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**PREVIDÊNCIA DOS SERVIDORES PÚBLICOS E CONCENTRAÇÃO DE RENDA:
TEORIA E EVIDÊNCIAS EMPÍRICAS PARA OS MUNICÍPIOS BRASILEIROS NO
PERÍODO 2000 A 2010**

**Porto Alegre
2018**

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Dissertação apresentada ao Programa de Pós-Graduação em Economia, da Faculdade de Ciências Econômicas da UFRGS, como quesito parcial para a obtenção do título de Mestre em Economia, com ênfase em Economia Aplicada.

Orientador: Prof. Dr. Giacomo Balbinotto Neto

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Todas las teorías son legítimas y ninguna tiene importancia.

Lo que importa es lo que se hace con ellas.

– Jorge Luis Borges

RESUMO

O objetivo desta dissertação é investigar a relação entre Previdência Social e distribuição de renda, com enfoque nos Regimes Próprios de Previdência para servidores públicos municipais brasileiros (RPPS) no período entre os Censos de 2000 e 2010. Para tanto, são apresentados dois ensaios complementares. O objetivo do primeiro é indicar que os regimes públicos de aposentadoria podem ser compreendidos como ferramentas para distribuição de renda. Inicialmente, apresentam-se as características básicas dos regimes de previdência atualmente encontrados no mundo, as modificações em curso e as justificativas para a manutenção desta política. Por meio de revisão bibliográfica de estudos econômicos relevantes, propõe-se que uma das funções da Previdência Social é a redistribuição de rendimentos. Assim sendo, parte-se para o segundo ensaio, focado na Previdência Social brasileira e seu impacto distributivo, tendo como objetivo central apresentar e testar a hipótese de que a criação de RPPS municipal, segundo as regras brasileiras, ocasionaria um aumento nos índices de concentração de renda no respectivo município. As características institucionais dos regimes de previdência são exibidas, com especial interesse na diferença existente entre as regras de aposentadoria aplicadas aos trabalhadores dos setores público e privado. Posteriormente, é apresentada uma revisão dos trabalhos empíricos tratando do tema, cujos resultados indicam que a previdência brasileira possui características regressivas. Com base nas características do sistema brasileiro, uma proposição teórica e um exercício de simulação são efetuados, embasando a hipótese de que a criação de RPPS causaria uma piora no índice de Gini do município. Tal hipótese é testada por meio do método diferença-em-diferenças, considerando a variação nos índices de concentração de renda (Gini e Theil-L) como variável dependente e a criação do RPPS como variável explicativa, juntamente a uma série de covariáveis. Os resultados empíricos não validam a proposição e podem ser considerados robustos, indicando que, para o período 2000-2010, não foram encontradas evidências de que a criação de RPPS aumentou a concentração de renda, possivelmente em face de efeitos indiretos e diretos atuando em sentido contrário. Todavia, considerando os dados existentes, a estratégia empírica possibilitou uma avaliação inédita sobre o tema. Em conclusão, sugere-se a repetição das análises após a divulgação dos dados censitários de 2020, a fim de avaliar se as tendências verificadas se manterão. Adicionalmente, os dados existentes permitem a utilização de outros métodos estatísticos quase-experimentais, cujos resultados poderão ser comparados aos apresentados por esta dissertação.

Palavras-chave: Previdência social. Distribuição de renda. Diferença em diferenças.

Classificação JEL: I38, D31, C23.

ABSTRACT

This dissertation aims to investigate the relationship concerning Social Security and income distribution, focusing on the special retirement regimes for civil servants in Brazil (RPPS) in the period between the years 2000 and 2010. In order to do so, two correlated essays are presented. The first study indicates that public retirement schemes can be understood as a policy to distribute income. Initially, the study displays the basic characteristics of modern Social Security, the reform trends and reasons to maintain such policies displayed. After presenting a literature overview of relevant economic studies, it proposes that one of the economic functions of Social Security is income redistribution. This conclusion sets the stage for the second essay, focused on Social Security in Brazil and its distributive impacts. The central hypothesis is that the institution of a municipal RPPS, following Brazilian rules, would cause an increase in income concentration in the respective city. Firstly, we present the institutional features of the pension schemes, with special interest in the differences between retirement rules applied to public and private workers. Later, a literature review is displayed, showing that most studies indicate the existence of regressive effects in Brazilian Social Security. Based on the features of the system as perceived in Brazil, we propose theoretical and simulation exercises in order to justify the hypothesis that creating RPPS would increase the local Gini index. A difference-in-differences estimation is performed to test such hypothesis. It considered income concentration indexes (Gini and Theil-L) as dependent variables and the institution of RPPS as independent, as well as a series of covariates. The empirical results indicate that the institution of RPPS between 2000 and 2010 did not increase income concentration and such finding can be considered robust. Empirical evidence on the impact of creating the special regime does not corroborate the central hypothesis, possibly as a result of direct and indirect effects acting in opposite directions. Nevertheless, considering the existing data, the empirical strategy adopted enabled for a different evaluation than previous studies on the subject. As a conclusion, we suggest the repetition of the analysis after the disclosure of data from 2020 Brazilian Census aiming to investigate if the trends estimated in this study will maintain themselves. Additionally, the currently available data allow for the implementation of other quasi-experimental methods, which would enable comparison of outcomes against the findings presented in this dissertation.

Keywords: Social security. Distribution of income. Difference in differences.

JEL Codes: I38, D31, C23.

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LIST OF ABBREVIATIONS AND ACCRONYMS

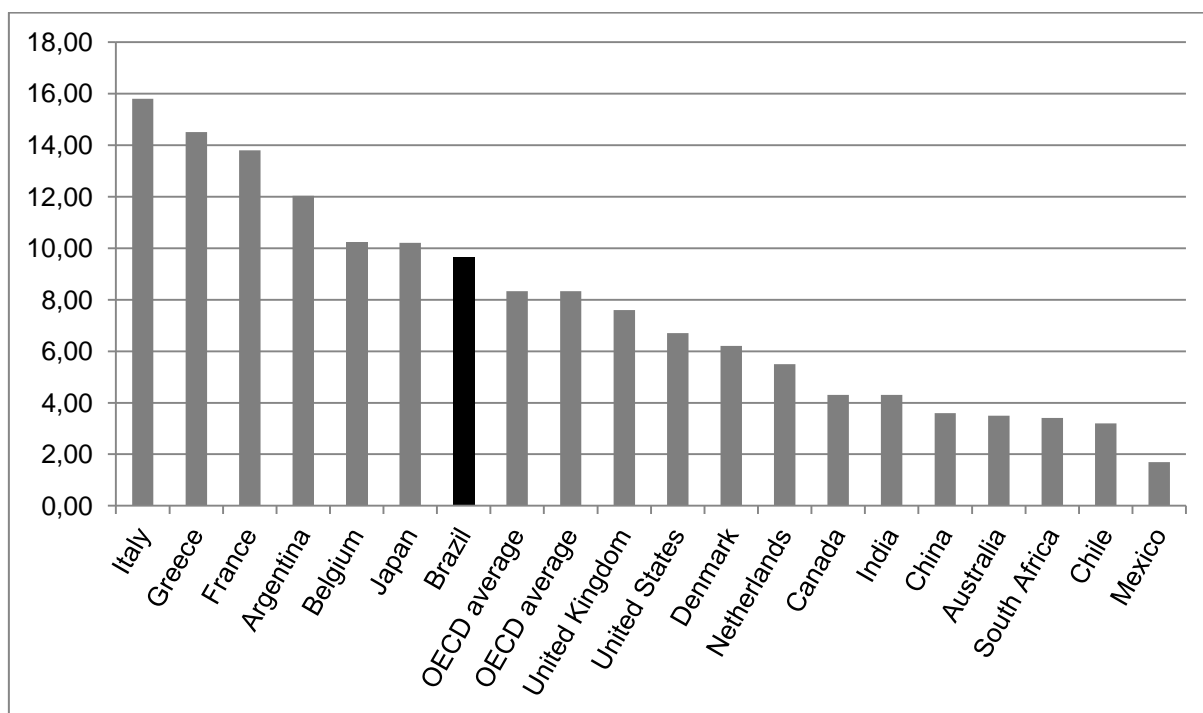
BRICS	Brazil, Russia, India, China and South Africa
DB	Defined benefit pension
DC	Defined contribution pension
FE	Fixed effects estimator
GDP	Gross Domestic Product
IBGE	Brazilian Institute of Geography and Statistics
ILO	International Labor Organization
IMF	International Monetary Fund
INSS	National Social Security Institute (<i>Instituto Nacional de Seguridade Social</i>)
IPEA	Instituto de Pesquisa Econômica Aplicada
MPS	Social Security Ministry (<i>Ministério da Previdência Social</i>)
NDC	Notional defined contribution pension
OECD	Organization for Economic Co-operation and Development
OLG	Overlapping Generations
OLS	Ordinary least squares
PAYG	Pay-as-you-go retirement scheme
PIB	Produto interno bruto
PNAD	Brazilian National Sample Survey of Households (<i>Pesquisa Nacional por Amostra de Domicílios</i>)
RPPS	Social Security Specific Regime (<i>Regime Próprio de Previdência Social</i>)
TSE	Tribunal Superior Eleitoral
UK	United Kingdom
UN	United Nations
US	United States
WB	World Bank

