff, civil police, Department of Correctional Services (*Superintendência dos Serviços Penitenciários - SUSEPE*) and technical-scientific employees. This distribution can be observed in Table 6.

Table 6 Number of active public employees in the main categories of the state of Rio Grande do Sul (RS)

CATEGORIES	NUMBER OF PUBLIC EMPLOYEES	%
General Staff	19,958	20.0%
Tech.-Scientific	1,984	2.0%
Teachers	56,713	56.9%
Civil Police	5,510	5.5%
SUSEPE	4,002	4.0%
Others	11,469	11.5%
Total	99,636	100.0%

Source: State Revenue Service of RS. Prepared by the authors.

In the wage growth estimate, career progression due to promotions and timely benefits in the form of three-year premiums were assumed. Under the law that regulates public service in the state of Rio Grande do Sul, the three-year premiums are 3% – *i.e.*, every three years, the wage of the public employee is increased by 3% over the basic salary – with the exception of teachers, whose three-year premium is 5%.

To obtain the mean wage growth, the wages of the actual positions from the categories listed above were used on two occasions: 2002 and 2012. In this time span of 10 years, it was

considered that (a) public employees had 3 three-year premiums and (b) the career progression was proportional to the time elapsed and to the total time in office for retirement purposes. For example, a technical-scientific employee was hired in 2002; until 2012, they incorporated 3 three-year premiums (9% over the basic salary) and received a promotion (the career consisting of four levels, and to reach the final level, three promotions are required).

Table 7 shows the calculation of wage growth based on the main categories.

Table 7 Annual wage growth of public employees from RS

CATEGORY (1)	PERIOD (2)	BASIC WAGE (R\$) (3)	OTHER PAYMENTS (R\$) (4)	WAGE WITHOUT THREE-YEAR PREMIUM (5)	THREE-YEAR PREMIUM (6)	WAGE WITH THREE-YEAR PREMIUM (7)	CORRECTED WAGE (8)	MEAN ANNUAL GROWTH (9)
General Staff	2002	215.99	-	215.99	-	215.99	413.22	7.05%
	2012	427.23	370.00	797.23	9%	835.68	835.68	
Technical-Scientific Employees	2002	1,302.15	-	1,302.15	-	1,302.15	2,518.17	2.82%
	2012	2,811.85	315.42	3,127.27	9%	3,380.34	3,380.34	
Teachers	2002	310.40	44.54	354.94	-	354.94	683.40	3.89%
	2012	884.10	-	884.10	15%	1,016.72	1,016.72	
Civil Police	2002	365.61	676.59	1,042.20	-	1,042.20	2,024.13	2.84%
	2012	824.27	1,829.87	2,654.14	9%	2,728.32	2,728.32	
SUSEPE	2002	247.49	458.00	705.49	-	705.49	1,370.18	5.64%
	2012	743.19	1,649.88	2,393.07	9%	2,459.96	2,459.96	

Note: The data used for the calculation of the corrected wage (column 8) and mean annual growth (column 9) refer to the following: in 2002, to December/01 and, in 2012, to different times, namely, General Staff and SUSEPE – April/12, Technical-Scientific Employees – July/12, Teachers – May/12, Civil Police – August/12.

Source: State Revenue Service of RS. Prepared by the authors.

Columns 3-5 show the value of the basic wage and the other wage portions totaling the minimum wage inherent to the position at current values. Columns 6-7 show the in-

crease resulting from incorporating the three-year premiums. Column 8 presents the wage corrected by the National Broad Consumer Price Index (*Índice Nacional de Preços*

ao Consumidor Amplo - IPCA) until August/2012. Finally, column 9 shows the mean annual wage growth index obtained by the wage variation for the period analyzed.

To obtain the mean actual wage growth of the chosen categories, growth indices per category were used (shown in Table 7) that were weighted by the number of

public employees that make up each category (shown in Table 6), which resulted in a figure of 4.59% per year. It must be emphasized that this index refers to the mean actual wage growth of public employees of the RPPS from the state of Rio Grande do Sul and should not be directly applied to other RPPSs.

