Long-term sustainability and post-reform analysis of the Special Social Security Scheme of the State of Rio de Janeiro

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1 – Introduction

Social Welfare, in accordance with article 194 of the Constitution of the Federative Republic of Brazil, "comprises an integrated whole of actions initiated by the Government and by society, with the purpose of ensuring the rights to health, social security and assistance". Therefore, social welfare in Brazil includes a broad and universal concept, rendered to whoever may need it, as long as the event to be covered is provided by law.

Regarding the Social Security, the Brazilian Constitution establishes its contributory basis and mandatory participation, with due regard for criteria that preserve financial and actuarial balance. The mandatory Brazilian social security system consists of two basic schemes, the General Social Security Scheme (RGPS) and the Special Social Security Scheme (RPPS). Furthermore, there is the Complementary Social Security Scheme (RCPS), of a complementary nature and organized on an autonomous basis in regards to the other two basic social security schemes.

The RGPS is the largest social security scheme, responsible for safeguarding the well being of the vast majority of Brazilian workers. RPPS insures public employees holding effective posts in the Union, the states, the federal district, and the municipalities, also including their associate governmental agencies and foundations. The RCPS is optional, based on the formation of mathematical reserves which guarantee the contracted benefit, and it is regulated by two supplementary laws (Federal Supplementary Laws No. 108/2001 and No. 109/2001).

The main objective of this paper is the study of RPPS, more specifically the scheme applied to servants of the State of Rio de Janeiro (RJ). However, the RGPS and the RCPS will also be addressed throughout the work. Public servants of RJ are ensured by a social security scheme on a contributory and solidary basis, with contributions coming from the respective public entity, from the current employees, retired personnel and pensioners.

In 1998, Brazil initiated a social security reform through the Constitutional Amendment No. 20/1998, which changed significantly the social security system for public employees. In order to ensure the financial stability of the newly social security system and to avoid risking its ability to fund the obligations as a state, RJ created a government agency to finance RJ's social security, the *Fundo Único de Previdência Social do Estado do Rio de Janeiro* (Rioprevidência), a government agency to finance RJ social security. Rio de Janeiro was the third Brazilian state to create a social security fund that concentrates payments of retirement and pensions of public employees of all of the state branches of government (Executive, Legislative and Judicial), all of which pay contributions to Rioprevidência.

In 2012, RJ passed legislation to amend its social security system in order to limit the increasing social security deficit and achieve long-term sustainability of its system (RJ Law No. 6,338/2012).

Pursuant to this new social security system, the assets and liabilities of Rioprevidência were split into two independent funds: the Financial Fund (*Fundo Financeiro*) and the Social Security Fund (*Fundo Previdenciário*). Both funds are part of Rioprevidência but have segregated budgets, balance sheets and independent accounting practices.

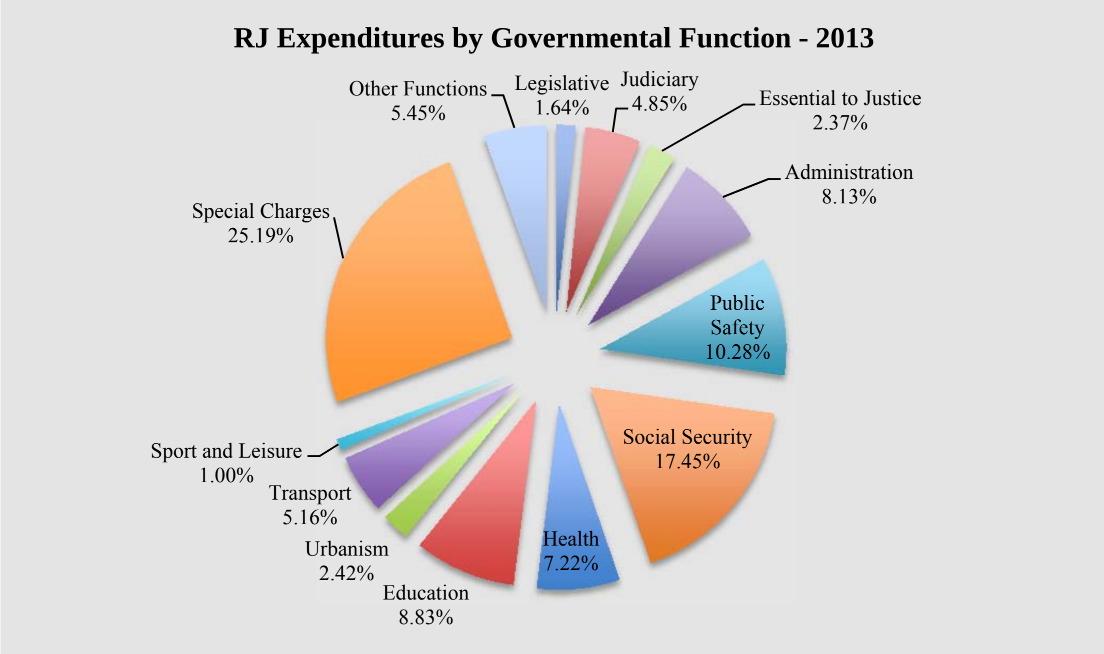
The Financial Fund is a pay-as-you-go system, which comprises most of Rioprevidência's current assets and liabilities, and is composed of all RJ's retired civil servants and all RJ's public employees hired before September 4, 2013 and has been funded with oil and gas revenues received by Rioprevidência. Since 2005, RJ promulgated a series of decrees that capitalized Rioprevidência with royalties and special participations. In 2009, RJ Decree 42,011/2009 consolidated various decrees with respect to the assignment of RJ's oil and gas revenue payments to Rioprevidência.

The Social Security Fund is based on a fully funded system and it is applicable to employees hired after September 4, 2013, excluding military personnel. It is structured in order to be self-sustainable such that contributions from participants, together with matching contributions from RJ, will be sufficient to meet the obligations of the Social Security Fund with respect to its benefits. Furthermore, *Fundação de Previdência Complementar do Estado do Rio de Janeiro* (RJPREV), a complementary retirement and pension fund independent from Rioprevidência, was created by RJ in 2013, in order to provide a supplemental benefit for RJ civil servants that make voluntary contributions to RJPREV (RJ Law No. 6,243/2012). Pursuant to this new structure, the benefits payable by the Social Security Fund will be limited to the same ceiling as is set by the RGPS.

This work aims to analyses whether the bifurcation of RJ's social security system into two segregated funds and the creation of the pension fund are expected to solve its social security deficit over the long-term due to the self-sustaining nature of both funds, Social Security Fund and RJPREV Fund, and the decrease over time of the Financial Fund's liabilities as there will be no new employees to the Financial Fund.

Despite the long-term benefits of mass segregation, RJ will be required to provide additional funding to the Financial Fund in the short-and-medium-term, because the contribution base from new employees will be reduced over time as all employees hired will contribute to the Social Security Fund.

The budget structure of RJ is formed by 25 governmental functions such as education, health, public safety, transportation etc; for which are destined the funds authorized in the budget. A governmental function is the highest level of aggregation of several operational areas related to the institutional mission of RJ. In 2013, the Social Security function, that aggregates the cost of payment of retirements and pensions to employees of RJ and their dependents, represented the second largest share, with 17.45% of the committed expenditure. For comparison, this share is greater than the sum of expenditures committed by RJ on health and education in the same period (Management Accounts Report 2013).



Source: Management Accounts Report 2013 – Secretariat of the State Treasury of RJ.

Therefore, regarding the significance of Social Security in the Social Welfare and the relevance of the participation of expenditures committed to this governmental function on RJ budget, the study of this new social security system framework is of paramount importance. The analysis of the impact of Rioprevidência's mass segregation and the creation of RJPREV, conjugated with the capitalization of royalties and special participations in this government agency, may suggest paths to reduce the actuarial and financial deficits of RPPS-RJ and alternatives to the achievement of the long-term sustainability of the social security system of RJ.

2 – Review of Literature

Social security schemes are schemes imposed and controlled by government units for the purpose of providing social benefits to members of the community as a whole, or of particular sections of the community. The social security schemes generally involve compulsory contributions by employees or employers or both, and the terms on which benefits are paid to recipients are determined by a government unit (OECD, 2007).

The debate on long-term sustainability of social security systems is a socioeconomic issue that composes the agenda of several researchers and policymakers around the world. Before the Brazilian social security reform, there was overwhelming evidence among researchers that the current social security system, principally the Special Social Security Scheme (RPPS) applied to employees holding effective public posts would become insolvent without a structural reform. Brazilian policymakers became more aware of the problem, and certain proposals to improve the solvency of Special Social Security Scheme (RPPS) have been adopted in the Brazilian social security reform carried from 1998 to 2005 (Giambiagi and Tafner, 2010).

Mascarenhas, Oliveira and Caetano (2004) presented the social security rules applied by the Ministry of Social Security (MPS) and analyzed, from an actuarial point of view, the impact of the Brazilian social security reform in the Special Social Security Scheme (RPPS) of the Union.

Caetano (2006) identifies the fundamentals of social security cost and sustainability through a theoretical framework that establishes quantitative and qualitative comparisons, giving emphasis on Brazilian position on the world scenario. The results presented in this paper places Brazil among the countries with the greatest difficulty to keep the long-term sustainability of its social security system.

Therefore, there is an extensive academic literature on the subjects of reform and sustainability in the long-term of social security systems. Numerous social security reform proposals are discussed in Lyon and Stell (2000) and in Diamond and Orszag (2003). Ornellas and Vieira (1999) addressed the new rules of the Brazilian social security system after the changes enacted by Constitutional Amendment No. 20/1998. Zylberstajn et alii (2006) complemented the debate on the Brazilian social security reform and calculated the transition cost of shifting to a new social security system based on the principles of actuarial fairness. The results showed that, although distributed over time, the transition cost is high.

Caetano *et alii* (2011) presented the financial situation of the Special Social Security Schemes (RPPS) in the Brazilian state level and offered three alternative scenarios to their reform and funding. The scenarios were the maintenance of the pay-as-you-go system, the adoption of a fully funded system with financing of the deficit in 35 years and mass segregation and the adoption of a mixed system. The results show that structural reforms that alter the financing of their systems from the pay-as-you-go system to the fully funded system are a way for the Brazilian states to avoid the rising costs with this governmental function in the long-term.

Garret and Rhine (2005) provided a direction for discussions on social security reform through the analysis of rates of return under social security versus private retirement accounts. The framework allowed individuals to invest some of their payroll taxes in private retirement accounts. Their evidences suggests that the great majority of current American retirees would have had a higher retirement income under private accounts than they do now with the current social security system.

3 – The State of Rio de Janeiro (RJ)

3.1 - General Framework

RJ is located in Southeast Brazil and covers an area of 43,778 km^2. It has 92 municipalities and its capital is the City of Rio de Janeiro, which was also the capital of independent Brazil prior to 1960. RJ is the smallest state in the Southeast macro-region and ranks 24th out of the 27 Brazilian states in terms of total area. It is, however, the third longest coastline in the country, after those of the states of Bahia and Maranhão, with approximately 635 kilometers (IBGE 2012).

Despite its relatively small size, based on information from the Brazilian Institute of Geography and Statistics (IBGE), RJ has the second largest economy of Brazil, after that of the state of São Paulo, and it is the third most populous Brazilian state, with an estimated population of 16.2 million in 2012, making the state the largest in the country in terms of population density, with approximately 370 inhabitants per square kilometer.

According to the Regional Accounts of Brazil by IBGE, the GDP of RJ in 2012 was approximately R$ 504.2 billion, making 11.5% of Brazil's GDP attributable to the RJ in that year. The GDP per capita was R$ 31,064.63, which was the second highest GDP per capita among the Brazilian states in 2012. The services sector was the most important sector of RJ's economy in 2012 and accounted for 67.4% of RJ's GDP. The industrial and the agricultural sectors accounted for 32.2% and 0.4%, respectively (RJ Management Accounts Report – 2013).