APRESENTAÇÃO

O objetivo desta dissertação é analisar as relações existentes entre dois temas que ocupam uma posição de destaque nas discussões da ciência econômica: Previdência Social e desigualdade de renda. Para tanto, dois ensaios foram desenvolvidos, buscando investigar se sistemas públicos de aposentadoria podem ser vistos como instrumentos para redistribuição de renda e, posteriormente, avaliar o impacto dos Regimes Próprios de Previdência Social brasileiros (RPPS) frente à concentração de renda nos municípios brasileiros para o período 2000-2010.

Os sistemas de Previdência Social são objeto de discussão permanente em economias democráticas. Tais Estados, via de regra, buscam políticas cujos objetivos são proporcionar bem-estar à população. Contudo, os regimes de previdência tornaram-se o maior componente nos orçamentos fiscais da maior parte dos países desenvolvidos e em diversos países em desenvolvimento, como o Brasil. O gráfico abaixo indica a importância dos gastos com previdência dos governos centrais em comparação ao Produto Interno Bruto para uma seleção de países.

Chart A – Gasto com Previdência Social em 2015 ou dado mais recente (% do PIB)



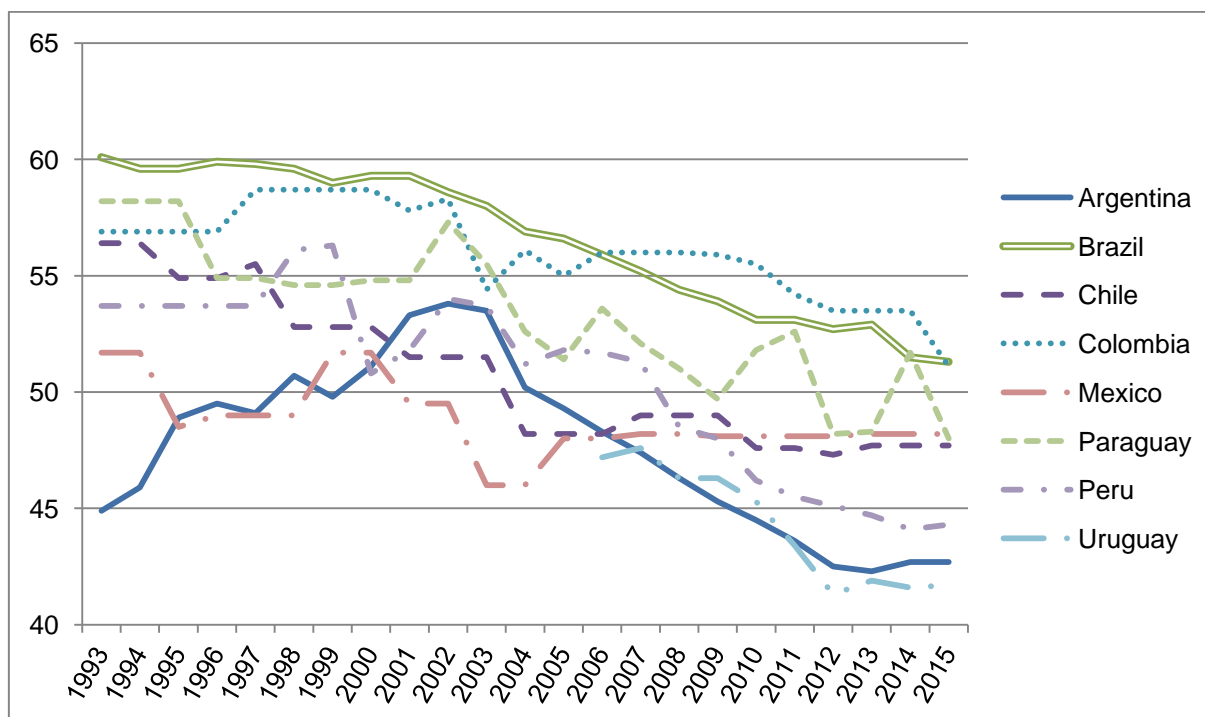
Fonte: banco de dados do Banco Mundial (World Bank, 2016), elaborado pelo autor.

Frente a esses dados, torna-se essencial investigar os impactos da Previdência Social para a economia, avaliando a pertinência de se manter tais regimes. Nesse sentido, Diamond (1977) propõe que os sistemas públicos de aposentadorias e seguridade social, dentre outras potenciais funções econômicas, podem agir como instrumento de redistribuição de renda na sociedade.

Atualmente, a redução nos níveis de desigualdade de renda ocupa posição proeminente nas agendas contemporâneas de desenvolvimento. Segundo o Banco Mundial (WB) (World Bank, 2016, p. 70), evidências empíricas sugerem fortemente que políticas públicas que contribuem para uma melhor distribuição de recursos podem auxiliar no crescimento econômico e na prosperidade de longo prazo. Assim sendo, uma relevante justificativa para a existência de sistemas de Previdência Social passa a ser também seu impacto redistributivo.

No que tange à distribuição de rendimentos entre os indivíduos, o Brasil segue apresentando um dos mais altos níveis de desigualdade de renda no mundo, conforme medido pelo Índice de Gini. Os avanços verificados no presente século não foram suficientes para colocá-lo em destaque em comparação a seus vizinhos regionais, como pode ser visto no gráfico a seguir.

Chart B – Evolução do Índice de Gini entre países sul-americanos selecionados



Fonte: banco de dados do Banco Mundial (World Bank, 2016), elaborado pelo autor.

Nesse sentido, esta dissertação tem dois objetivos centrais e relacionados, sendo, assim, estruturada por dois ensaios. O primeiro apresenta uma revisão das diferentes formas de organização dos sistemas de aposentadorias no mundo, descrevendo os arranjos institucionais dos sistemas de Previdência Social e as proposições teóricas sobre o tema com o objetivo de destacar a importância deste programa como ferramenta para redistribuição de renda. Para chegar a este resultado, procedeu-se a uma revisão da literatura econômica relevante sobre o tema, buscando uma análise normativa do assunto.

É importante ressaltar que avaliar os aspectos distributivos da Previdência Social implica uma alteração de foco nas análises sobre o assunto, vez que, inicialmente, reconhecia-se como único objetivo dos sistemas de previdência a manutenção do padrão de consumo dos indivíduos quando sua capacidade laborativa se esgotava.

O segundo ensaio, por sua vez, direciona seu foco ao caso brasileiro e tem como objetivo principal realizar uma avaliação dos impactos distributivos ocasionados pela instituição de regras de aposentadoria distintas para empregados públicos e privados nos municípios brasileiros entre 2000 e 2010. A hipótese central é a de que a criação de um regime de previdência especial para os servidores públicos municipais, seguindo as regras autorizadas pela legislação brasileira, aumentaria os índices de concentração de renda do município em questão.