4 MIXED PLAN SIMULATIONS

After reviewing the assumptions used in the actuarial calculations, the adoption of a mixed plan for the RPPS was simulated. In this mixed plan, during the period when the public employee is active, their contributions, the contributions of the entity and financial gains from the investment of these resources will form a reserve. Based on the value of this reserve, the value of the benefit that the fund will be able to pay is calculated. If the value of the benefit that the public employee is entitled to – in accordance with constitutional provisions – exceeds the value of the funded benefit, the difference will be covered by transfers from the entity to the RPPS. If the value of the constitutional benefit is lower than the funded value, its equalization shall be addressed as provided by Ordinance no. 403 (2008).

The mixed plan is based on the momentary inability of most entities that performed mass segregation³ – and therefore have financial funds and pension funds – to contribute above the minimum required pension rate of 11% (deducted from federal public employees) of the wage contribution of the beneficiaries to the fund. This inability results because the entity is also responsible for paying retirement and pension benefits for public employees belonging to the simple distribution system. Over time, the pension expenditure of the entity will be reduced for two reasons: the group of current retirees and pensioners will become gradually extinct, and the inflow of new pensions will be paid by the funded system.

This simulation considered that the contribution rate will remain at 11% equitably between beneficiaries and the entity, for a total of 22%. Only when the payment of the pension benefit begins will the benefit amount that the public employee or their dependent is entitled to be calculated, which was effectively funded. The remaining amount to complement the value of the benefit constitutionally guaranteed to the beneficiary or beneficiaries will be borne by the State Treasury under a simple distribution financial scheme.

4.1 Individual Funding.

In this first simulation, for comparison purposes, the calculation of the amount actually funded was performed for each public employee, with the difference as the state's responsibility. The minimum contribution rate provided by law of 11% was adopted for the public employee plus 11% for the entity, in addition to the maximum and minimum parameters provided by Ordinance no. 403 (2008). The si-

mulation of the constitutional benefit that the public employee is entitled to, the funded benefit and funding deficit are presented in Table 8.

Table 8 Simulation with parameters of Ordinance no. 403 (2008)

ITEM	VALUES
Age of Entry	30
Retirement Age	57
Initial Wage (BRL)	1,500.00
Annual Wage Growth	1.0%
Constitutional Benefit at Retirement (BRL)	1,753.63
Funded Benefit (BRL)	1,491.20
Funding Deficit (BRL)	262.42

Note: A percentage of 4.47% destined to cover risk benefits is assumed. Prepared by the authors.

It is projected that the contribution plan is insufficient for full funding of the constitutional benefit that the public employee will be entitled to at the time of retirement. The example described herein uses the mean ages of entry (30 years) and retirement (57 years) of the RPPS beneficiaries from the state of Rio Grande do Sul together with the mean initial public service salary of BRL 1,500.00. The constitutional benefit that such public employees will be entitled to is BRL 1,753.63 (this value is the mean of the 80% largest salary contributions and not the final payment, which is BRL 1,942.88). The contribution plan, by contrast, will fund a mathematical reserve that is proportional to a benefit of BRL 1,491.20, or 85% of the total projected constitutional benefit.

In the study case, the fund remains responsible for the full payment of the benefit to the public employee, BRL 1,753.63, which inevitably reveals consecutive actuarial deficits and, as observed in actuarial projections, the insolvency of the fund for the payment of benefits at a given time.

According to the initial simulation for the effective funding of a public employee that joins the RPPS, the required contribution rate should be approximately 25%, which is split between the public employee and the entity; this calculation would result in 11% for the public employee and 14% for the entity. However, the situation is not so simple, as will be shown next.

It is worth emphasizing that this simulation refers to a new public employee that joins the entity and not to those that have contributed for a long time; the possible effects of class gains,

³ According to Ordinance no. 403 (2008), mass segregation is the separation of beneficiaries of the RPPS into different groups that will comprise the financial plan and the pension plan. The first refers to senior public employees and is financed by means of distribution. The second provides coverage to employees with less employment time in public service and is funded.

as described above, are not projected. For these cases, the calculation is more complicated.

As described before, it is projected that the minimum and maximum parameters established by Ordinance no. 403 (2008) are not in compliance with the RPPS. Because of this non-compliance, the projection of the effective funding was performed through the same contribution process with aggregation of these parameters.

For this case, the life table AT-2000, M(+1) was chosen, replacing the IBGE-09; the wage growth projected became 4.59% annually, instead of 1%, and the actuarial interest rate was reduced from 6.0% to 4.5% annually. The simulation with these aggregated parameters is shown in Table 9.