Approximately 40% of the population of the RJ is concentrated in the City of Rio de Janeiro. The City of Rio de Janeiro is the headquarters of many major private and state-owned Brazilian companies, such as the National Economic and Social Development Bank (BNDES), Petrobras, Vale do Rio Doce, Eletrobras, Light, telecom giants Oi S.A. and Embratel, and Organizações Globo, the largest conglomerate of media and communications companies in Latin America.

The City of Rio de Janeiro is also the headquarters for many national and international oil and gas companies with offices in Brazil, including the Brazilian subsidiaries of Exxon, Chevron, Statoil, Shell, El Paso, BP, BG, and Inpex. Several Brazilian conglomerates have also chosen the City of Rio de Janeiro as their headquarters, including Odebrecht, Queiroz Galvão and HRT.

In 2014, several matches of the FIFA World Cup in Brazil were held at the newly renovated Maracanã Stadium in the City of Rio de Janeiro, including the final match. Additionally, in 2016, the Olympic Games will take place in the City of Rio de Janeiro, which will mark the first time that a South American city will host this global event. These events have spurred substantial urban, security and infrastructure investments in both RJ and the City of Rio de Janeiro.

3.2 - Organization and Administration

RJ's Constitution provides for separation of powers in three branches, similar to that of the federal government of Brazil. The executive branch is headed by the governor, who is elected for a four-year term and may be reelected for one additional consecutive mandate. The legislative branch comprises a State Legislative Assembly. Its deputies are elected for four-year terms. The judicial branch is composed of a Court of Justice (*Tribunal de Justiça – TJ-RJ*), Lower Courts (*Juízes de Direito*), Trial Courts (*Tribunais do Juri*), Military Justice Councils (*Conselhos da Justiça Militar*), Special Courts (*Juizados Especiais*) and Courts of Appeals (*Turmas Recursais*). The RJ's State Constitution also provides for financial and budgetary oversight by the State Accountability Office (*Tribunal de Contas do Estado – TCE-RJ*).

3.3 - Relationship with the Federal Government

In the late 1990s many Brazilian states, including RJ, renegotiated their debt with the federal government pursuant to the Program for Restructuring and Fiscal Adjustment (PAF). According to the agreements reached within the PAF framework, many states and the federal government agreed to strict fiscal rules and restrictions on debt incurrence. RJ entered into agreements pursuant to the PAF with the federal government in 1997 and 1999.

Another important fiscal landmark was the enactment of the Federal Fiscal Responsibility Law (LRF), which provided a detailed, comprehensive framework of fiscal rules within which municipalities, states and the federal government must operate (Supplementary Federal Law No. 101/2000). Both the PAF and the LRF contributed to reducing state debt and generally strengthening the fiscal performance of the public sector in Brazil. RJ and other states have benefited from this framework, which has been effective in preventing poor financial management (Giambiagi and Tafner, 2010).

3.4 - Revenues, Expenditures and Budget

In 2013, RJ's total revenues were approximately R$ 67.9 billion and the principal source of revenues was taxation, which amounted to R$ 35.7 billion. The main source of RJ tax revenue in 2013 was from the state VAT (*Imposto sobre Circulação de Mercadorias e Serviços* - ICMS), which amounted approximately R$ 26.1 billion (RJ Management Accounts Report – 2013). The table below shows RJ's expenditures by governmental function in 2013:

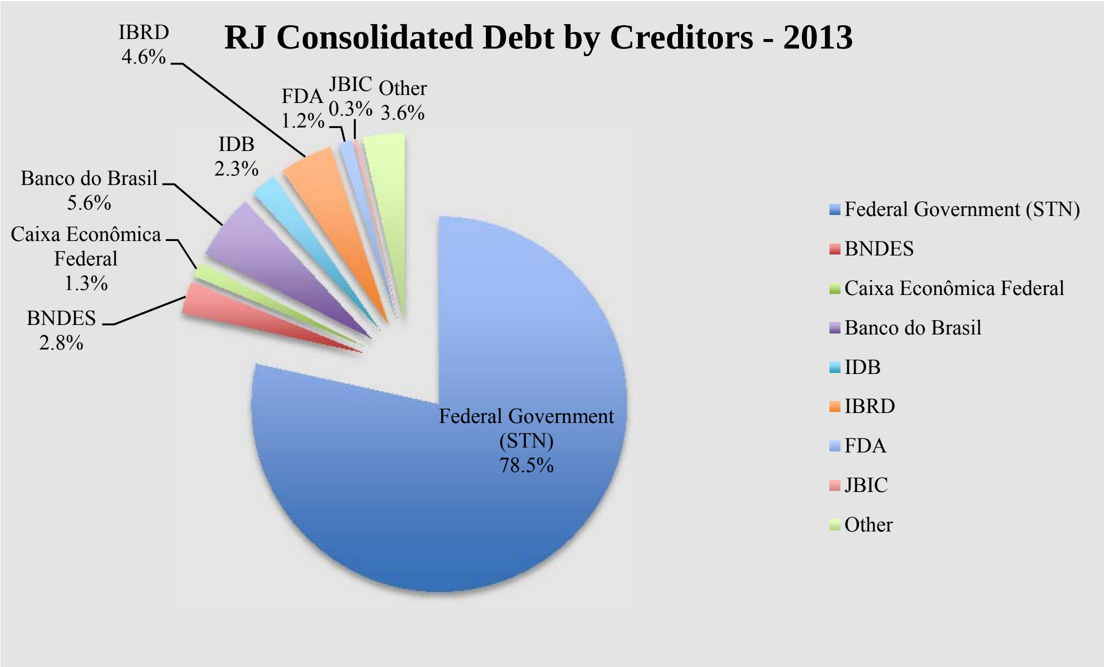
Expenditures by governmental function – RJ 2013 (thousand R$)		
Function	**Expenditure**	**Percentage**
Legislative	1,122,234	1.64%
Judiciary	3,320,168	4.85%
Essential to Justice	1,620,204	2.37%
Administration	5,559,025	8.13%
Public Safety	7,032,863	10.28%
Social Security	11,934,542	17.45%
Health	4,937,302	7.22%
Education	6,041,860	8.83%
Urbanism	1,657,606	2.42%
Transport	3,526,987	5.16%
Sport and Leisure	685,083	1.00%
Special Charges	17,224,394	25.19%
Other Functions	3,726,047	5.45%
Total:	**68,388,315**	**100.00%**

Source: Management Accounts Report – 2013 - RJ's Finance Secretary

According to the Management Accounts Report of the RJ's Finance Secretary, in 2013, RJ had a budget deficit of R$ 470.7 million.

3.5 - Debt

RJ has a high level of debt, approximately R$ 79.8 billion as of December 31, 2013. Substantially all of RJ' debt that is owed to the Federal Government is denominated in Reais, amortizes monthly, accrues interest at six percent per annum, and is indexed to inflation according to the General Price Index (IGP-DI). RJ' other debt primarily consists of loans from multilateral agencies, such as the World Bank (WB), and international agencies, such the French Development Agency (FDA), the Japan Bank for International Cooperation (JBIC) and the Inter-American Development Bank (IDB) (Management Accounts Report – 2013 - RJ's Finance Secretary).



Source: Management Accounts Report – 2013 - RJ's Finance Secretary

Under the LRF, the maximum ratio of consolidated net debt to net current revenues of any state is 2.0. For 2013, RJ's ratio of consolidated net debt to net current revenues was 1.54. Furthermore, under the LRF, consolidated payroll expenses, including executive, legislative and judiciary employees cannot exceed 60% of net current revenues. In 2013, RJ' ratio was 38.4% (Management Accounts Report – 2013 - RJ's Finance Secretary).

3.6 - Program for Restructuring and Fiscal Adjustment (PAF)

According to Federal Law No. 9,496/1997 and as part of the debt renegotiation between RJ and the federal government under the framework of the PAF, RJ entered into the RJ Assignment Agreement and an Acknowledgement, Commitment, Consolidation and Refinancing of Debt Agreement (*Contrato de Confissão, Promessa de Assunção, Consolidação e Refinanciamento de Dívidas*) with the federal government.

Pursuant to this agreement, RJ assigned approximately[1] R$10.8 billion of RJ oil revenue rights to the Federal Government. As consideration for these RJ oil revenue rights and pursuant to the RJ refinancing agreement, the Federal Government reduced the debt of RJ by approximately R$2.5 billion and transferred approximately R$8.3 billion of Certificados

[1] Such value determined as of October 29, 1999.

Financeiros do Tesouro (CFT)[2] to RJ, which were used to capitalize Rioprevidência.

According to the RJ assignment agreement, the RJ oil revenue rights have been transferred to the Federal Government in 255 monthly scheduled payments, from December 20, 1999 to February 20, 2021. The amount of RJ oil revenue rights is readjusted on an annual basis according to the IGP-DI. Payments pursuant to the RJ Assignment Agreement are made through the deduction of amounts from RJ oil revenues received from the National Treasury.

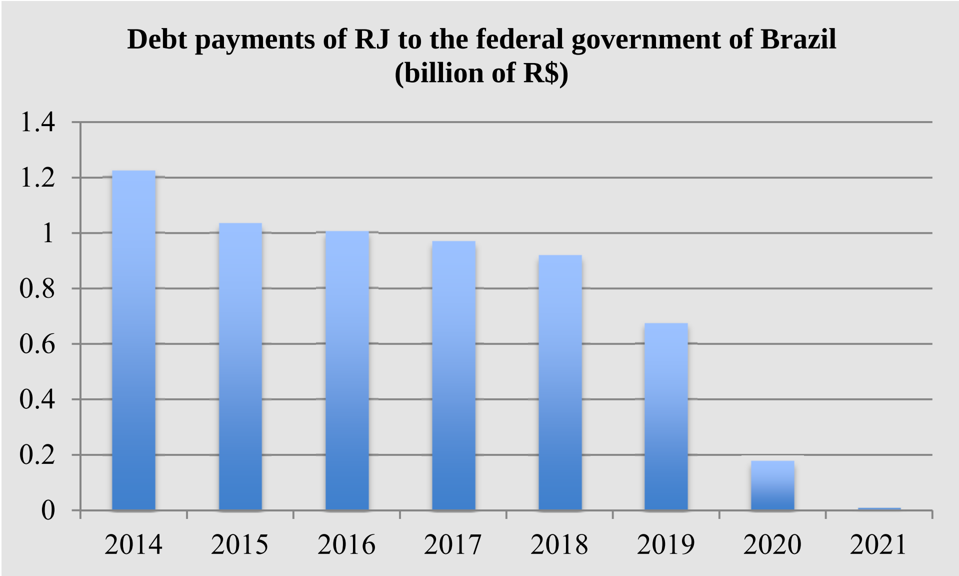
Pursuant to the terms of the RJ Assignment Agreement, if the monthly assigned amounts are not sufficient to pay the respective monthly scheduled payments, the amount of such shortfall would be transferred to a specific account (residual account 1). Any unpaid balance as of December 31 of each year would then be transferred from residual account 1 to a second residual account (residual account 2) and interest on such unpaid balance would accrue at an annual rate of 12%, plus any adjustment for inflation based on the IGP-DI.

During any month in which the assigned amounts are greater than the respective monthly scheduled payments, then the excess funds will be used in a determined[3] manner and order. After all of the scheduled payments for the applicable year have been paid, if there is no remaining balance in the residual account 1 and residual account 2, all remaining assigned amounts for such year will be paid directly to RJ.

The following chart shows the aggregate amounts per year to be deducted from RJ oil and gas revenues and paid to the federal government pursuant to the RJ assignment agreement:

[2] CFT is the result of an operation with the National Treasury, established in 1999, by which RJ obtained financial assets of the National Treasury against exchange for flow backed by revenues from royalties and special participations on oil and gas production, which initially would extend to 2014. However, there was negotiation to change this flow with its end in 2012.