Para tanto, apresenta-se, inicialmente, uma síntese da forma de organização do sistema de previdência no Brasil e uma revisão da literatura empírica sobre os impactos distributivos dos regimes. Adicionalmente, com base nas características institucionais específicas do caso brasileiro e considerando a inexistência de um modelo formal específico, propõe-se uma análise teórica e uma simulação dos impactos potenciais considerando as características institucionais dos regimes atualmente vigentes.

Posteriormente, utilizando-se dos dados censitários do Instituto Brasileiro de Geografia e Estatística (IBGE), bem como outras informações disponibilizadas pelo Ministério da Previdência Social (MPS) e outras instituições oficiais, será avaliado o impacto da criação de Regime Próprio de Previdência Social (RPPS) na distribuição de renda dos municípios. O método utilizado é diferenças-em-diferenças, o qual

busca estimar o efeito causal da instituição de tal regime frente aos indicadores de concentração de renda calculados com base nas avaliações censitárias. Por fim, discutem-se os resultados obtidos e suas implicações.

A estratégia empírica adotada objetiva contornar o problema ocasionado pela existência de informação na Pesquisa Nacional de Amostra a Domicílio (PNAD) quanto à fonte pagadora das rendas de aposentadoria. Assim, o método mais utilizado em estudos precedentes, a decomposição dos índices de concentração de renda, somente avalia diretamente a participação da Previdência Social brasileira como um todo na distribuição de rendimentos familiares ou individuais.

Com o presente trabalho, busca-se estimar o impacto exclusivo da diferenciação de regras previdenciárias entre trabalhadores públicos e privados, considerado por alguns cientistas como o principal motivo para explicar os resultados segundo os quais a previdência brasileira gera resultados regressivos (FERREIRA, 2006, p. 259; HOFFMANN, 2009, p. 224).

Espera-se, assim, fornecer justificativas para a compreensão da Previdência Social como ferramenta de redistribuição de renda e elementos objetivos que contribuam com a perene discussão acerca do sistema de aposentadoria brasileiro, bem como indicações de futuros trabalhos que possam aprofundar o entendimento sobre os efeitos econômicos e sociais de tais regimes.

Considerando que os ensaios foram redigidos na língua inglesa, um esclarecimento prévio faz-se necessário. O termo *Social Security* deve ser lido como Previdência Social, e não conforme sua tradução literal, “seguridade social”. Isto, porque, a legislação brasileira adotou um conceito de seguridade social – incluindo saúde e assistência social – diferente daquele usualmente utilizado pela literatura econômica – o qual diz respeito a aposentadorias (por idade, tempo de trabalho, invalidez ou vulnerabilidade social) e pensões.

Assim sendo, os gastos com Previdência Social no Brasil, seguindo os trabalhos referenciados nesta dissertação, compreenderiam os benefícios pagos pelo Instituto Nacional de Seguridade Social (INSS) e RPPS adicionados ao Benefício de Prestação Continuada (BPC-LOAS), não gerenciados pelo INSS.

Adicionalmente, sugere-se a leitura do Apêndice A, que trata da nomenclatura pertinente ao tema. Feitos estes esclarecimentos, espera-se reduzir eventuais problemas terminológicos que possam afetar a compreensão dos ensaios.

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1 ENSAIO I: SOCIAL SECURITY AROUND THE WORLD: INSTITUTIONAL FEATURES AND DISTRIBUTIVE CONSEQUENCES

Current chapter comprises the first essay of the dissertation.

1.1 INTRODUCTION

Social Security has been a frequent theme of discussion in the past decades. Not only economists in particular and social scientists in general have shown interest in this matter, but policymakers and supranational institutions also have devoted technical and political efforts regarding the subject. Both academics and technicians aim to address the current and future challenges imposed by demographic changes and its impact on retirement in order to enhance general well-being of the elderly and the society as a whole.

Nevertheless, according to Barr and Diamond (2009, p. 6), it's misleading to call the current status of Social Security worldwide as product of a crisis. On the contrary, the authors propose that the so called "ageing problem" is in fact a triumph, as human beings are living longer. The main cause of the financial problems in the systems, according to the authors, is a failure to adapt to long-term trends.

Aware of that matter, the majority of the countries – especially among the developed world – have conducted reforms in their pension systems aiming mainly for long term sustainability. Although tackling the financial problems of Social Security is essential, any proposed reform should realize that the system impacts the society through different aspects, meaning that the subject must be analyzed using broad lenses (BARR; DIAMOND, 2009).

On that regard, the main objective of the present study is to emphasize that Social Security analyses should focus on the income redistributive consequences of the systems. In order to do so, it is needed to demonstrate how the initial purpose of Social Security – the maintenance of individual consumption during old age – is not the only economic justification for keeping public retirement schemes. Once these systems help to mitigate relevant problems such as income concentration, market failures, and insufficient savings, Social Security can be seen as arguably the most relevant public policy regarding directly to the general wellbeing of the society.

Intending to display the distributive aspects of the institutional features concerning Social Security around the globe, the current work will present a brief history of retirement systems and relevant data to contextualize the current state of the subject. In the sequence, we'll summarize the different Social Security arrangements found worldwide, presenting architectural features and differences in the calculations of benefit and in the form of financing the systems, among other characteristics.

Later, the economic functions of Social Security will be presented, concentrating in the distributional aspects of the systems, as already mentioned. Finally, a literature overview with theoretical works on the effects of Social Security on income redistribution will be summarized, followed by concluding remarks.

Additionally, in order to facilitate the comprehension of the present work, the main terms used relating to Social Security are summarized in Annex 1. The definitions are in accordance to Barr and Diamond (2009, p. 2-3), Pallares-Miralles, Romero and Whitehouse (2012, p. 201-205), and Whitehouse (2016).

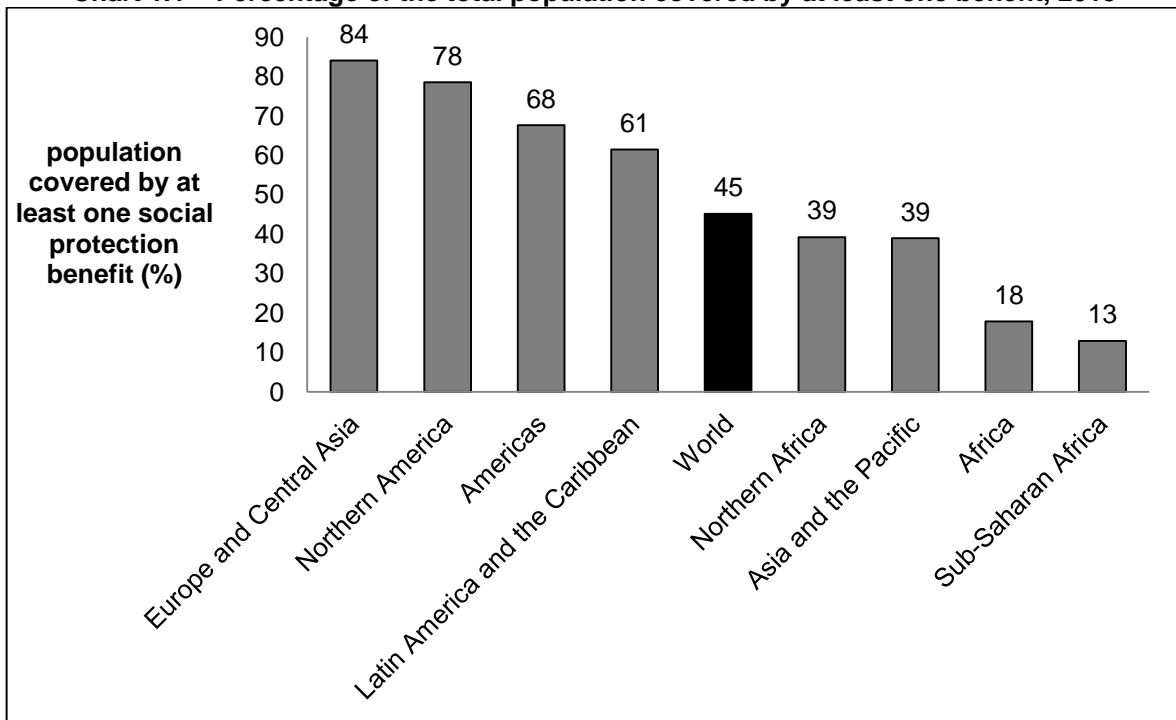
1.2 SOCIAL SECURITY AROUND THE WORLD

The existence of public security systems that assure an income to the elderly and those unable to provide for themselves is the norm in the world of today. According to data collected by the International Labor Organization (ILO), ninety seven per cent of countries in the world maintain old-age pension scheme anchored in national legislation providing periodic benefits. That figure means that only six countries do not possess any form of cash transfer program to the elderly (ILO, 2017, p. 78).