Table 9 Simulation with aggregated parameters

Item	Values
Age of Entry	30
Retirement Age	57
Initial Wage (BRL)	1,500.00
Annual Wage Growth	4.59%
Constitutional Benefit at Retirement (BRL)	3,132.77
Funded Benefit (BRL)	1,504.87
Funding Deficit (BRL)	1,627.90

Prepared by the authors.

In this new simulation, with actuarial parameters aggregated as described above, the result is bleak. Of the total projected constitutional benefit, BRL 3,132.77, it is estimated that only 48% will be funded, *i.e.*, BRL 1,504.87. For the effective funding of the total benefit, the required rate shall be 41% of wages, 11% from the public employee and 30% from the entity, in this example.

Numerous simulations can be performed that will indicate that the funding level of the RPPS will be insufficient to meet the payment of all public employee pension benefits. The parameter changes made for the second simulation (Table 9) only evidence such a reality, given that future commitments will likely be closer to the simulation performed with these parameters.

The final projected deficit goes from 15% of the total benefit, by the initial parameters, to 52% of the total benefit, according to the calculation made with more conservative assumptions. The effect of each parameter change is ultimately compounded when applied simultaneously, considering that these changes are not independent.

For illustrative purposes, the impact that each parameter would add to the initial funding deficit is demonstrated in Table 10, if applied individually.

Table 10 Individual effect of parameter changes

Item	Initial parameter	New Parameter	Deficit Increase
Life Table	IBGE-09	AT-2000(+1)	18.17%
Wage Growth	1.00%	4.59%	98.30%
Interest Rate	6.00%	4.50%	174.82%

Prepared by the authors.

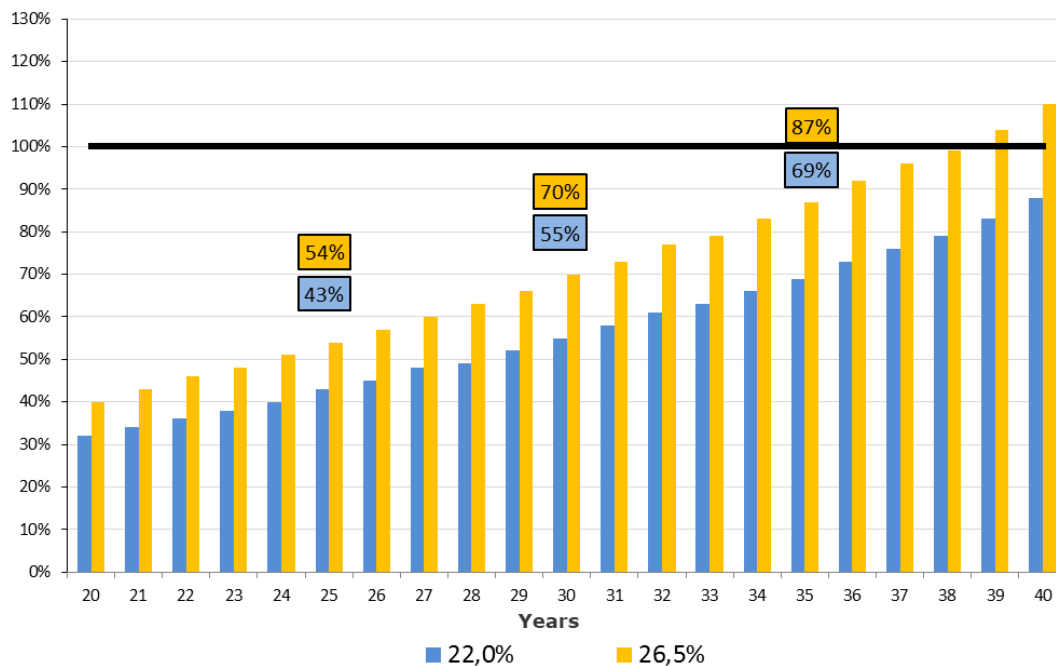
According to the simulation of individual parameter changes, the reduction in the interest rate from 6% to 4.5% per year would produce the greatest effect, with an increase of 174.82% in contribution deficits.

With reference to the descriptions in section 3.2 of the effects produced by wage growth, the simulation demonstrates larger deficits in funding, in view of the increase in this parameter. In the study case, with the single modification of the wage growth projection from 1.0% to 4.59% per year, the increase in the deficit is 98.30%.