[3] First, to pay the debt balance contained in residual account 1; second, to pay the unpaid debt balance that remains in residual account 2; and third, to make advance payments of the scheduled payments due in the current year.



Source: *Ofício* SEFAZ/SGAB No.840/2014, prepared by the Secretary of Finance of RJ.

4 – The Special Social Security Scheme (RPPS) of RJ

4.1 - The Brazilian Social Security Reform

The fiscal responsibility in the state level had been the focus of much attention after 1994 due to the macroeconomic stabilization policy promoted by the *Plano Real*; a set of measures taken to stabilize the Brazilian economy. In 1997, the Program for Restructuring and Fiscal Adjustment (PAF) was one of the first actions taken by the federal government in order to obtain a long-term fiscal balance in the post-Real period for all states of the federation. The fiscal balance in the state level was considered by the federal government as a necessary condition for the effective fight against inflation (Giambiagi and Tafner, 2010).

The debt renegotiation related to the PAF made explicit the financial difficulties faced by the Brazilian states. Among the several conditions imposed by the federal government to the states, regarding the PAF agreements, were the actuarial balance of its social security systems and the commitment to the adequacy of the states' legislation to the changes approved in the Federal Constitution, under the social security reform.

The reform of the Brazilian social security was initiated by the Constitutional Amendment No. 20/1998 and by the Federal Law No. 9,717/1998. Thereafter, the Constitutional Amendment No. 41/2003 and the Constitutional Amendment No. 47/2005 completed this reform.

According to the post-reform framework, the public employees holding effective posts in Brazil, therein included their associate government agencies and foundations, are ensured of a social security scheme on a contributory and solidary basis, with contributions from the respective public entity, from the current employees, retired personnel, and pensioners, with due regard for a criteria that preserves financial and actuarial balance of the system (Article 40 of the Constitution of the Federative Republic of Brazil 1988).

4.2 - The Report of Actuarial Evaluation Results (DRAA)

In order to monitor the RPPS's performance in pursuant its actuarial and financial balance, the Federal Law No. 9,717/1998 established the development of an initial actuarial evaluation and an actuarial evaluation for each fiscal year, to adapt the cost of the benefits to the funding plan. The Report of Actuarial Evaluation Results (DRAA) must necessarily be submitted to the Ministry of Social Security (MPAS) as a requirement for obtaining Social Security Regularity Certificate (CRP) issued by the MPAS.

The DRAA is a summary of the results of the annual actuarial evaluation of the RPPS and consists of the values of mathematical provisions, costs, technical result (surplus or deficit), financial projections and expert advice on the situation of the actual social security system.

4.3 - RJ's RPPS – General Framework

Before the general framework presentation, it is necessary to clarify some issues regarding the RJ's Special Social Security Scheme (RPPS). The Brazilian legislation on RPPS accepts three possible financial systems to be adopted by the entities in the management of its social security funds: the fully funded system (*Capitalização*), the share capital coverage system (*Repartição de Capitais de Cobertura*) and the pay-as-you-go system (*Repartição Simples*) (MPS Ordinance 403/2008).

Pursuant to the fully funded system's funding plan, the contributions to be paid by RJ and its current employees and beneficiaries, added to the revenues generated by its current assets and other financial resources, shall be sufficient to guarantee the future obligations of RJ's benefits and its management fee.

The share capital coverage system determines that the contributions established in the funding plan, to be paid by RJ and its current employees and beneficiaries, in a specific fiscal year, shall be sufficient to constitute mathematical reserves to the benefits initiated by events that occurred within the same fiscal year, admitting the creation of a social security fund to smooth the risk of financial oscillations.

In the pay-as-you-go system, the contributions established in the funding plan, to be paid by RJ and its current employees and beneficiaries, in a specific fiscal year, shall be sufficient to fund the benefits occurred within the same fiscal year, without the intention of resource accumulation, admitting the creation of a social security fund to smooth the risk of financial oscillations.

According to Tafner (2008), most of Brazil's Special Social Security Scheme (RPPS) in the state level adopted the pay-as-you-go system, which its benefits funded not only by the current flows of social security contributions of current employees and beneficiaries, but also by taxes collected from the whole society to cover the deficit.

Furthermore, according to Caetano *et alii* (2011), when some share of a state's fiscal revenue is applied in increasing payments of retirements and pensions, specially ICMS, the predominant regressive VAT tax in the RJ's fiscal revenue, these regressive transfers tend to increase inequality in RJ.

Rather than paying the individual benefits from a fund that they have built up over time, as the fully funded retirement and pension system dictates, a pay-as-you-go system relies on tax revenue from current employees to fund the benefits of current beneficiaries (Garret & Rhine, 2005).

The applied post-reform federal legislation on social security authorizes the federal entities to adopt certain proposals in order to smooth the transition from a pay-as-you-go system to a fully funded system such as mass segregation and the creation of a private supplemental pension fund (MPS Ordinance 403/2008).

4.4 - Mass Segregation

Mass segregation is the explicit definition of some cutting-line separating the servers between two segregated funds - an older, covered by a pay-as-you-go system; and a newer, self-financed by a fully funded system (RJ Law No. 6,338/2012).

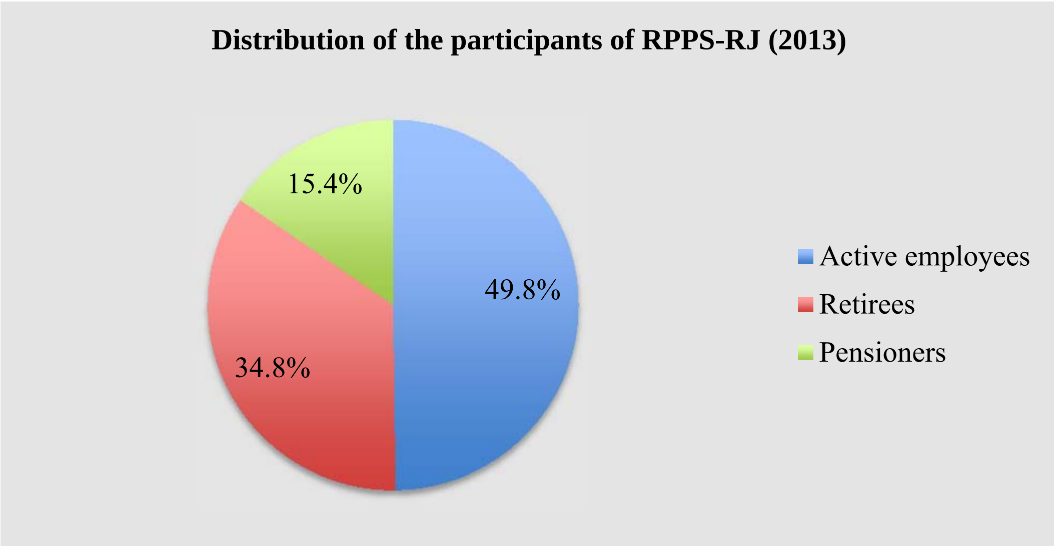
The employees hired before the cutting-line were allocated in the older fund, the Financial Fund (*Fundo Financeiro*), which is a segregated and independent fund (RJ Law No. 6,338/2012). At first, this Financial Fund will gradually increase its deficit position, but with a declining trend in the medium-term and extinction in the long-term.

To the employees hired after the cutting-line it is applied the newer fund, the Social Security Fund (*Fundo Previdenciário*), with a financial surplus in the short-and-medium-term that shall be sufficient to guarantee mathematical reserves for a definitive actuarial balance in the long-term. This financial surplus will be reduced over time to the extent that the benefits are granted. During the transition period, the financial deficit of the Financial Fund shall be cover by RJ government.

Until the adoption of mass segregation by RJ (RJ Law No. 6,338/2012), the Special Social Security Scheme (RPPS) of RJ was a pay-as-you-go system, which means that most of the payroll taxes that RJ employees and RJ government pay in went directly to retirees, pensioners and other beneficiaries. As long as the number of employees paying into RJ social security system greatly exceeded the number of retires and pensioners, this system could finance itself on a pay-as-you-go basis.

However, the ratio of employees to beneficiaries in RJ decreased significantly in the last decades, reflecting the declining birth rates in Brazil and the retirement of the large cohort of people born in the years immediately after World War II, the baby boomers. Moreover, the longer life expectancy in Brazil accentuates this issue, which means that people spend many more years in retirement than they used to, which contributes to the unsustainability of this system in the long-term.

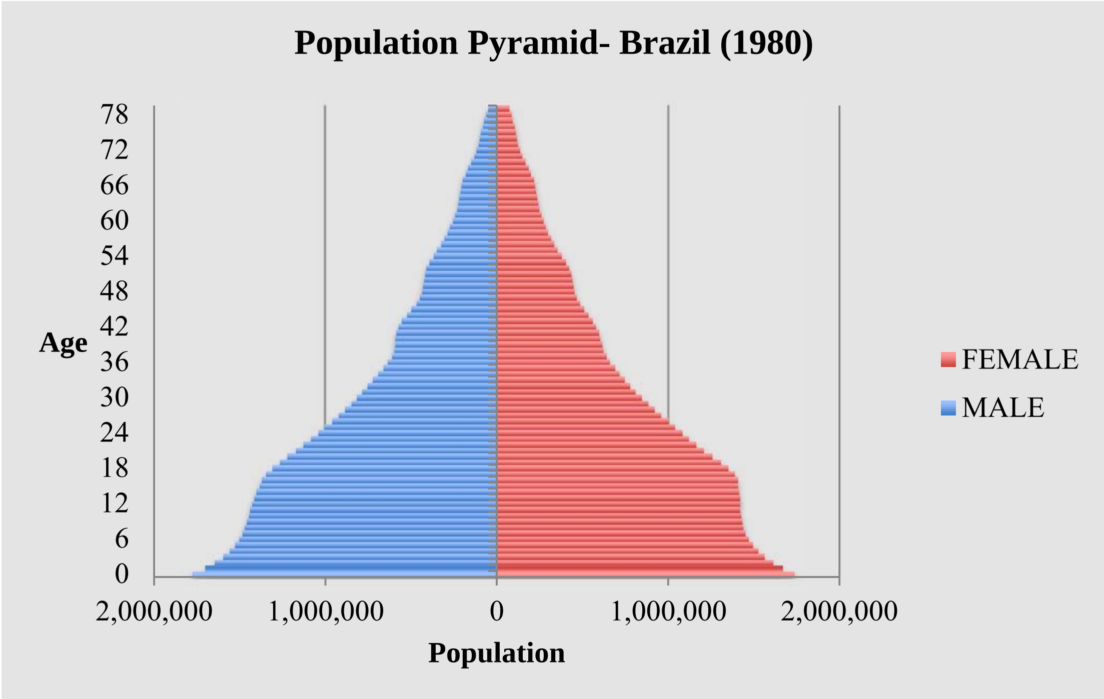
The chart below depicts the distribution of the participants of RJ's Special Social Security System (RPPS-RJ) in 2013:



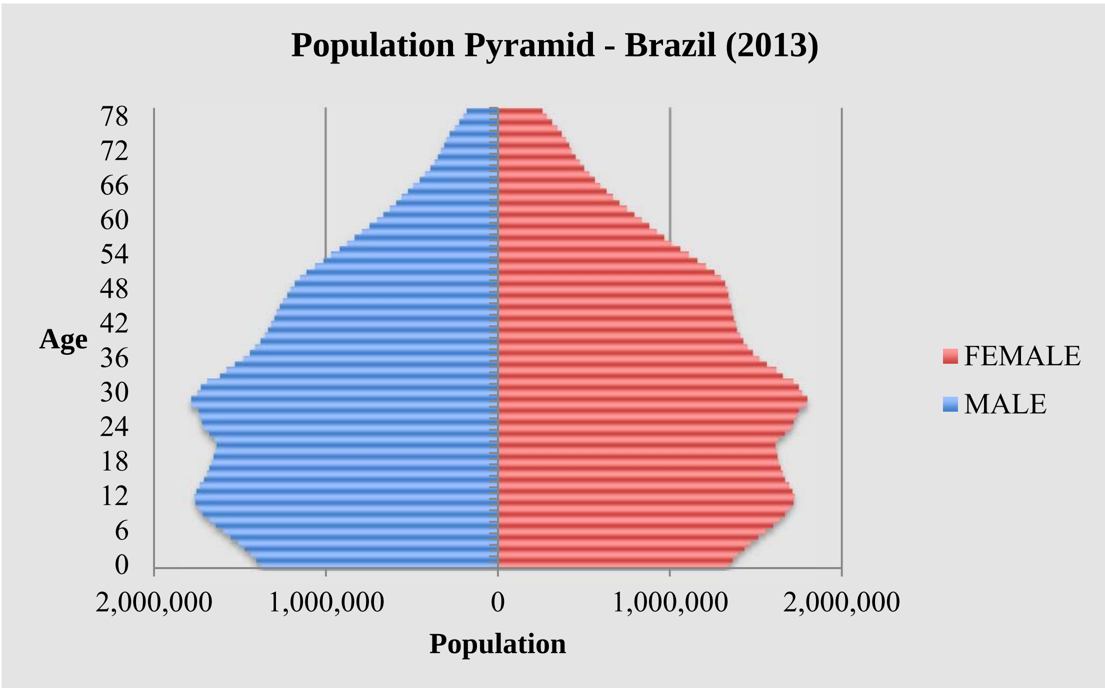
Source: DRAA – 2014/RPPS-RJ

According to Rioprevidência's Report of Actuarial Evaluation Results (DRAA) – 2014, published by Caixa Econômica Federal (CEF), over 225 thousand retirees and pensioners received benefits through the RJ's social security system in 2013. In the same year, RJ had approximately 223 thousand active employees.

The figures below show the structural demographic changes in the Brazilian society for 1980, 2013 and 2050 (projected):



Source: IBGE



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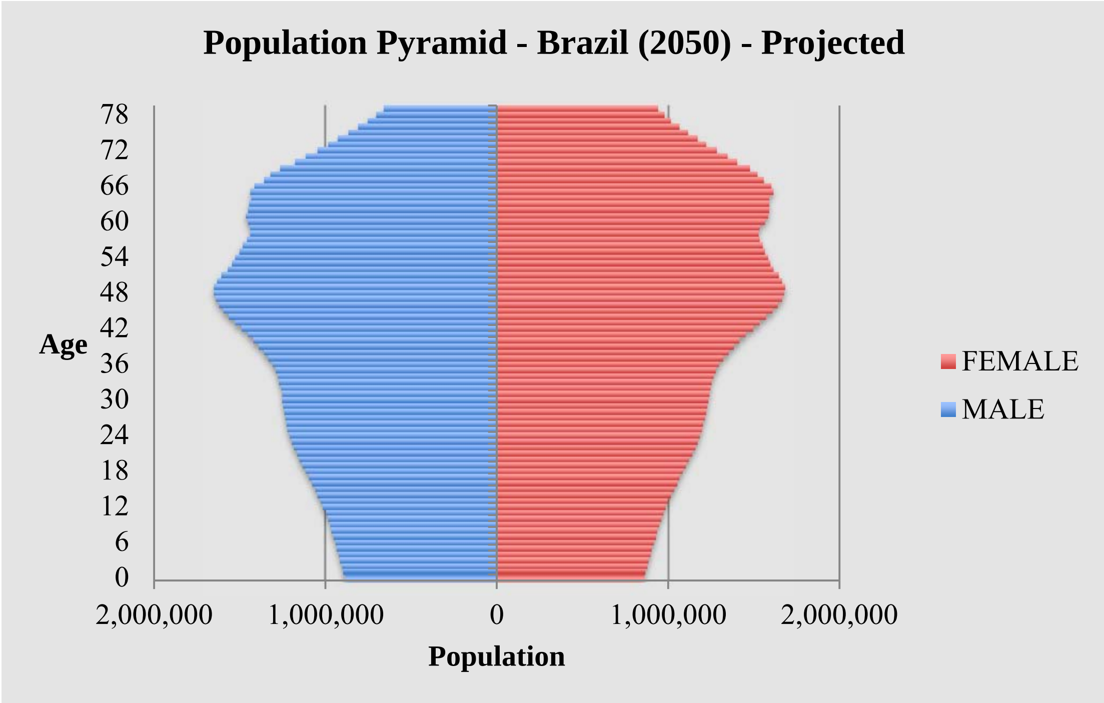


Source: IBGE

The problem related to mass segregation arises from the fact that, under this new framework, RJ's social security payroll taxes cannot be used anymore to fund benefits to currents retirees and pensioners. Thus, as the payrolls taxes are directed toward the Social Security Fund, Rioprevidência will not receive sufficient revenue to pay the current benefits from the Financial Fund.

In order to achieve the balance of these systems in the long-term, it is necessary to pay a transition cost. The payment of the transition cost may includes the sale of RJ's public assets such as real estate, revenues from royalties and special participations, companies or securities. Another option is increase taxes such as ICMS and/or the payroll taxes (Caetano *et alii*, 2011)

4.5 - The RJ's Complementary Social Security Scheme (RCPS)

The social security reform also allowed, to the states that established a Complementary Social Security Scheme (RCPS) for their respective employees, stipulations for the amount of retirement and pensions to be granted by the Special Social Security Scheme (RPPS) until the same maximum limit established for the benefits of the General Social Security Scheme (RGPS) (Paragraph 14, Article 40 of the Federal Constitution of Brazil 1988).

This Complementary Social Security Scheme (RCPS) shall be instituted by the states through closed private pension plan companies, of a public nature, which will offer to their respective participants benefit plans exclusively in the defined contribution mode. The complementary social security scheme may be applied to an employee who has entered public administration on or before the date of publication of the act which instituted the corresponding complementary social security system only if such employee has previously expressed such option (Federal Supplementary Laws No. 108/2001 and No. 109/2001).

Pursuant this new legal framework, *Fundação de Previdência Complementar do Estado do Rio de Janeiro* (RJPREV), a retirement an pension fund independent from Rioprevidência, was created in 2013 by RJ in order to provide a supplemental benefit for RJ civil servants that make voluntary contributions to the RJPREV Fund (RJ Law No. 6,243/2012).

5 – Rioprevidência

5.1 - General Framework

Rioprevidência is a retirement and pension fund to finance the RJ's social security system. It was created by RJ government in 1999 (RJ Law No. 3,189/1999), regarding the Brazilian social security reform that changed expressively the Special Social Security Scheme (RPPS) for public employees.

It is an autonomous government agency that is part of the RJ Secretary of State for Planning and Management (SEPLAG-RJ). It is subjected to the Ministry of Social Security (MPS), the federal ministry responsible for regulating social security in Brazil.

The purpose of Rioprevidência is guarantee and manage financial assets to fund benefits granted by RJ and its government agencies and foundations to public servants and their dependents. Rioprevidência is also charged with the duty to effect payments of all social security benefits as specified in the applicable laws.

5.2 - Sources of Revenues

The RJ's Treasury is the guarantor of all of the obligations of Rioprevidência to fund amounts owed as benefits. In the event that Rioprevidência cannot meet any of its obligations with respect to retirement benefits, RJ would have to fund such obligations. In the event Rioprevidência is dissolved or becomes subject to a liquidation process, all of its assets must be integrated into the assets of the RJ, which shall be its successor with respect to all of its rights and obligations (Paragraphs 1 and 2, Article 1 of RJ Law No. 3,189/1999).

In accordance with applicable Brazilian legislation and in order to allocate predictable resources to its social security system, legislative actions[4] were taken by RJ to assign oil and gas revenues to Rioprevidência. In December 2005, Rioprevidência recorded certain amounts of royalties and special participations as assets. The revenues attributable to such royalties and special participations were actually received and recorded by Rioprevidência as revenues in 2006.

In addition to these oil and gas revenues, other sources of revenue for Rioprevidência include employer and employee social security contributions, redemptions of bonds issued by the Brazilian federal government, compensation for the use of any of its assets (rents), proceeds from the sale of assets, payments received from overdue public liabilities, revenues from financial investments and social security offsetting with respect to the COMPREV[5] system.

Employee and employer social security contributions of 11 and 22 percent, respectively, of the monthly wage of each RJ civil servant are collected by RJ and transferred to Rioprevidência (Articles 33 and 35-A of RJ Law No. 3,189/1999).

After the debt renegotiations between RJ and the federal government in 1999, pursuant to which the federal government issued the CFTs bonds to Rioprevidência, the fund has used cash proceeds from redemptions of CFTs, among other things, to fund its cash shortfall. In 2012, Rioprevidência redeemed the last of its remaining CFTs. After the redemption of the

[4] Article 13, item XII of RJ Law No. 3,189/1999, amended by RJ Law 4,237/2003 and RJ Decree 42,011/2009.
[5] The COMPREV system aims to operationalize the offsetting between the Brazilian social security systems.

CFTs, and in order to meet its funding obligations, Rioprevidência sold some amounts of its oil revenue rights to Brazilians banks, in 2013, for an aggregate amount of approximately R$3.3 billion.

5.3 - Certificate of Social Security Regularity (CRP)

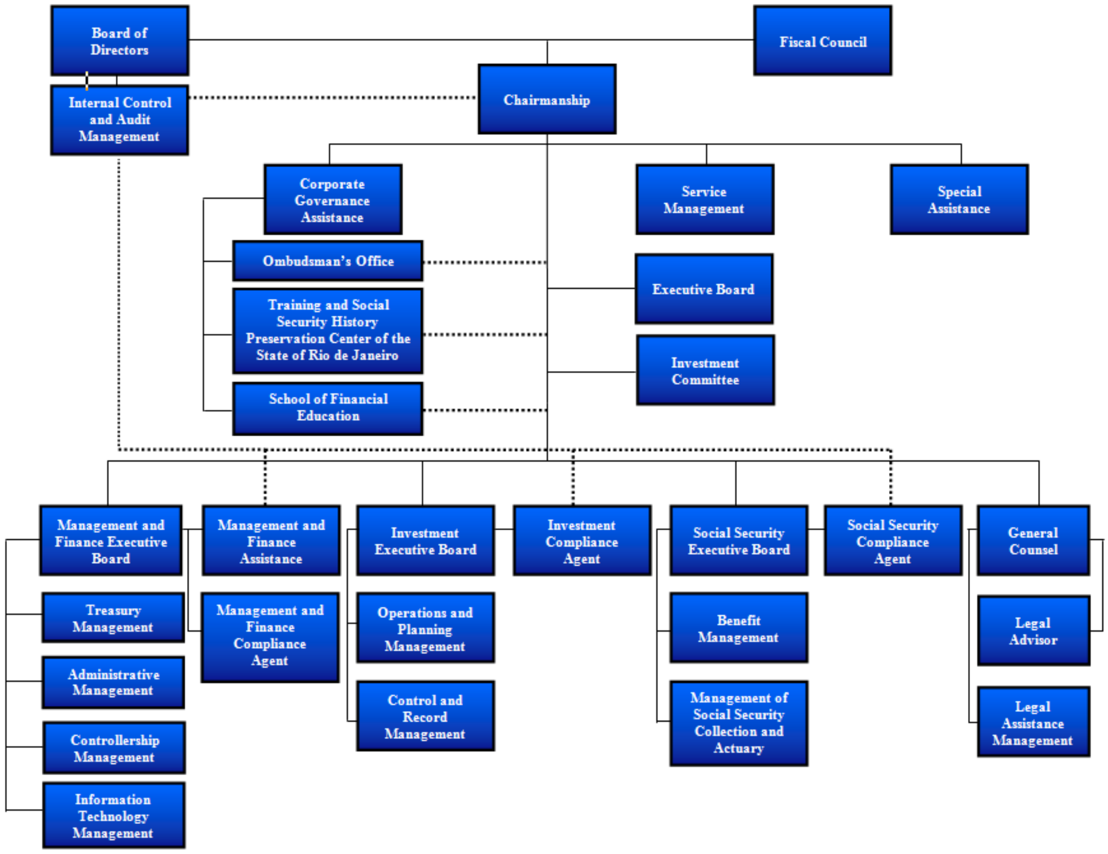
In 1998, the Brazilian National Congress approved Federal Law No. 9,717/1998, which established a series of regulations applicable to Special Social Security Scheme (RPPS) for civil servants of the states and pursuant to which the Ministry of Social Security (MPS) was determined to be the regulator. Within this framework, the MPS has the power to issue the Certificate of Social Security Regularity (CRP), that certifies to certain regulatory bodies and the federal government that a particular RPPS is in compliance with this federal law (Federal Decree No. 3,788/2001).