Nonetheless, these data can be misleading. Even though it may appear positive to notice that the absolute majority of the countries developed old age retirement plans for its citizens, the fact that the percentage of the population covered by these systems vary heavily among the different parts of the world is concerning. The next chart illustrates this situation.

As indicated by the figures in Chart 1.1 and stressed by ILO (2017, p.1), fifty five per cent of the world population is not covered by any form of state provided social protection, a figure that accounts for approximately four billion people worldwide.

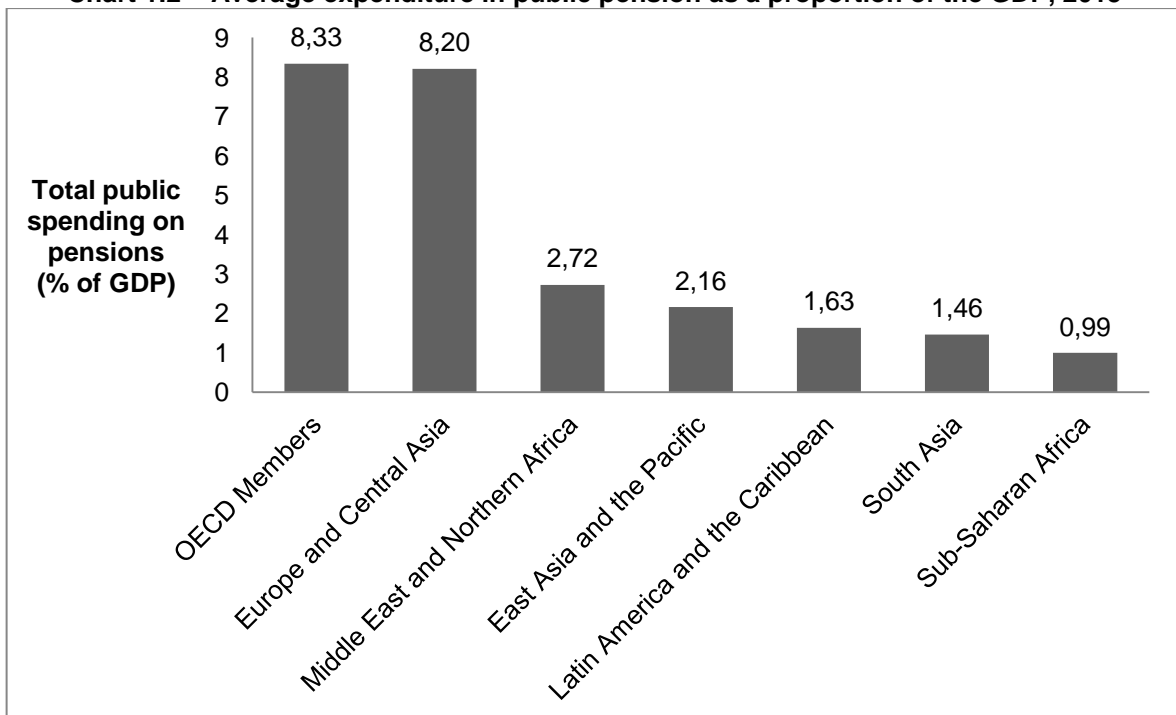
Chart 1.1 – Percentage of the total population covered by at least one benefit, 2015



Note: Coverage corresponds to the sum of persons protected by contributory and non-contributory benefits expressed as a percentage of the total population. Regional and global estimates weighted by the number of people.

Source: ILO (2017, p. 9).

Chart 1.2 – Average expenditure in public pension as a proportion of the GDP, 2015



Note: OECD countries were excluded from their regional peers.

Source: OECD (2016), calculated by the authors.

In accordance with the data previously presented, it is noticeable that the challenges faced by the industrialized countries differ substantially in comparison to the developing nations. While the latter must focus on expanding the population covered and the regimes as a whole, the former now struggle to sustain a system that may have become too large for their national economies. Bloom and Mckinnon (2013, p. 2) summarizes the challenges as follows:

Of course, the degree of the problem varies widely. At one extreme are industrial countries, in most cases Organisation for Economic Co-operation and Development (OECD) members, where Social Security provision is typically both comprehensive (with provisions for old age, disability, survivorship, maternity, work injury and occupational diseases, unemployment, family allowances, medical benefits, and for a small but growing number of countries, longterm care) and universal (ostensibly covering 100 per cent of the target population). At the other extreme are lower-income countries in sub-Saharan Africa and South Asia where coverage may extend to less than 10 per cent of the population and handle only a limited number of contingencies (e.g., old age, disability, survivorship, and work injury). In the middle are a majority of countries, where risk coverage is at the intermediate level, as is the proportion of the population with access to such protection [...].

On account of that, this work will center its analysis in the Social Security as seen in the developed nations, while also including the developing countries which already have an established and reasonably embracing Social Security system, as is the case of Brazil and the other BRICS, for instance.

In this regard, although the level of coverage presented by these countries may indicate that their systems are well designed, almost every one of them is facing an enormous pressure on its financial viability, according to Gruber and Wise (1997). The same authors (2005) propose that this reality resulted mainly from the fast aging and longer lives of its populations as well as the reduction in the labor force participations rates among older citizens, increasing the fiscal burden over the younger population.

Pallares-Miralles, Romero and Whitehouse (2012, p.12) state that the older population have increased intensely over the last century, highlighting projections which indicate that the number of people over sixty in the world will reach two billion by 2050, ten times the figure recorded in 1950.

As a response to the demographic changes, a series of reforms were conducted in their Social Security systems, especially since 1990 (OECD, 2017, p. 16-17). As mentioned in the introductory section, the fundamental goal of these

modifications was the long term financial sustainability of the schemes, although that same end can be pursued through several distinct ways.

The reforms in Social Security systems usually include one or more of the following measures:

- a) lifting pension eligibility age;
- b) penalizing early retirement or incentivizing elderly to continue working;
- c) reducing accrual rates, the amount of pension earned for each year of contribution;
- d) eliminating indexation of pension benefits;
- e) raising assets to fund defined benefit (DB) plans;
- f) stipulating a restraint to benefits complemented with defined contributions (DC) schemes; and
- g) transforming pay-as-you-go (PAYG) into DC schemes (OECD, 2017, p. 21-29).

Whitehouse (2016, p. 17-18) proposes that some of these modifications may have the financial consequences shown in Table 1.1, presenting different impacts depending on the form of organization of the regimes. The propositions highlight that there are no perfectly predictable measures in order to achieve financial sustainability.

Another relevant aspect in the discussion developed in Whitehouse (2016) is that the decisions pertaining to reforms on pension systems should be preceded by the definition of the desired features of the regimes, such as main objectives as well as fiscal, labor, savings, and other specific consequences. That way, direct and indirect effects of a given arrangement could be evaluated in relation to individual outcomes, enabling more objective discussion on this important subject.

Trying to further evaluate that idea, the next sections will display the historical background and the evolution of Social Security, followed by the presentation of diverse sets of institutional arrangements pertaining to different possible systems, as found worldwide nowadays.