Because they are not independent effects, the total sum of the individual increments of the parameters is not equivalent to the combined effect. The added effect of the parameters is approximately 247.19%, given that the funding deficit increased from 14.96% to 51.96% between simulations.

Another way to project the contribution deficit is to use simple mathematical reasoning in relation to the marked number of RPPS beneficiary teachers. In these cases, a total contribution of 22% (public employee plus entity) over the wage shall occur for approximately 25 years of activity, and the payment of 100% of the benefit for a mean life expectancy of 35 years shall occur after retirement. This calculation certainly cannot be afforded by the fund because 22% is paid to the fund for 25 years and 100% is payable for 35 years. One possible solution for this equation is for the fund to reach high profitability levels from fund investment, which is unlikely, as previously observed.

According to the assumptions defined as more adherent to the RPPS of the state of Rio Grande do Sul (Table 9) and the mean records used in the individual projections, Figure 2 compares the contribution period (in years) with the portion of the benefit that will be effectively funded (as a percentage). Two distinct contribution plans were simulated: the first considers the total rate of 22% (11% for the public employee and 11% for the entity), the minimum required by the pension law. The second establishes a contribution level of 26.5% (13.25% for the public employee and 13.25% for the entity), which is the current situation of the state of Rio Grande do Sul.



Prepared by the authors.

Figure 2 Comparison between contribution time and funded benefit

The benefit will not be fully covered by contributions and earnings even in the second plan (26.5%) because that would require a contribution period of 38 years, at least, whereas in the first plan (22%), more than 40 years of contribution would be necessary. Both situations of such long contribution periods are not found in practice because the databases of the state of Rio Grande do Sul demonstrate that public employees contribute, on average, for 27 years.

For these simulations, financial compensation effects were not considered between schemes because such compensation typically is not sufficient for the commitments made by the RPPS, which would decrease the amount funded by the simulations.

4.2 Collective Funding of the State of Rio Grande do Sul.

This section analyzes the collective capitalization of public employee pensions in the state the Rio Grande do Sul based on the new parameters defined as more realistic.

The pension fund for public employees was created on July 15, 2011, with the passage of Complementary Act no. 13.758 (2011). The current value of the wages of active employees is BRL 720,627,054.35, after considering all future wages of the current group of public employees who belong to FUNDOPREV, the funded state pension fund. The commitments of the fund, as well as the percentages relative to payroll, are presented in Table 11.

Table 11 Benefits granted and to be granted from RS pension funds

Commitments	Values in BRL	% wages
Benefits Granted	-	0.00%
Benefits to be Granted	371,928,941.27	42.46%
Benefits to be Granted– Future Generation	-	0.00%
Total	371,928,941.27	42.46%

Prepared by the authors.

Table 12 shows the earnings that the first contribution plan (22%) will yield to the funds.

Table 12 Income from pension funds in the 22% contribution plan

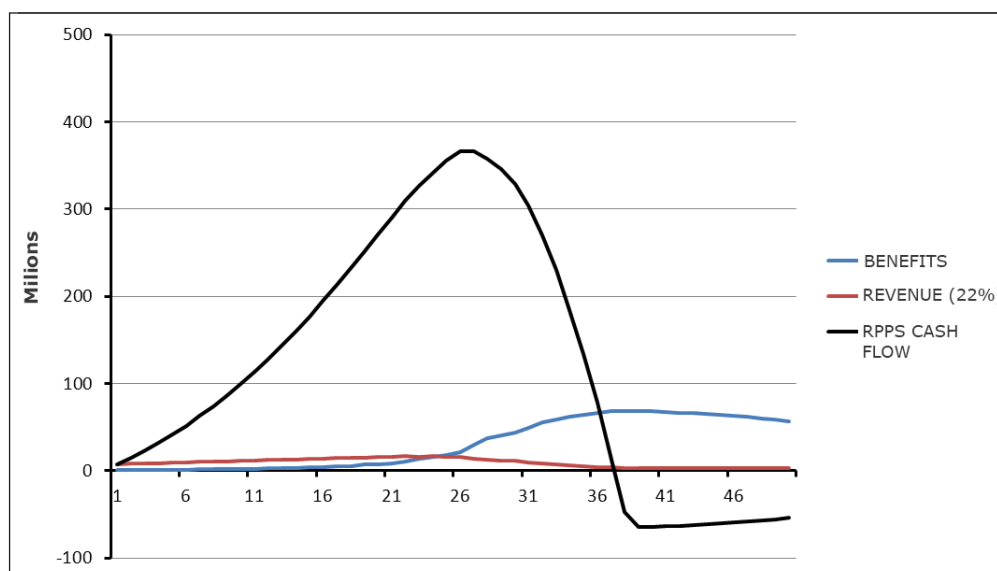
Income	Value in BRL	% wages
Contribution of Active Employees	96,350,943.70	11.00%
Contribution of Pensioners	11,157,868.24	1.27%
Pension Compensation	7,438,578.83	0.85%
State Contribution over the Wages of Active Employees	96,350,943.70	11.00%
State Contribution over the Wages of Pensioners	-	0.00%
Total	211,298,334.46	24.12%