The CRP is required to be issued by the Ministry of Social Security prior to the occurrence of any voluntary transfers of funds by the federal government, except for transfers related to education, health and social assistance, before entering into any agreements or contracts; receiving financings, guaranties or other assistance from the federal government; and before paying any amounts owed by the General Social Security Scheme (RGPS).

In order to receive and maintain a CRP, the state must comply with financial and actuarial equilibrium with respect to defined costs and estimated expenses. Furthermore, any states that decrease the capital of their social security funds that have a financial or actuarial deficit will cause their CRP to be revoked or will not be renewed, which would result in the inability of such state to receive federal funding, enter into any financing agreements or carry out or benefit from any of the activities described above (MPAS Ordinance No. 204/2008).

5.4 - Organization

The following chart depicts Rioprevidência's organizational structure:



Source: Rioprevidência 2014

5.5 - Board of Directors

The Board of Directors is the decision-making body responsible for defining Rioprevidência's overall strategic guidelines and general rules of organization, and the social security policies and investments of Rioprevidência. The Board of Directors establishes the general management, investment and fund allocation; monitors the operations of the agency; analyzes and approve the annual balance sheets, the actuarial analysis and the budget; authorizes any contracts and agreements that permit the creation of liens on properties of Rioprevidência; prepares and amends, to the extent necessary and desirable, Rioprevidência's internal regulations; establishes parameters for the operation of the Unified System of Social Security Benefit Payments; and monitors management of the institution's payroll (Rioprevidência Ordinance No. 271/2015).

The Board of Directors is composed of fifteen members and holds regular meetings once every quarter and may hold special meetings from time to time. Its resolutions must be adopted by a simple majority vote, and in the event of a tie vote the chairman has a casting vote, in addition to his vote. Alternate members are appointed by the governor of RJ for each member of the board of directors. There is no fixed term for the appointed members of the Board of Directors. Each member serves until replaced by a member that has been appointed by the governor (Articles 5, 6 and 7 of RJ Law No. 3,189/1999).

5.6 - Fiscal Council

The Fiscal Council is the body responsible for independently overseeing the economic and financial management of Rioprevidência. The members of the Fiscal Council analyze and prepare opinions on the accounts in the interim balance sheets; prepare written opinions on the annual balance sheet, accounts and actions of the executive board, as well as on compliance with the social security benefits plan and on the consistency of the results of actuarial analyses, including actuarial assumptions on which such analyses are based; analyze the financial books and records of Rioprevidência; inform the Board of Directors of any irregularity found, and suggest corrective measures; and request, when necessary, the Board of Directors to engage an expert technician or company, without prejudice to the external control of accounts (Rioprevidência Ordinance No. 271/2015).

The Fiscal Council is composed of three members and three alternate members, each appointed from among the social security holders and beneficiaries, after consultation with the corresponding labor union. They are appointed by the Governor for a one year term. The Fiscal Council meets ordinarily once every quarter, upon a call notice sent by the chairman of the fiscal council. The resolutions of the fiscal council must be adopted by a majority vote (Articles 10 and 11 of RJ Law No. 3,189/1999).

5.7 - The Executive Board

The Executive Board is composed of executive officers who are principally responsible for the management of Rioprevidência and for implementing the general policies and guidelines set by the Board of Directors.

The Executive Board is composed of five executive officers of Rioprevidência appointed by the Governor of RJ: the chief executive officer, the investment director, the administrative and financial director, the social security director, and the general counsel. The social security officer must be nominated based on a list of three candidates prepared from submissions from each association representing each class of insured public servants and beneficiaries. The investment officer must be a professional that has been certified pursuant to an examination administered as provided by the Brazilian social security laws by an independent Brazilian capital markets firm recognized for its technical ability that has been approved by the Board of Directors. The general counsel must be a state prosecutor (Rioprevidência Ordinance No. 271/2015).

The Executive Board is required to meet every week, and may from time to time hold special meetings to resolve matters of general interest to Rioprevidência. Its decisions must be adopted by a majority vote, and in the event of a tie, the chief executive officer shall be entitled to a casting vote (Articles 8 and 9 of RJ Law No. 3,189/1999).

5.8 - Audit of Benefits and Management Initiatives

Since 2012, Rioprevidência has been performing an intensive audit of the benefits it has been paying. The audit is divided into two stages and is based on compliance of the payment of benefits with applicable Brazilian law and assessment of whether the correct amounts of benefits have been paid.

The first stage of the audit was the review of pensions granted exclusively to members of the military, which in certain cases do not include all of the necessary processes and assessments at the time benefits are granted; the review of pensions in excess of the limit of benefits provided for in Brazilian law. This review consisted of the assessment of certain pensions that were calculated incorrectly; the review of the pensions granted exclusively to single daughters of deceased pensioners that were older than 21, a type of benefit that has not been available since 1998; and new examinations of disabled beneficiaries, as well as re-assessments to confirm that beneficiaries do in fact qualify as disabled.

The second stage of the audit, which is still being implemented, will consist in the review of the calculation of benefits payments. This review will be conducted based on the methodology used to calculate benefits both at the time of granting and for periodic increases and include a review of the wages and other information on which benefits were calculated; a review of the status of certain disability beneficiaries; and cross-check Rioprevidência's database with that of other federal entities through a Social Security Information Management System (Siprev) for public servants that determines benefits that exceed certain constitutional limits (Rioprevidência's Corporate Governance Report – 2014).

6 – RJ Oil and Gas Sector

6.1 - Petroleum Law

In 1997, the Petroleum Law (Federal Law No. 9,478/1997) opened the oil and gas sector to private investment, making the sector more competitive internationally while maintaining both the federal government's monopoly on oil and natural gas reserves located within the territory of Brazil, including its territorial waters; and its control over Petrobras.

According to the Petroleum Law, Petrobras must compete with other oil and gas companies for concessions and authorizations; however, it may choose partners to share in the risks and benefits of exploitation and production activities regarding the Brazilian oil and gas industry.

This new regulatory framework established by the Petroleum Law provides the federal government with power to grant concessions and authorizations to Brazilian companies, including those companies that are wholly-controlled by non-Brazilian companies, to participate in activities in the Brazilian oil and gas industry.

The Petroleum Law also created a policy board and an independent regulatory agency to regulate the oil and natural gas and the renewable fuel sectors in Brazil. The National Energy Policy Board (CNPE) and the National Agency of Petroleum, Natural Gas and Biofuels (ANP), were also created to enhance the competitive environment in the Brazilian oil and gas sector.

6.2 - The National Energy Policy Board (CNPE)

The National Energy Policy Board (CNPE) is a normative body created by the Petroleum Law and has the authority to set policies for the Brazilian oil and gas industry. CNPE is also responsible for the formation of strategic reserves of oil and gas, as well as to define which offshore and onshore blocks may be subject to rounds of bidding.

According to its structure and functions regulations, CNPE must meet every six months and may hold special meetings whenever called by its chairman. The CNPE’s board of directors is composed of fourteen members, with nine seats occupied by ministries of the federal government (Federal Decree No. 3,520/2000).

6.3 - National Agency of Petroleum, Natural Gas and Biofuels (ANP)

ANP is an executive body subject to oversight by the Ministry of Mines and Energy (MME) and is charged with the responsibility of regulating the oil and natural gas industry (Federal Decree No. 2,455/1998). The ANP is also responsible for entering into contracts with concessionaires and monitoring the economic activities of the oil and gas sector in Brazil. ANP has the authority to enact rules with respect to the calculation and payment of royalties and special participations, supervise the calculation and payment of such government participations and impose and enforce penalties in case of default.

6.4 - Concession Regime

The Petroleum Law created the Concession Regime, whereby the federal government, through the ANP, arranges auctions to grant rights to oil and gas exploration and encourages production companies to conduct oil and gas exploration and production activities in certain onshore and offshore blocks. Any company interested in oil and gas exploration and production that meets the necessary technical, legal and financial qualification criteria may participate in such auctions.

After winning a round of bidding, each company must enter into a concession agreement with the ANP. Under this regime, the concessionaires have property rights over the oil and gas produced from the particular oil field subject to the concession agreement and must pay royalties and special participations to the Brazilian federal government, states and municipalities as financial compensation for the exploitation of such oil and gas.

6.5 - Production Sharing Regime

In 2010, the Production Sharing Regime was established by Federal Law No. 12,351/2010. The Production Sharing Regime is a specific regulatory framework for oil and gas exploration and production activities performed in the pre-salt reserve areas defined by the federal government. The pre-salt reserve area is composed of oil and gas deposits located below a thick layer of salt, approximately six thousand meters under the seabed and approximately 300 kilometers off the Southeastern coast of Brazil (Petrobras, 2014).

Under the Production Sharing Regime, a portion of the oil and gas produced is paid to oil and gas companies as compensation for their exploration and production costs, and the remaining production is shared among the federal government and the respective oil and gas companies.

6.6 - Onerous Transfer of Rights Regime

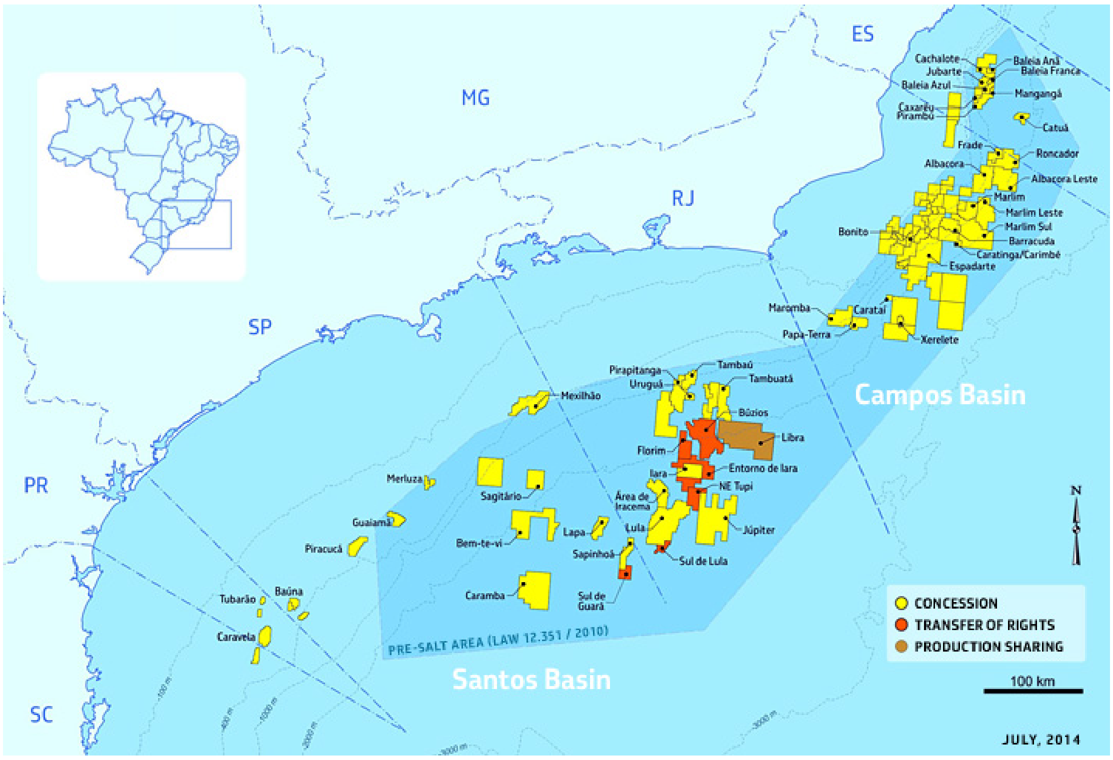
Under the Onerous Transfer of Rights Regime, the federal government granted to Petrobras the right to undertake exploration and production activities in pre-salt areas that are not under the Concession Regime, after due legal permission and through direct contracting (Federal Law No. 12,276/2010).