Table 1.1 – Financial Impact of Reform Measures

Reform	Private-sector workers (DB)	Private-sector workers (DC or Notional)	Public-sector workers (DB)
Reduced accrual rates	positive, but may be offset by higher spending on safety-net benefits	not applicable	positive, but may be offset by higher spending on safety-net benefits
Less generous indexation	positive	none	positive
Increase on pensionable age	positive: extra revenues and shorter benefit duration, but may be offset by higher accruals and higher spending on unemployment or disability benefits - positive effect if extra benefits reduce spending on safety-net schemes	small or zero: extra contributions balanced by extra benefits and shorter benefit duration by higher benefit amount may be offset by higher spending on other benefits. Positive effect if extra benefits reduce spending on safety-net schemes	positive: extra employee contribution revenues and shorter benefit duration, but may be offset by higher accruals and higher spending on other benefits or by higher pay bill. Positive effect if extra benefits reduce spending on safety-net schemes
Increase on employee contributions	positive, but may be offset by labor supply effect	none: extra contribution revenues balanced by extra benefits	positive: extra revenues, but may be offset by upward wage pressure
Increase on employer contributions	positive, but may be offset by labor demand effect	none: extra contribution revenues balanced by extra benefits	none, re-labelling

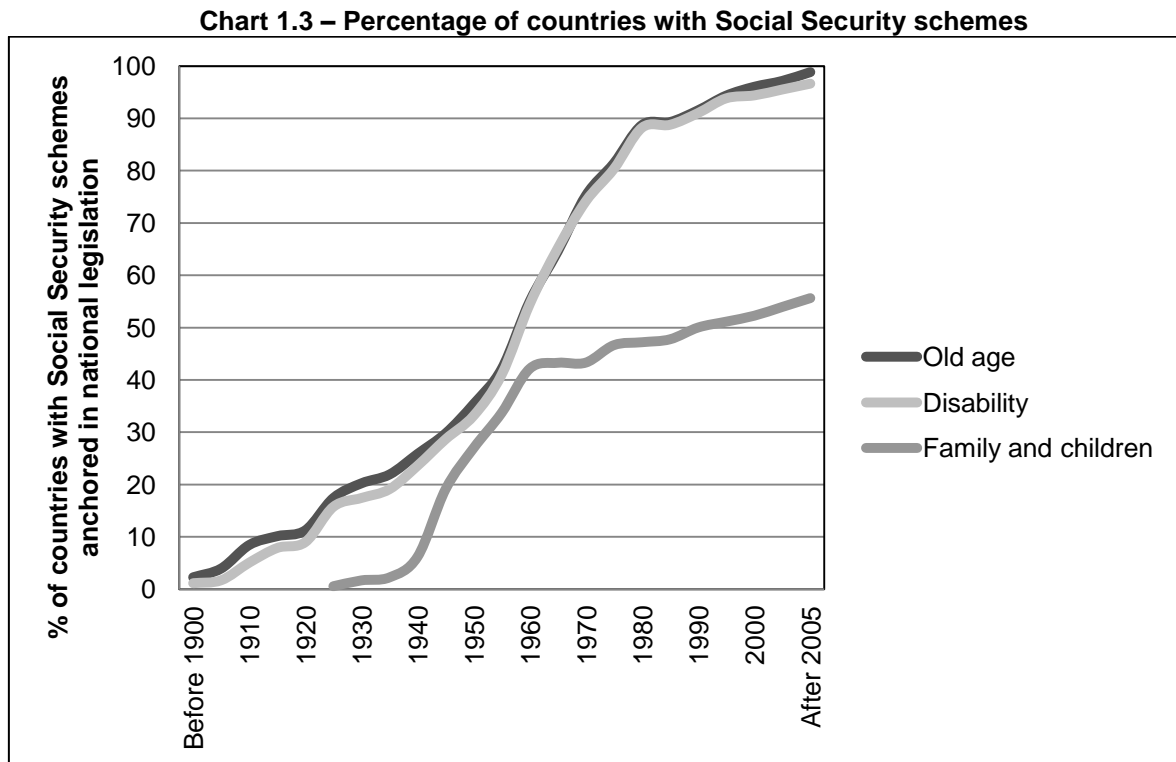
Source: Whitehouse (2016, p. 17-18)

1.2.1 Historical background

As reported by Stolleis (2013), the first public system to provide an old-age retirement and disability insurance plans to a significant part of the population was created in Germany in 1889, designed by its Chancellor Otto von Bismarck. The formal designation of the pension system took place more than one century after the

former German state of Prussia passed its General Law Code – 1788, in the wake of the Enlightenment – which represented, in the words of the author, the first time a government formally recognized taking care of the poor as a state task.

In consonance with the following figure, it was during the twentieth century that almost every country in the world developed a Social Security system.



Source: ILO (2014, p. 4).

Although the previous data indicate that the vast majority of countries currently display a Social Security system, it's relevant to note that thirty two percent of the world population is not covered by any social protection system, according to the UN (2017, p. 19), and fifty five per cent is not covered by retirement or disability plans, as stated by the ILO (2017, p.9) and mentioned previously.

That explains why the implementation of embracing and appropriate Social Security systems is one of the United Nation Sustainable Development Goals, adopted by all country members in 2015. The target 1.3 proposes to “implement social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable” (ILO, 2017, p. 76).

Therefore, it is noticeable that, being a relatively modern state feature even among the developed countries, most developing nations have yet to design a comprehensive system for their populations.

1.2.2 Architecture of Social Security

Although the institutional arrangements pertaining public Social Security vary widely around the globe, there are basic characteristics behind the regimes which help to analyze the theoretical and practical implications of the architectural choices made by different nations.

Following the taxonomy proposed by the World Bank (1994) and later updated by Holzmann and Hinz (2005)¹, the first feature of Social Security is the pillars, which refers to the basic objective of the regime. According to Holzmann and Hinz (2005, p. 2-4), during the last century, most countries developed a single pillar plan. That systems were usually better designed to support one particular group in the society, which could be the poor elderly, civil servants or private employees, for instance.

On the other hand, as proposed by Diamond (1977, p. 278-282), the Social Security systems should have different objectives, such as:

- a) reducing poverty and redistributing income and wealth;
- b) reducing market failures regarding savings, such as absence of safe long term investment and uncertainties about working life length and overall longevity; and
- c) providing income for those who have not saved enough for retirement.

Accepting that view, Pallares-Miralles, Romero and Whitehouse (2012, p. 34) and Hinz and Holzmann (2005, p. 20) highlight that, for the past decades, countries

¹ It is important to note that scholars such as Barr (2002) criticize the use of the term “pillar”, as it connotes a focus on instruments instead of objectives. The author proposes the use of “tier”, arguing that the first term suggests that a desirable Social Security should develop every pillar to stand correctly, whilst the second term possesses an additive aspect, better representing the fact that each tier – or pillar, for that matter – aims for a different objective. He admits later that the term “multi-pillar” had also become linked to a specific set of reforms proposed by the World Bank, so choosing not to use it was intended to keep a neutral position in that discussion (BARR, 2000, p. 22-23). Without mentioning such discussions, the terms are used as interchangeable by the OECD (2017). The current work won’t focus on the implications of each term, choosing to reproduce the WB proposition for practical reasons, as most of the countries have presented pension reforms based on the corollary proposed by the Bank. For a deeper discussion in that subject, see Barr and Diamond (2009, p. 19-22).

have been moving towards a multi-pillar design to provide for different groups of citizens with diverse needs and goals. These modifications followed mostly the practical propositions presented by the World Bank (1994).

Table 1.2 summarizes the pillars structure, as presented by Hinz and Holzmann (2005, p. 10). The terminology follows Appendix A. The first three pillars relies on governmental action – given their mandatory affiliation and/or dependency on general state revenues – although pillar two assets can be invested by private organizations, as seen in Australia, Chile, Denmark, Iceland, Israel, and Mexico, for instance (OECD, 2017). Intending to deepen the analysis on the role of the state, the present work will mainly focus on the first three pillars.