Prepared by the authors.

According to Tables 11 and 12, the formation of a mathematical reserve of BRL 160,630,606.81 (BRL 371,928,941.27 – BRL 211,298,334.46) will be required, *i.e.*, 22.29% over the wages of active employees. In this model, the pension fund of the state of Rio Grande do Sul will have approximately 37 years of solvency. Beginning in 2048, it will no longer have the funds to afford to pay benefits to its retirees and pensioners, as Figure 3 shows.

This chart shows the pattern of three variables: (a) benefits

paid to retirees and pensioners; (b) revenue from the contributions of beneficiaries and the State; and (c) fund resources (contributions plus earnings). The negative impact on fund assets, beginning in the 25th year, will occur with an increase in expenses due to the payment of retirement benefits and pensions associated with reduced pension revenue because the beneficiaries contribute only over the amount that exceeds the maximum limit of benefits from the General Social Security System (*Regime Geral de Previdência Social - RGPS*).



Prepared by the authors.

Figure 3 RPPS cash flow (22% contribution)

In the second contribution plan (26.5%), revenues will increase by BRL 39,416,295.15 (BRL 250,714,629.61 - BRL 211,298,334.46) based on an increase of 4.5% in the full

pension rate. Table 13 shows the distribution of revenues in this new model, approved by Complementary Act no. 14016 (2012).

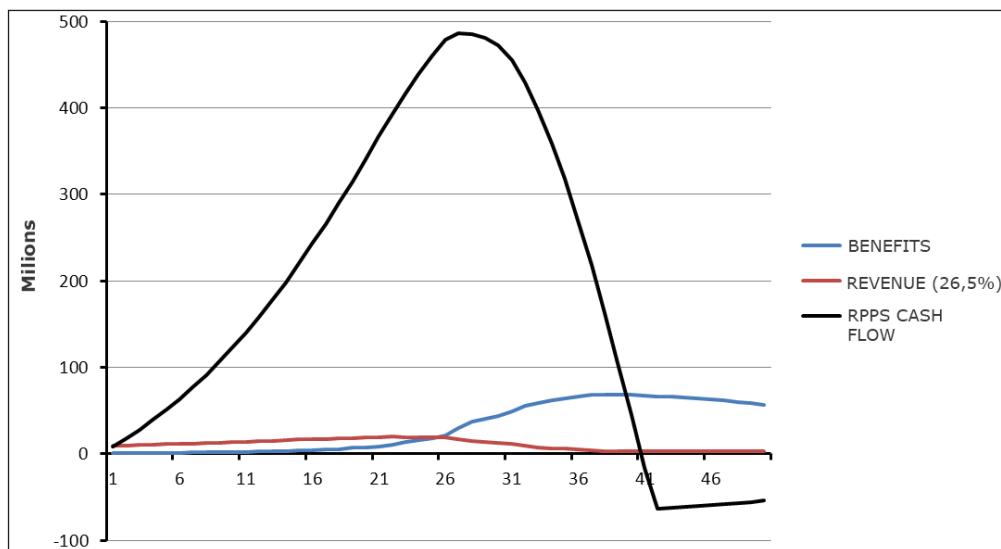
Table 13 Income from funds in the 26.5% contribution plan

Revenue	Values in BRL	% wages
Contribution of Active Employees	116,059,091.28	13.25%
Contribution of Pensioners	11,157,868.24	1.27%
Pension Compensation	7,438,578.83	0.85%
State Contribution over the Wages of Active Employees	116,059,091.28	13.25%
State Contribution over the Wages of Pensioners	-	0.00%
Total	250,714,629.61	28.62%

Prepared by the authors.