The criteria and conditions used to determine the values for production done under this regime were set via negotiations between the federal government and Petrobras, based on technical reports issued by international certification entities. Petrobras is responsible to bear all costs and take-on all production risks regarding these areas under the Onerous Transfer of Rights Regime.

6.7 - RJ Oil and Gas Sector

In Brazil, the federal government owns the oil and gas reserves, but Petrobras and private companies can extract it, in accordance with certain forms of participation fees payments, such as royalties and special participations, to the Brazilian federal government, states and municipalities as financial compensation for this exploitation. In RJ, the Concession Regime governed the oil and gas exploration and production activities until 2010, when laws 12,351/2010 and 12,276/2010 were enacted and established, respectively, the Production Sharing Regime and the Onerous Transfer of Rights Regime. Since then, these three regimes have coexisted in Brazil and RJ: Concession, Production Sharing, and Onerous Transfer of Rights.

RJ Oil and Gas Production Regimes – July, 2014



Source: Petrobras 2014.

In 2013, according to ANP, RJ accounted for 72.02% of Brazil’s oil production and 35.51% of its natural gas production. Furthermore, in 2013, RJ had proven oil reserves of approximately 12.4 billion bbls or 79.63% of Brazil’s proven oil reserves and proven natural gas reserves of approximately 257 billion m^3 or 56.14% of Brazil’s proven natural gas reserves.

Campos Basin and the Santos Basins are two sedimentary basins located along the coast of

RJ. The vast majority of Brazil's oil production originates from the Campos Basin and most of the pre-salt discoveries and large untapped reserves are located in the Santos Basin. These relevant fields may continue to increase the importance of the oil and gas sector in RJ over the coming years (ANP, 2013).

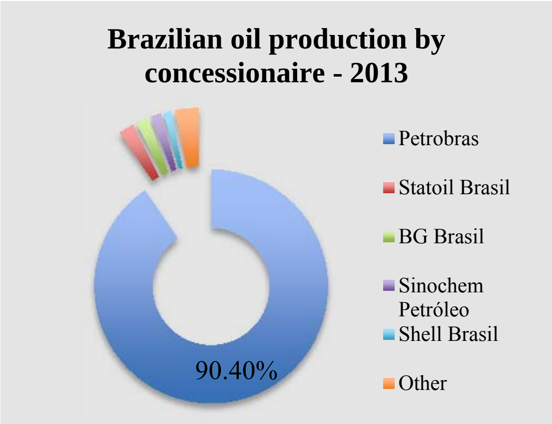
6.8 - Petrobras

Before the enactment of the Petroleum Law, the Brazilian oil and gas sector was controlled by the federal government through Petrobras. After the enactment of the Petroleum Law, Petrobras lost its monopoly over oil and gas production activities and was required to transfer to the ANP certain information and data that the company maintained on Brazilian basins, as well as information associated with research, exploration and production of oil and natural gas, obtained as a result of its exercise of the monopoly (Petroleum Law, Article 31).

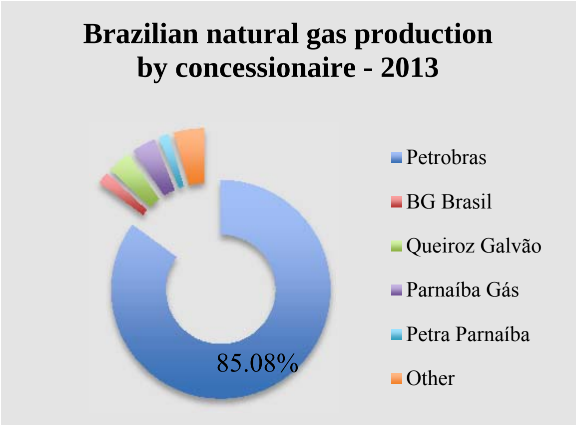
Petrobras entered into concession agreements for each such oil field with the ANP, however, its rights to continue producing oil in fields in which it had production rights prior to the enactment of the Petroleum Law were guaranteed (Petroleum Law, Article 32).

The Brazilian federal government maintains control over Petrobras' investment budget and establishes limits on its investments and long-term debt. As a state-controlled entity, the company must submit its proposed annual budgets to the Ministry of Planning, Budget and Management (MPOG), the Ministry of Mines and Energy (MME) and the Brazilian Congress for prior approval.

In 2013, the principal concessionaire acting in the Brazilian oil and gas sector was Petrobras, which, according to the ANP, accounted for the production of approximately 90.40% of oil and 85.08% of gas produced in Brazil. Thus, Petrobras is the largest payor of royalties and special participations to Rioprevidência.



Source: ANP/SDP as per Decree No. 2,705/1998.



Source: ANP/SDP as per Decree No. 2,705/1998.

6.9 - Royalties

Royalties are characterized as financial compensation due to the federal government, states and municipalities by the oil and gas concessionaires. Each concessionaire must pay royalties to the National Treasury (STN) that in turn distributes these royalties to the beneficiaries. The payments of royalties to beneficiaries must be made no later than the end of the second month following production (Federal Decree No. 1/1991).

Royalties are due by concessionaires in percentages calculated on the actual monthly production volumes and may vary from a minimum of 5% to a maximum of 10%, according to the applicable concession regime (Petroleum Law, Federal Law No. 7,990/1989 and Federal Decree No. 2,705/1998).

The rules for the distribution of royalties to the states, municipalities and the federal government depend on the volume of oil and natural gas that are extracted from onshore and offshore blocks, when the oil and natural gas are extracted from the continental shelf, specifically the seabed and the subsoil of the marine areas that are within 200 miles from the coastline.

The amount of royalties due each month for each concessionaire is determined by multiplying the rate of royalties, the monthly productions of oil and natural gas from the applicable concessionaire and the oil and natural gas reference prices published by ANP for the applicable month (Articles 7 and 8 of Federal Decree No. 2,705/1998).

The formula below depicts this calculation:

$$Royalty = \left(TCP_{oil} \times RP_{oil} + TCP_{gas} \times RP_{gas}\right) \times Rate \qquad (6.1)$$

Where:

- Royalty: is the value in Brazilian Reais (R$) of royalties from concessionaire production in a particular month;
- TCP_{oil}: is the total concessionaire's production in m^3 of oil in a particular month;
- TCP_{gas}: is the total concessionaire's production in m^3 of natural gas in a particular month;
- RP_{oil}: is the reference price of oil produced in a particular month (in R$/1,000$m^3$);
- RP_{gas}: is the reference price of natural gas produced in a particular month (in R$/1,000$m^3$); and
- Rate: is the percentage value that may vary from 5% to 10%.

The reference price to be applied monthly to the oil produced from each concessionaire during the relevant month must be equal to the greater of its international sale price utilized by the concessionaire under normal market conditions and the minimum price for such oil established by the ANP (ANP Ordinance No. 206/2000).

For the international market price of oil is in foreign currency (usually US$), such price must be converted into Brazilian Reais using the average daily Central Bank (BACEN) official exchange rate for this currency during the applicable month. The minimum price of oil extracted by each concessionaire is fixed by the ANP based on the monthly average of a basket of oil prices in the international market.

The international sale price for oil is free on board (FOB) and, therefore, excludes sales taxes and oil shipping costs incurred outside the concession area. However, the international sale price includes transfer costs within a concession area, as the transport costs of oil through pipelines that are owned by the concessionaire.

The reference price to be applied monthly to the natural gas produced from each concessionaire during the applicable month is equal to the weighted average of the sale prices agreed in each natural gas supply agreement entered into by the concessionaire and its respective purchaser of the natural gas. The applicable sale price excludes sales taxes and the natural gas transportation tariff paid by its purchaser (ANP Ordinance No. 45/2000).

6.10 - Special Participations

The special participations is a form of extraordinary financial compensation payable to the federal government, states and municipalities by the concessionaires when a particular concession area has high production volume or is highly profitable (Article 50 of the Petroleum Law regulated by Federal Decree No. 2,705/1998).

The special participations are calculated on the quarterly gross production revenue, less royalties, investments in exploration, operational costs, depreciation and taxes. This revenue is defined as net revenue (NR) for purposes of calculation of special participations. The special participations have progressive rates (PR) ranging between 10% and 40% of net revenue depending upon the location of the production, the number of years of production and the volume of the quarterly audited production (VAP). Furthermore, there is an amount deductible of the quarterly net revenue, the net revenue deductible amount (RDA), that is a function of the tabulated values (TV) by the Federal Decree 2,705/1998, the quarterly net revenue and the volume of the quarterly audited production.

The formulas below depicts this calculation:

$$Special\ Participation = (Net\ Revenue - RDA) \times Progressive\ Rate \qquad (6.2)$$

And,

$$RDA = TV \times NR/VAP \qquad (6.3)$$

Where:

- Special Participation: is the value, in Brazilian Reais (R$), of special participations from concessionaire's net revenue in a particular quarter;

- Net Revenue: is, in Brazilian Reais (R$), the gross production revenue, less royalties, investments in exploration, operational costs, depreciation and taxes from a concessionaire in a particular quarter;

- RDA: is the amount deductible, in Brazilian Reais (R$), of the concessionaire's quarterly net revenue;

- Progressive Rate: is the percentage value, progressive from 10% to 40%, pursuant to Federal Decree No. 2,705/1998;

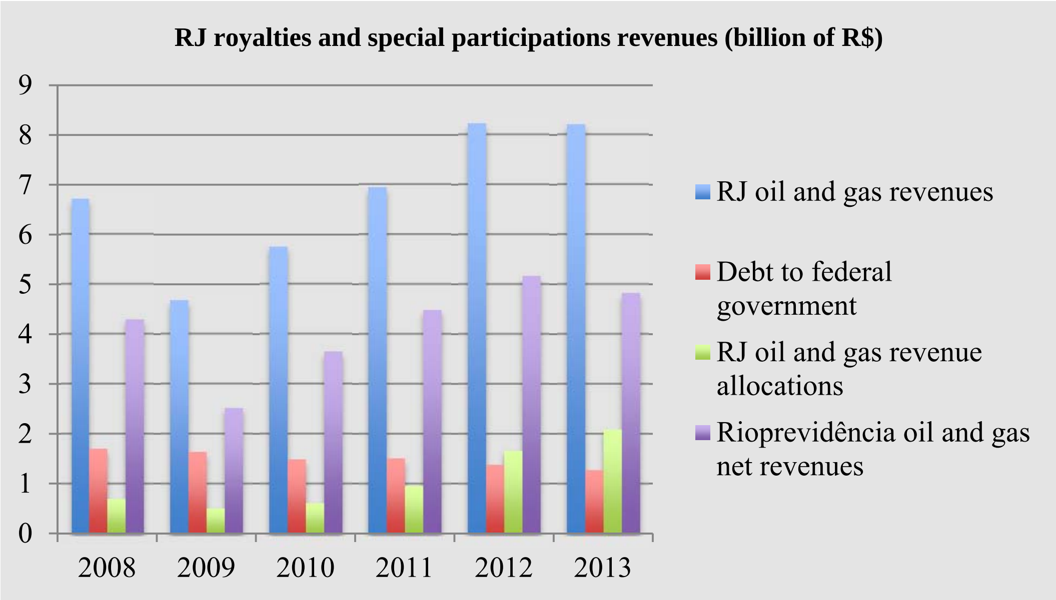
- TV: is the tabulated value, fixed regarding the volume of the concessionaire's quarterly audited production (VAP), pursuant to Federal Decree No. 2,705/1998; and

- VAP: is the volume of the audited production of the concessionaire, in 1,000 m^3 of oil equivalent, in a particular quarter.