The last two pillars, having a voluntary enrolment, are usually provided by private institutions. It is relevant to note that even in the cases in which governments arrange such schemes they are regarded as private once the revenues should not be computed in the state general budget.

Based on data collected by the World Bank, Pallares-Miralles, Romero and Whitehouse (2012, p. 39-40) summarize the architecture of Social Security systems worldwide, showing that over eighty countries currently have a zero pillar scheme, whilst 151 present pillar one. These data are displayed in Table 1.3.

Focusing on Latin America, the same authors (p. 60) state that most middle-income countries in the region present zero-pillar Social Security as a means-tested scheme, a feature commonly seen in developed countries. Conversely, less than 20% of Middle Eastern and African countries possess such pillar.

They highlight that the most extensive pillar zero coverage is found in Brazil: although not universal, the country provides all rural workers, individuals with disabilities, and poor elderly² with a noncontributory pension equivalent to 100 percent of the national minimum wage. According to 2014 figures, 80.2 per cent of those aged 65 or over received a pension in the country (ILO, 2017, p. 82).

² According to the Brazilian Social Assistance Act (BRASIL, 1993), every person aged 65 or older living in a household with a per capita income of less than one fourth of the minimum wage is entitled to a means-tested pension worth one national minimum wage.

Table 1.2 – Multi-Pillar Pension Taxonomy

Pillar	Target group			Main criteria		
	Lifetime poor	Informal sector	Formal sector	Characteristics	Participation	Funding
0	X	X	x	“Basic” or “social pension,” at least social assistance (universal or means tested)	Universal or residual	Budget or general revenues
1			X	Public pension plan, publicly managed (DB or NDC)	Mandatory	Contributions and financial reserves
2			X	Occupational or personal pension plans (fully funded DB or DC)	Mandatory	Financial assets
3	x	X	X	Occupational or personal pension plans (partially or fully funded DB or funded DC)	Voluntary	Financial assets
4	X	X	X	Access to informal support (family), other formal social programs (health care), and other individual financial and nonfinancial assets (homeownership)	Voluntary	Financial and non-financial assets

Note: The appearance of x reflects the importance of each pillar for the respective target group in the following increasing order: x < X < X.
Source: ILO (2017, p. 82).

Table 1.3 – Basic System Architecture by Region

Region	Number of countries	Modality of pillars		
		Zero	1	2
East Asia and Pacific	28	11	17	1
Eastern Europe and Central Asia	30	17	30	14
High income OECD	24	20	20	3
Latin America and Caribbean	37	19	29	10
Middle East and North Africa	20	2	18	1
South Asia	8	4	4	1
Sub-Saharan Africa	46	8	33	2
Total	193	81	151	32

Source: Pallares-Miralles, Romero and Whitehouse (2012, p. 40)

Apart from pillar-zero, Brazilian Social Security comprises a pillar one divided in a national system for private workers – organized by the National Social Security Institute (*Instituto Nacional de Seguridade Social*, INSS) – and specific arrangements for civil servants organized by each governmental level (federal, state and local) – called Social Security Specific Regimes (*Regime Próprio de Previdência Social*, RPPS). Next section will further investigate these later schemes.

Another architectural feature of Social Security relates to the basic form of benefits paid. Pallares-Miralles, Romero and Whitehouse (2012, p.34) states that countries can provide paybacks through three different methods: defined benefit, defined contribution or hybrid arrangements such as notional defined contribution. Regarding how to fund the benefits, the same authors mention the possibilities of systems to be financed on a full or partial PAYG basis, or they could be fully funded in advance³.

Pallares-Miralles, Romero and Whitehouse (2012, p. 34-35) highlight the existence of a strong linkage between the features mentioned previously. The authors mention that the majority of DB systems are financed on PAYG or partially funded basis, while DC must be fully funded.

³ The general definition of each term is presented in the glossary, at Appendix A.

Following these denominations, the next table presents the structure of systems for a collection of countries:

Table 1.4 – Structure of retirement-income provision

Country	Basic	Minimum	Public	Private
Argentina	x	x	DB	
Australia	x			DC
Austria			DB	
Belgium		x	DB	
Brazil		x	DB	
Canada	x		DB	
Chile	x			DC
China		x	NDC+DC	
Czech Republic	x	x	DB	
Denmark	x			DC
Finland	x		DB	
France		x	DB+Points	
Germany			Points	
Greece	x		DB	
Hungary		x	DB	
Iceland	x			DB
India		x	DB + DC	
Ireland	x			
Israel	x			DC
Italy		x	NDC	
Japan	x		DB	
Korea			DB	
Mexico		x		DC
Netherlands	x			DB
New Zealand	x			
Norway	x		NDC	DC
Poland		x	NDC	
Portugal		x	DB	
Russian Federation	x		Points	DC
Saudi Arabia		x	DB	
South Africa	x			
Spain		x	DB	
Sweden	x		NDC	DC
Switzerland		x	DB	DB
Turkey		x	DB	
United Kingdom	x		DB	
United States			DB	

Source: OECD (2017), selected countries.

1.2.3 Separated schemes for private and public employees

Focusing on the nations that exhibit embracing Social Security systems, one characteristic which stands out as relevant whilst studying this subject is the existence of different pension schemes for government and private employees.

In many countries, the existence of pension schemes for public service workers actually preceded the creation of public retirement plans for private employees, dating from as early as the 19th century. Lindeman (2002, p. 2-3) notes that most of these regimes conceded benefits calculated in the public servants final pay.

According to Ponds, Severinson and Yermo (2011, p. 5), the existence of specific arrangements for public employees – usually with more generous rules in comparison to the general PAYG system applied to the private sector – can be justified for a number of reason, as it contributes to the attractiveness of a career in the civil service by providing security, integrity and independence for the workers.

Nowadays, as stated in Pallares-Miralles, Romero and Whitehouse (2012, p. 34), almost half of the countries in the world have separated retirement plans for private and public workers. The figures are summarized in Table 1.5.

Table 1.5 – National Scheme and Civil Servants Scheme

Region	Number of countries	Separated	Integrated	Partially integrated	None
East Asia and Pacific	28	9	7	2	10
Eastern Europe and Central Asia	30	1	29	0	0
High income OECD	24	10	11	2	1
Larin America and Caribbean	37	3	22	5	7
Middle East and North Africa	20	7	8	3	2
South Asia	8	6	1	0	1
Sub-Saharan Africa	46	24	11	1	10
Total	193	60	89	13	31

Source: Pallares-Miralles, Romero and Whitehouse (2012, p. 40)

Those numbers call for investigations on the difference among the regimes. Generally speaking, Palacios e Whitehouse (2006, p. 73) characterize the difference between the schemes as follows:

The civil service pension schemes tend to be more generous and less financially viable than those covering the rest of the formal sector. Taking the scope of coverage into account, they are also more expensive. Costs have spiraled in many countries as the schemes have matured and past promises have come due. Most projections show that the situation will worsen without reform raising concerns about possible crowding out of important social programs.

Considering the complexity of public retirement systems, the current and former sections presented relevant yet basic information on the state of Social Security worldwide. It also intended to set the stage for the next section, which will investigate economic studies on the justification for the existence of these systems.

1.3 ECONOMIC FUNCTIONS OF SOCIAL SECURITY

Albeit regarded as a basic human right by the UN General Assembly (1948, p. 6), Social Security may present a political economy issue in a context of limited financial resources as well as administrative capacities. Channeling fiscal revenues to old-age pension program will come at the cost of moving expenditure away from other social policy goals (BLOOM; MCKINNON, 2013). Such choices may represent a trade-off between equity and efficiency (McCord, 2010), a duality which helps to justify the effort invested by economists in investigating the subject.

On top of that, the expenditure through these systems represents a significant share of many countries GDP. As already presented in Chart 1.2, the average expenditure in public pension across OECD countries represented 8.33 per cent of each country GDP in 2015, ranging from 15.8 per cent in Italy and 14.5 per cent in Greece to no less than 2.1 per cent in Iceland and 3.5 per cent in Australia. In Brazil, the figure reached 9.65 per cent of its GDP in the same year, highest percentage amongst the BRICS, while in Argentina total public expenditure represented 12.04 of the country GDP.