Based on Tables 11 and 13, the deficit amount in the new contribution plan of the state of Rio Grande do Sul is BRL 121,214,311.66 (BRL 371,928,941.27 - BRL 250,714,629.61), *i.e.*, 16.82% of active employee wages. The projection indicates

that by 2051, the resources from pension funds will end, *i.e.*, the MILITARY FUNDOPREV and FUNDOPREV will only be able to pay the pension benefits for 40 more years before they become insolvent.



Prepared by the authors.

Figure 4 RPPS cash flow (26.5% contribution)

In Figure 4, the shape of the fund benefit, revenue and resource curves is similar to that shown in Figure 3. The difference is that at a contribution level of 26.5%, the pension revenue is higher, which ensures the solvency of the

fund for another three years. It is noted that, even with the increase of the rate from 22% to 26.5%, the increase in pension revenue is not sufficient to maintain the balance of the RPPS.

5 CONCLUSION

The biometric and financial assumptions of the RPPS actuarial valuation are contained in the minimum and maximum parameters set forth in Ordinance no. 403 (2008). As demonstrated throughout this study, the choice of parameters, the IBGE-09 life table and actual wage growth of 1% per year, do not reflect the current reality that is faced by the pension fund of the state of Rio Grande do Sul; the reality, unfortunately, is that these assumptions result in a smaller pension deficit for the RPPS of the state.

Thus, this study seeks to provide insight to managers of state pension funds so that – together with the responsible actuary – they can choose the most plausible assumptions to maintain the actuarial and financial sustainability of the scheme.

According to the case analyzed from the state of Rio Grande do Sul, delegating full payment of pension benefits to the fund, regardless of reciprocal funding, will result in the gradual consumption of financial resources until they are inevitably extinguished.

In addition, the Rio Grande do Sul case also shows that increasing the entity transfer rate will be insufficient due to the entire context involved, even if applied at the very high levels described herein. Furthermore, it should be emphasized that higher entity transfer rates may prove impossible to implement in practice, whether because of legal and tax impediments or because of the economic scenario that such entities eventually face.

Insufficient funding of all commitments to RPPS beneficiaries is therefore a real projection for the fund in this case study. To mitigate this problem, a form of mi-

xed financing, partly funding and partly simple distribution, was suggested. Under this assumption, the fund would be responsible for the effectively funded part on the individual account of the public employee, and the complement, if necessary, to reach the constitutional benefit is payable by the entity and financed by simple distribution.

It is important to highlight two key aspects of this method: first, such financing mechanism does not prevent the benefit from becoming fully funded, whether by means of additional contributions or even due to favorable factors over time. In this case, the fund would be responsible for 100% of the benefit without the need for additional transfers, *i.e.*, the proposed mixed plan format does not exclude the possibility that the traditional mechanism of full funding may be used.

The second important factor is that the fund and – indirectly – the entity would not have to address the constant pressure to equalize actuarial deficits during its management, and in the case of the mixed plan, the mathematical reserve is always equivalent to the assets, and the plan would be in actuarial balance permanently.

As evidenced in this study, the proposal of a mixed plan aims to ensure the continued sustainability of the pension fund to prevent it from being liable for the payment of benefits over its capacity, thus prematurely extinguishing the fund's resources, which would be a setback for the public employee pension system.

The mixed plan allows the continuation of a funding scheme in the RPPS, which adds real financial gains to the federal entity over time.

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APPENDIX – DESCRIPTION OF ACTUARIAL METHODOLOGY

1 OBJECTIVE AND SCOPE

This technical note aims to establish the technical and actuarial valuation basis of the **Pension Regime for Government Workers (RPPS)**, consistent with current legislation, benefit plans and contribution plans.

1.2 The benefit plans, under the law, are structured in the form of “defined benefits” that encompass public employees holding permanent offices associated under the RPPS, with their respective state/municipal entity as the sponsor of the plan.

1.3 The methodology of actuarial valuation developed in this technical note establishes:

- 1.3.1 Current value of obligations of the benefits granted;
- 1.3.2 Current value of obligations of the benefits to be granted;
- 1.3.3 Current value of contribution rights;
- 1.3.4 Current value of financial compensation to be received;
- 1.3.5 Mathematical provisions.

1.4 The full version of the actuarial methodology adopted is available from the authors upon request.