6.11 - Royalties and special participations payments to Rioprevidência

According to the current Brazilian applied legislation, a portion of the RJ's oil and gas revenues derived from oil and gas exploitation by the concessionaires is required to be allocated to each of the municipalities within RJ, to the Program for the Formation of Assets of Public Servants (PASEP), to State Fund for Environmental Conservation and Urban Development (FECAM) and to the federal government in repayment of certain indebtedness owed by RJ.

The chart below shows certain information in regards to the RJ royalties and special participations revenues and to Rioprevidência oil and gas revenues and the legal allocations above in the last fiscal years.



Source: *Ofício* SEFAZ/SGAB No.864/2014, prepared by the Secretary of Finance of RJ.

7 – Quantitative and Empirical Section

7.1 - General Framework

As discussed previously, Brazilian social security actuarial and financial problems have received widespread attention from researchers and policymakers due to its unsustainability over the long-term. The main purpose of this section is to analyze the achievement of financial and actuarial balance of RJ's social security system in the medium-and-long-term, through the transition from a social security system (Financial Fund) based on a pay-as-you-go system to the constitution of a social security system (Social Security Fund) on a fully funded basis.

According to Rosen and Gayer (2014), an actuarial fair return system is an insurance plan that on average pays out the same amount that it receives in contributions. Thereby, an actuarial and financial balance can be defined as the collection of contributions to build up mathematical reserves at a level sufficient for the payment of present and future benefits. The bifurcation of RJ's Special Social Security Scheme (RPPS-RJ) into two segregated funds, together with the creation of the complementary retirement and pension fund, are expected to solve its social security actuarial deficit over the long-term due to the self-sustaining nature of both funds, Social Security Fund and RJPREV Fund, and the decrease over time of the Financial Fund's liabilities as there will be no new entrants to this fund.

7.2 - Database and Economic Assumptions

The analysis in this work principally uses the database and the economic and demographic assumptions of the Report of Actuarial Evaluation Results (DRAA) – 2014 from RPPS-RJ. According to this report, the base date of the database is December 30, 2013.

The database used in this work contains information of active employees, retirees and pensioners of RJ. Its technical basis relies on the current legislation[6] and several premises, assumptions and mathematical techniques that integrate the actuarial evaluation calculation (DRAA – 2014/RPPS-RJ).

Additional assumptions were used in this section for the sake of simplicity, such as setting the mass segregation's cutting-line[7] on December 31, 2013 and the distribution of social security compensation revenues over time in proportion to the annual amount of active employees of each fund.

The following table shows the assumptions adopted by the DRAA of RPPS-RJ.

Assumptions used (per year)	
Real interest rate[8]	6.00%
Inflation rate	0.00%
Real wage growth rate[9]	1.00%
Real beneficy growth rate	0.00%
Turnover ratio[10]	1.00%
Administrative fee tax rate	0,61%
New employees	Yes
Social Security compensation[11]	Yes

Source: DRAA – 2014/RPPS-RJ

Tables	
Mortality table	AT-49
Life Expectance table	IBGE-2011
Disablement table	Alvaro Vindas
Mortality table for disabled	IBGE-2011

Source: DRAA – 2014/RPPS-RJ

6 Constitutional Amendments No. 20/1998, No. 41/2003, No. 47/2005 and No. 70/2012, Federal Laws No. 9,717/1998 and No. 10,887/2004 and MPS Ordinances No. 204/2008, No.402/2008, No. 403/2008.

7 Actually, the cutting-line is September 4, 2013.

8 According to the Article 9 of MPS Ordinance No. 403/2008, the real interest rate of DRAA actuarial calculation can not exceed 6% per year.

9 According to the Article 8 of MPS Ordinance No. 403/2008, the real wage growth of DRAA should have a minimum increase of 1% per year.

10 According to the Article 8 of MPS Ordinance No. 403/2008, the DRAA maximum turnover rate is 1% per year.

11 Contributions from General Social Security Scheme (RGPS) and other Special Social Security Schemes (RPPS).

7.3 - Algebraic Principles Applied to the Financial Fund (pay-as-you-go-system)

To understand how a social security system in a pure pay-as-you-go basis works, it is important recall that under this system the benefits received by retirees and pensioners in a given year come from contributions made by current employees in this given year (Rosen and Gayer, 2014). According to Caetano (2006), the contributions paid by current employees in a given year are the product of the contribution rate (τ), the number of current active employees (L_t), and the average wage per current active employee in this given year (W_t). On the other side, the total benefits in a given year are de product of the number of beneficiaries (A_t) in this year and the average benefit per employee in this same year (B_t). Hence, the actuarial and financial solvency requires that:

$$\tau \times W_t \times L_t \geq B_t \times A_t \qquad (7.1)$$

Where:

- τ: is the average contribution rate of the social security system in a given year;
- W_t: is the average wage per current active employee in a given year;
- L_t: is the average number of current active employees in a given year;
- B_t: is the average benefit per current active beneficiary in a given year; and
- A_t: is the average number of beneficiaries in a given year.

By rearranging these terms, it is possible to see that:

$$\tau \times \frac{W_t}{B_t} \geq \frac{A_t}{L_t} \qquad (7.2)$$

Where:

- $\frac{B_t}{W_t}$: is the replacement ratio of the social security system; and
- $\frac{A_t}{L_t}$: is the dependency ratio of the social security system.

The second term on the left-hand side is the inverse of the replacement ratio (B_t/W_t). The replacement ratio is the ratio of the average benefits (B_t) to the average active employees wages (W_t) in a given year. The term on the right-hand side is the dependency ratio (A_t/L_t). The dependency ratio is the number of beneficiaries (A_t) to the number of active employees (L_t) in a given year.

From inequation (7.2), it is possible to observe three determinants on the long-term sustainability of a social security system on a pay-as-you-go basis: the contribution rate, the replacement ratio and the dependence ratio.

In 2013, the dependence ratio of Special Social Security Scheme (RPPS) from RJ was about 1.01, which means that there was roughly one beneficiary for every active employee. In 2020 the expected dependence ratio is 1.15, which means there will be less active employees supporting each beneficiary.

The replacement ratio is the relationship between the average value of benefits and the average wage of the active employees. In 2013, the replacement ratio of RJ's Special Social Security Scheme (RPPS) was 1.04, which means that the beneficiaries received in average more than the current active employees.

The table below shows the total and the average monthly earnings by each segment of RPPS-RJ in 2013.

Segment	Total monthly earnings (R$)	Participants	Average monthly earnings (R$)
Active Employees	771,313,417.87	223,586	3,449.74
Retirees	581,528,103.91	156,242	3,721.97
Pensioners	225,170,725.22	69,190	3,254.38
Beneficiaries (Retirees and Pensioners)	806,698,829.13	225,432	3,578.46
RPPS-RJ	**1,578,012,247.00**	**449,018**	**3,514.36**

Source: DRAA – 2014/RPPS-RJ

To emphasize the source of the RJ's social security system unsustainability, let's rearrange the inequation (7.1) again:

$$\tau \times \frac{W_t}{B_t} \times \frac{L_t}{A_t} \geq 1 \qquad (7.3)$$

Translating this mathematical equation in words, in order for a social security system based in a pay-as-you-go basis be sustainable, the contribution rate divided by the product of the replacement ratio and the dependence ratio must be greater than or equal to one. In other words, what matters for the social security system sustainability in the long-term is the behavior of these three variables together over time. According to Caetano (2006b), the left-hand side of inequation (7.3) can be understood as the sustainability index to this social security system. In 2013, the sustainability index related to the RJ's Special Social Security Scheme (RPPS) was 0.32.

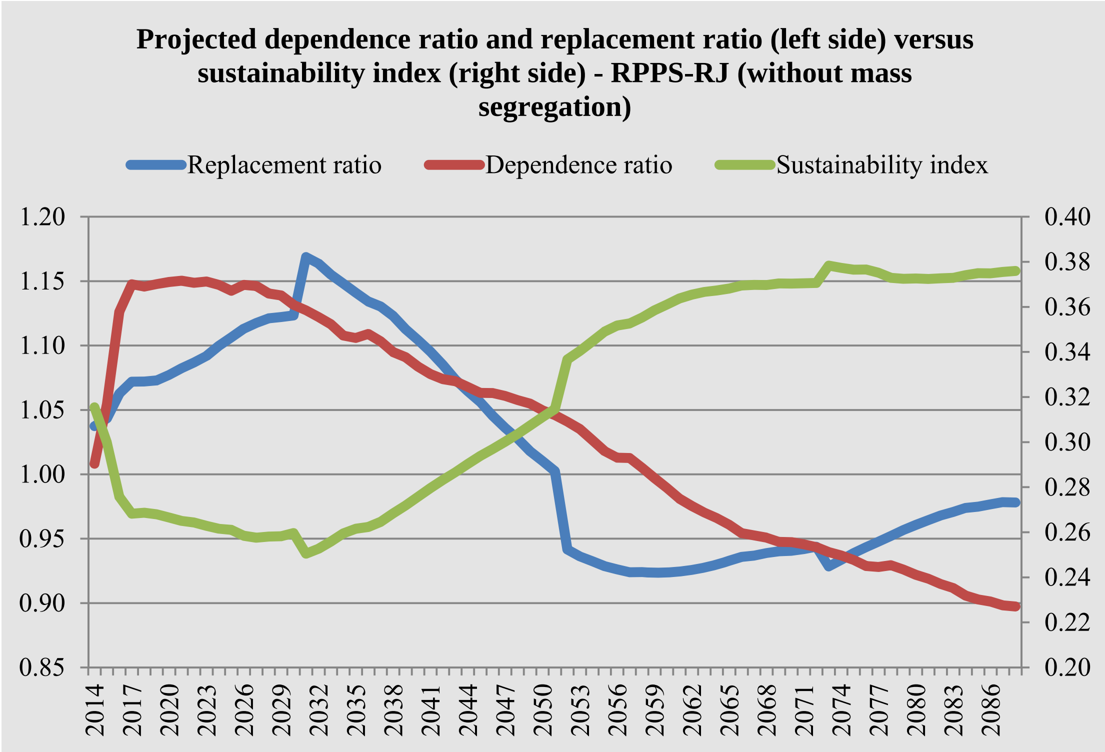
The table below summarizes these variables related to the RJ's Special Social Security Scheme (RPPS) in 2013, as well as the sustainability index to this system.

RPPS-RJ 2013 - Variables	
Contribution rate	33%
Dependence ratio	1.01
Replacement ratio	1.04
Sustainability index	0.32

Source: DRAA – 2014/RPPS-RJ

7.4 - The effects of mass segregation to RPPS-RJ

The chart below simulates the projected dependence ratio, replacement ratio and sustainability index for the Special Social Security Scheme (RPPS) of RJ over time, without the adoption of mass segregation.