Therefore, the combination of channeling an expressive amount of resources and theoretically reducing economic efficiency calls for a strong justification for the existence of Social Security. Aiming for that goal, Diamond (1977) proposed that the system should be evaluated pertaining its functions on the economy in order to justify its existence.

The author listed four main reasons a state should have such a program: (i) raising revenue; (ii) redistributing income; (iii) correcting market failures; and (iv) paternalism. Arguing that Social Security in the United States (US) did not generate surpluses at the time – according to Hinz and Holzmann (2005, p. 23-28) a persistent and worsening characteristic of systems worldwide – Diamond (1977, p. 278) disregarded the first proposed function, focusing instead in the income insurance to the citizens provided by the government through Social Security.

The following sections will present the basics ideas regarding each one of these functions.

1.3.1 Distribution of Income

According to Falkingham and Jonhson (1993, p. 3), from the perspective of the individuals, the basic goal of every pension system is to offer income security in the old age. In order to achieve that objective, the first impact on income performed by such a system occurs in the individual level. Social Security, in any of its forms of financing and paying benefits, represents an intertemporal transfer of income from years of employment to years of retirement.

The same authors (1993, p. 1-3) argue, however, that distributional outcomes of Social Security across different cohorts and generations are its most relevant feature and must be a central aspect of pension system analysis.

On this matter, it is important to note that scholars such as Barr (2006, p. 57) implies that income distribution function of Social Security could be divided into two objectives: redistribution itself and poverty relief. The society would be willing to subsidize consumption for those who failed to earn a minimum income represented by a poverty line, although not by much.

In this same sense, Hinz and Holzmann (2005, p. 5) states that “all pension systems should, in principle, have elements that provide basic income security and poverty alleviation across the full breadth of the income distribution”.

Even though redistributions and poverty relief should not be treated as interchangeable, in the case of Social Security the former can be seen as a means for the later. In that sense, the present section will follow Diamond (1977 and 2004) and focus in the distribution of income, once it works as the channel to reduce poverty through Social Security.

Diamond (1977, p. 278) indicates two different ways by which Social Security serves this function: *within* and *across* generations. The first can be obtained mostly due to progressive taxation⁴ and the fixation of a minimum retirement income, whilst the second relates mostly to the financing structure of the systems (e.g. fully or partially funded, PAYG).

Considering this effects and the current trend of Social Security reforms, Barr and Diamond (2008) indicate that one of the most commonly committed mistakes whilst discussing possible shifts in retirement schemes is ignoring distributional effects. They present the matter as follows:

That pension systems can redistribute across cohorts with different birth years, it is necessary to consider who gains and who loses. An egregious error is to ignore the fact that any choice between funding and PAYG necessarily makes choices about redistribution across generations. The point is most obvious if policymakers are establishing a brand new pension system. If they introduce a PAYG system, the first generation of retirees receives a pension, but returns to subsequent generations are lower; if they fully fund, later generations benefit from higher returns, but the first generation receives little or no pension. Thus it is mistaken to present the gain to pensioners in later generations as a Pareto improvement, since it comes at the expense of the first generation. The same argument applies in a country that already has a PAYG system: a policy to move toward funding through higher contributions or lower benefits redistributes from current generations to future ones. (BARR; DIAMOND, 2008, p. 16-17)

Diamond (1977, p. 279) argues, however, that the redistributive functions are not enough to validate by themselves the need for Social Security systems in

⁴ Although Deaton, Gourinchas and Paxson (2002) formulated theoretical models to indicate that the existence of a Social Security tax as a percentage of individual earnings, even at a non-progressive rate, pools risks and thus limit the growth of life-cycle inequality within generations.

the current fiscal proportions. The following sections will present further justifications proposed by the author.

1.3.2 Weakening Market Failures

According to Diamond (1977, p. 279), a national Social Security system can help reducing three market failures concerning the accumulation of funds to cover retirement consumption:

- a) the absence of safe long term investment opportunities;
- b) the inexistence of real annuities; and
- c) insuring the risk associated with a varying length of working and post retirement life.

Diamond (1977, p. 280) argues that the first two problems could be weakened with some sort of indexing returns on assets and annuities on government bonds instead of through Social Security, if they were the only problem to solve.

The third market failure, concerning uncertainties on the length of productive and inactive life, is regarded by Diamond (1977, 208) as a very large one for individuals and not easily handled by financial institutions, as any attempt to insure such risk faces moral hazard and adverse selection problems.

Therefore, pooling the risks associated with these market failures across the society appears to be a strong justification for the existence of Social Security also in the words of Hinz and Holzmann (2005, p. 40). The authors complement such thoughts arguing that even when financial products aiming to weaken such problems exist, “they often require public intervention in the form of education and guarantee funds to address behavioral impediments to their use. Without such products, governments need to intervene and provide the required products in a market-substituting manner.”

1.3.3 Compelled Savings

According to data referenced by Diamond (1977, p. 284), almost half of US population over 65 years old at the time reported receiving no income from assets. Hinz and Holzmann (2005, p. 40), following similar empirical evidence, state that individual, when left on their own planning, undertake insufficient, if any, retirement savings.

Diamond (1977, p. 281) proposes three possible reasons for such behavior:

- a) individuals may not have enough information to decide on the level of savings needed for retirement;
- b) having the information, people may not be able to produce an efficient decision; or
- c) the individuals could have a high personal discount rate.

Hinz and Holzmann (2005, p. 40) refer that there are strong empirical indications in favor of the last motivation.

Regardless of the theoretical explanation for the individual actions, both studies focus in the fact that empirical results show the need for government action in order to induce mandatory savings.

Having set economic justifications for the existence of Social Security, the next section will further analyze previous studies regarding the distributional aspects of the system.

1.4 SOCIAL SECURITY AND REDISTRIBUTION

The current section presents a literature overview of relevant economic studies in the relationship between public retirement schemes and distribution of income.

Most economic studies on Social Security base their theoretical approach on Overlapping Generations (OLG) models to produce static analysis examining the impact of Social Security on steady state labor supply, savings, and welfare. The model basic ideas are established following the then innovative proposition of Irwin Fisher in 1930 and further developments, specially the Life-Cycle Hypothesis

proposed by Franco Modigliani and the Permanent Income Hypothesis by Milton Friedman.

The first study to investigate the role of Social Security on income distribution was performed by Feldstein (1974). The author inserted a *Social Security Wealth* variable in Modigliani consumption function. Utilizing aggregate data from the US from 1929 to 1971, Feldstein (1974, p. 923-925) concludes that social security reduces the expected retirement income of the elderly in comparison to private personal savings.

Concerning earlier works in the subject, Auerbach and Kotlikoff (1987, p. 8) note that theoretical works relied on static models to examine the impact of Social Security on steady state aggregate variables. The authors (1987, p. 145-179), intending to capture effects of government action over individuals, develop a dynamic model of fiscal policies with 55 overlapping generations to simulate the impact of PAYG Social Security in welfare of individuals of different ages. This work set the path for further analysis on income effects throughout generations. The simulations performed indicate that unfunded Social Security would decrease private savings and the income of the elderly.

The main noticeable effect captured by these first works on PAYG or partially funded Social Security was the resulting loss of economic efficiency in comparison with first-best solutions, where each individual would save enough of their productive income to finance their own retirement.

Regarding that matter, Diamond (1977, p. 278-279, 2004, p. 5) criticizes first-best analysis regarding Social Security. He argues that some properties of competitive equilibrium are unrealistic when compared to empirical data on individuals financing their own retirement. As a result, the life-cycle and permanent income hypotheses do not hold without compelled savings. The author proposes that the need for government action regarding this subject should be justified by stressing the redistributions aspects of Social Security as a second-best solution⁵.