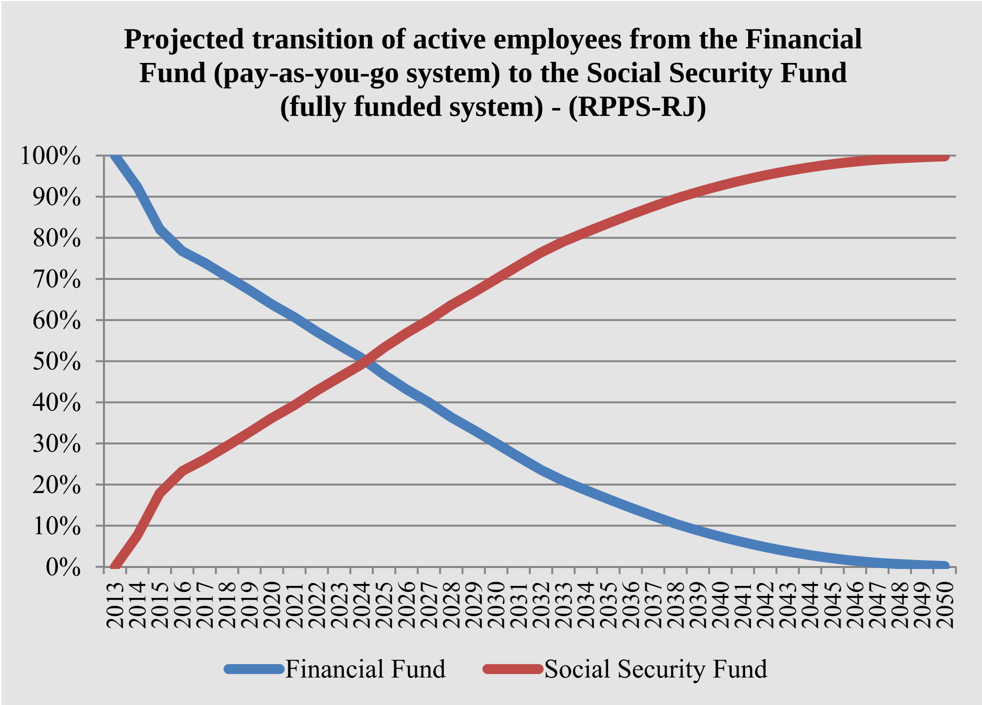
Source: DRAA – 2014/RPPS-RJ

The chart above illustrates two interesting statements. The first is that, without the adoption of mass segregation, the sustainability index projected for the RPPS-RJ would not be sustainable in the long-term. The second statement illustrated is the inverse relationship between the sustainability index and both the replacement ratio and the dependence ratio.

7.5 - The Transition Cost

The adoption of mass segregation will decrease the Financial Fund's liabilities over time, as there will be no new entrants to this fund. However, an objection to mass segregation arises from the fact that, after its adoption and over time, RJ's social security contributions will be directed toward the Social Security Fund and than RJ's social security system will not receive sufficient revenue to pay current benefits.

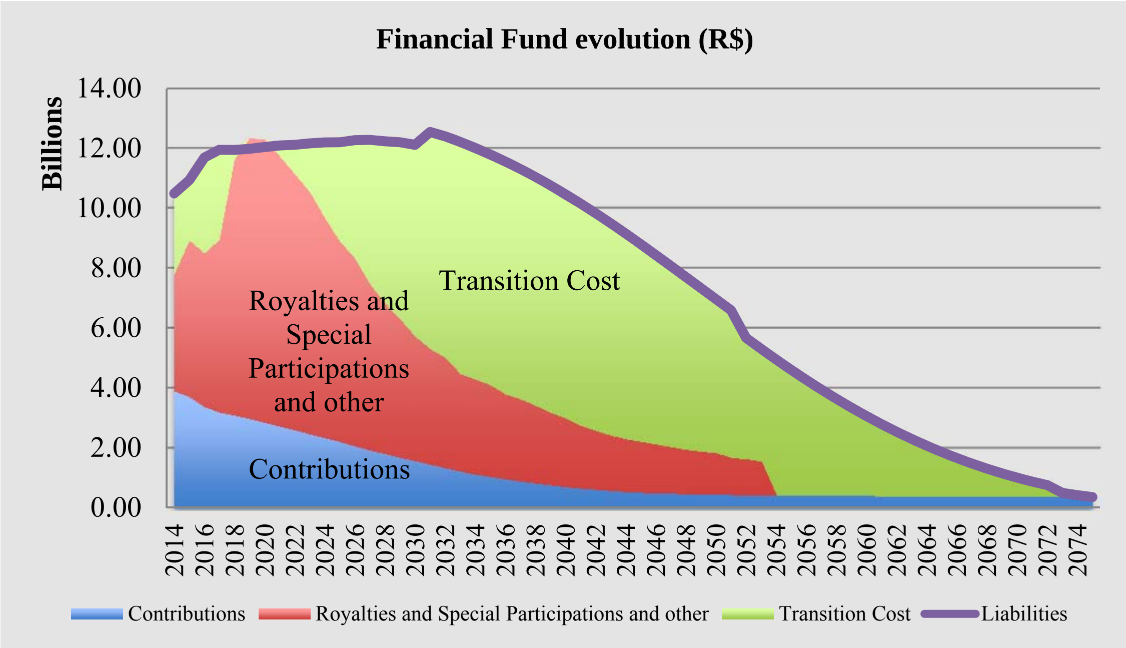
The chart below shows the projected transition of RJ's active employees from the Financial Fund (pay-as-you-go system) to the Social Security Fund (fully funded system) over time.



Source: DRAA – 2014/RPPS-RJ

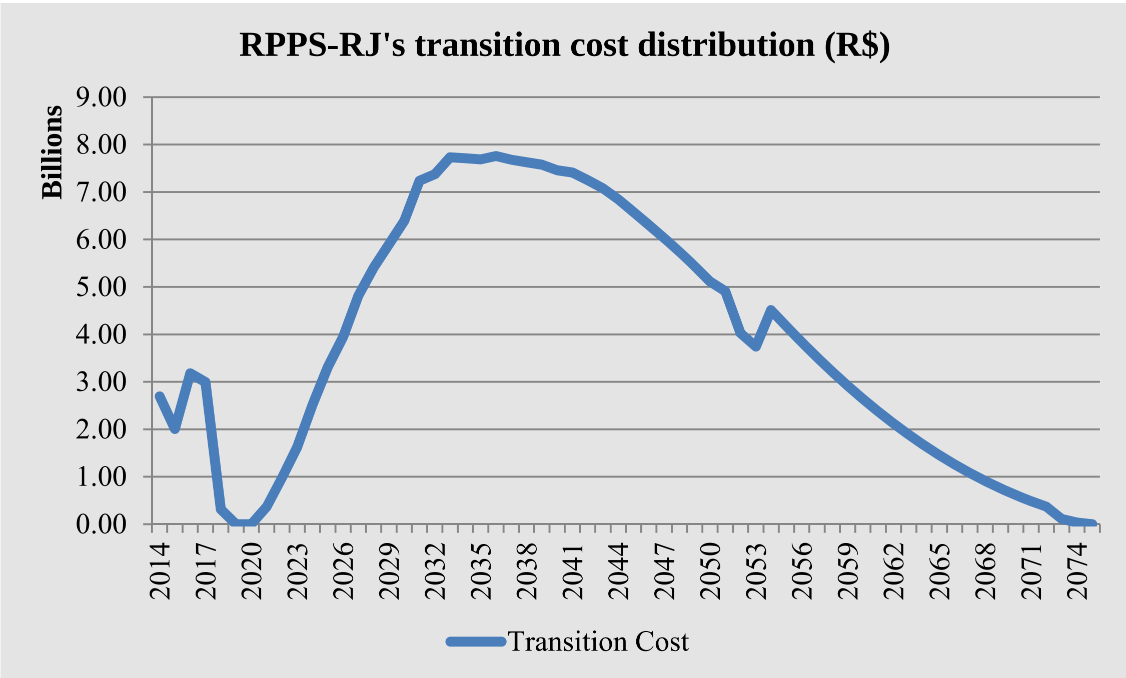
This chart tells us that the transition will be completed around the year 2050, when the employees from the Social Security Fund will account for the totality of the current employees. After the year 2025, the employees from Social Security Fund are expected to be greater than the employees from Financial Fund.

Formally, RPPS-RJ's transition cost can be defined as the difference between the projected expenditures with benefits and the projected revenues from contributions and royalties and special participations to the Financial Fund over time. The chart below depicts the expected decrease of the Financial Fund as well as the expected amounts of its components over time.



Source: RDAA – 2014/RPPS-RJ

The chart below shows the distribution over time of RPPS-RJ transition cost:



Source: RDAA – 2014/RPPS-RJ

8 – Conclusions

Social security is the second largest governmental function expenditure from the State of Rio de Janeiro (RJ). From the standpoint of actuarial and financial solvency, the evidences in this work suggest that the reform on the social security system that occurred in Brazil enhanced the long-term sustainability of RJ's social security system.

After the social security reform, RJ adopted two important changes in its Special Social Security Scheme (RPPS) legislation: mass segregation (RJ Law No. 6,338/2012) and the creation of RJPREV, a complementary retirement and pension fund (RJ Law No. 6,243/2012).

Through mass segregation, the assets and liabilities of Rioprevidência were split into two independent funds – the Financial Fund, on a pay-as-you-go system and the Social Security Fund, on a fully funded system. Furthermore, the creation of RJPREV, the complementary retirement and pension fund, limited the benefits payable to the same ceiling as set by the General Social Security Scheme (RGPS), reinforcing the sustainability of this new fully funded system.

Despite the actuarial and financial long-term benefits of mass segregation, RJ will be required to pay a transition cost, providing additional funding to the Financial Fund in the short-and-medium-term, because the contribution base from new employees will be reduced over time as all employees hired will contribute to the Social Security Fund. The transition cost is a key element that should be administered in the long-term planning of RJ.

RJ is currently Brazil's largest state producer of oil and gas and receives royalties and special participations from the oil and gas concessionaires as a financial compensation for this exploitation. As these revenues are capitalized in Rioprevidência, the transition cost of social security system has its long-term performance strongly linked to that of the Brazilian oil and gas sector.

As exposed in this work, the revenues from royalties and special participations are subject to the world oil and gas market price, the exchange rate and the amount of oil and gas production within the territory of RJ. Thus, RJ's royalties and special participations revenues are vulnerable to shocks. When these shocks are taken together with short-run rigidities and high costs of adjustment, the expected result is a high volatility in these revenues.

Therefore, RJ's social security system has a high dependence on revenues from royalties and special participations. Additionally, this high dependence is mainly concentrated in a single concessionaire, Petrobras, the Brazilian state-owned oil and gas company. As Petrobras' controlling shareholder, the Brazilian federal government may engage Petrobras in activities that give preference to the objectives of the Brazilian federal government rather than Petrobras' own economic and business objectives.

Despite the difficulty of predicting the transition cost behavior in the long-term, because of the high volatility of royalties and special participations revenues, some answers regarding the RJ's social security transition from the pay-as-you-go system to the fully funded system were obtained in this work.

Through the framework exposed in the quantitative and empirical section, is possible project that around 2050 all the active employees will be linked to the Social Security Fund. In other words, the active employees transition from the pay-as-you-go system to the fully funded system will be complete around 2050.

Furthermore, is possible to project that the Financial Fund, based on a pay-as-you-go system, will have its liabilities extinct around 2075. After the extinction of the Financial Fund, the long-term sustainability of the social security system of RJ is expected to be achieved due to the self-sustaining nature of the Social Security Fund.

Thus, mass segregation and the creation of RJPREV are useful components of the comprehensive overhaul of the RJ's social security system, but by themselves it is unlikely to eradicate the projected actuarial and financial deficit for this system in the long-term.

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