Seidman (1986) presents the first study on the expected effects of funding Social Security. Through simulations using a model similar to Auerbach and

⁵ Instead of the Pareto-efficient result of letting every individual save part of their current wages to support their own needs in retirement (DIAMOND, 2004, p. 4).

Kotlikoff (1987), the author was the first to propose that the elimination of unfunded Social Security would result in economic gains.

Falkingham and Johnson (1993) offer the first attempt to simulate different life-cycle intragenerational redistribution outcomes resulted from several possible PAYG and funded Social Security schemes. Their work utilizes a dynamic cohort microsimulation model calibrated with demographic and labor data referring to the United Kingdom (UK). The main results show that lower income citizens and women benefit more in flat-rate PAYG systems, while men accumulate much higher pension capital in funded schemes. The variance of benefits would be greater in the funded systems, with some men and many women failing to achieve minimum pension levels. Finally, the simulations performed on hybrid systems showed that the higher the proportion of PAYG payments, the greater the replacement rate for the bottom 40 per cent in lifetime income distribution. The simulations did not evaluate welfare or production outputs.

Leimer (1994) promotes a study based on historical administrative data to assess past and simulate future net transfers performed by the US Social Security. The work proposes different PAYG arrangements as counter-factual to evaluate the pension system. The author (1994, p. 44) highlights that the simulations suggest that current and future cohorts will experience regressive redistributions as a result of Social Security taxes and benefits, differently than the progressive effects noticed across older generations.

The IMF (1998) performed simulations utilizing a general equilibrium OLG model calibrated with data pertaining to the US, focusing on intragenerational distribution. The results suggested that United States PAYG Social Security scheme is lifetime progressive across gender and education levels, but lifetime regressive across race.

Kotlikoff, Smetter and Walliser (2002) summarize the results achieved by these authors in previous studies which extended the Auerbach-Kotlikoff model to explicitly analyze the distributional effects of Social Security. The authors included intragenerational heterogeneity to perform simulations which indicate that privatization (in the sense of funding individual accounts for retirement purposes) would result in long run economic gains for both the lifetime poor and rich, at the expense of welfare losses to transition generations. It is worth to note that these

works did not include separated gender cohorts in the models and the results focused mostly in the intergenerational redistribution.

Conesa and Kruger (1999) found similar results whilst analyzing the implementability of a fully funded Social Security system in a society with heterogeneous individuals. Utilizing OLG models, the authors show that even assuming that a newborn individual would prefer a fully funded system, no policy reform aiming to eliminate PAYG Social Security would gain majority support because of the welfare loss imposed on current generations.

Deaton, Gourinchas and Paxson (2002), utilizing consumption models with Permanent Income Hypothesis consumers and later incorporating precautionary motives and liquidity constraints, investigate the impact of Social Security in the income distribution inside the same generation. The model indicates that the existence of a Social Security tax to finance pensions results in a decrease in income inequality. Shifting to a fully funded DC scheme would have the opposite effect.

The works analyzed corroborate with the propositions of Barr and Diamond (2009) in the sense that there is no single best way to organize Social Security. The choice between PAYG and funded schemes, for instance, will impact private savings, labor supply, and (intra and intergenerational) income inequality in different ways. The former variables affect each other, as well as economic output, in contradictory directions and magnitudes, making it a massive task to anticipate the net results of such interactions.

What stands out is the relevant role that Social Security performs regarding income and consumption inequality. As stated by the WB (2016, p. 69), reducing income concentration matters both by itself and in the context of reducing poverty. In addition to that, scholars such as Alesina and Rodrik (1994) and Persson and Tabellini (1994) propose that high levels of inequality hurt the economic results of a given country, a fact that should bring the distributive aspects of Social Security in the center of public policies debates.

1.5 CONCLUDING REMARKS

In the current work, we have presented a review of current state of Social Security around the world, focusing on the countries which have embracing schemes. It provided a foundation to discuss the economic and social impacts of different possible systems.

The data presented in the earlier sections indicate the necessity for pension reforms in many countries, Brazil included. Demographic changes, specially the fall in fertility rates and the increase on life expectancy, implicate the need for reviewing the financial aspects of the systems.

The theoretical works analyzed indicate that Social Security affects economy in different ways. The earlier studies, focusing mostly in the aggregate economic effects of unfunded systems, propose that a mandatory pension scheme reduce the expected output of the whole economy, mostly by reducing private savings and labor supply. Privately funded individual accounts would modify these effects.

However, later works show that PAYG retirement schemes have a progressive effect on income distribution both inside and across generations, although Leimer (1994) finds that the demographic changes may alter that relationship for future cohorts. Fully funded systems, on the other hand, tend to worsen income inequality.

The former indications help to explain the current state of the debate regarding pension reforms. Any form of Social Security organization tends to create positive and negative effects on the society and the economy as a whole.

Concerning reforms, scholars such as Barr (2002), Diamond (1977 and 2004), and Hinz and Holzmann (2005) stress the need to include distributive consequences while discussing changes in Social Security systems. Falkingham and Johnson (1993, p.2) make the following compelling case in the same direction:

[...] economic and fiscal pressures are not the only factors that need to be considered in any pension reform; equally important are the distributional outcomes of pension systems. If pension reforms so alter pension outcomes that large groups of the pensioner population become incapable of supporting themselves in old age then the reforms will fail.

They will fail politically if they cannot gain the support of the electoral majority, and they will fail economically if the government ends up substituting minimum income welfare payments for pensioners who previously would have received minimum person benefits. Pension reform proposals, therefore, need to be assessed in terms of their distributional as well as their fiscal and macro-economic consequences.

These facts call for further investigations on the economic effects of Social Security given specific institutional arrangements. That is the goal of the next essay comprised in the current dissertation.

Aiming to achieve this objective, the study will focus on Brazilian Social Security, with special attention to the separated regimes regarding public and private workers. The choice possesses several justifications:

- a) Brazil, although experienced a reduction in the income concentration in the current millennium, still presents one of the highest Gini indexes in the world;
- b) Social Security reform is currently being discussed in the National Congress;
- c) Brazil is expected to face demographic changes in the next decades;
- d) Brazilian institutional arrangements authorize cities to choose over two given sets of pension scheme for its employees;
- e) existence of data enabling comparative empirical investigations;
- f) modern developments in statistics pertaining to causal inference.

On top of that, theoretical studies and empirical investigations estimating causal effects of Brazilian Social Security on income redistribution were not found in current economic literature. Therefore, it is expected that the following essay can contribute for the discussions regarding current state and future options related to public retirement schemes.

2 ENSAIO II: CIVIL SERVANTS PENSION FUNDS AND INCOME DISTRIBUTION: IMPACT EVALUATION ON THE ESTABLISHMENT OF MUNICIPAL RETIREMENT SCHEMES IN BRAZIL

This chapter presents a theoretical exercise and an empirical evaluation of the distributional impacts of Social Security in Brazil.

2.1 INTRODUCTION

Social Security is one of the most important state related features in industrialized countries, and in Brazil it is not different. According to the data displayed in Brasil (2017b, p.17) and Brasil (2017c, p. 15-16), the central government channeled R\$ 561 billion to pensions for private workers, R\$ 54 billion to means-tested benefits, and R\$ 124 billion to the pension scheme for civil servants.

Adding up the state and local schemes for civil servants, with a total expenditure of R\$ 162 billion in 2016 (BRASIL, 2017a, p. 801), the Social Security system concentrated R\$ 901 billion in benefits paid during the year of 2016. This amount accounts for 14.3 per cent of Brazilian gross domestic product in the same period, stressing the relevance of any study on the subject.

Such a vast public policy needs justification. In accordance to Diamond (1977), although the main purpose of Social Security is to guarantee an *adequate level of consumption* during old age, there would be different ways to ensure that goal. Therefore, the adoption of a public pension scheme can be necessary as it also provides other positive impacts to the economy.

In that sense, Diamond (1977, p. 278) proposes three reasons why a government should maintain a Social Security system: income redistribution, weakening market failures related to safe long-term investments, and forcing individuals to save for retirement.

On regard to those economic functions, the first could be seen as extremely important for Brazil. Even after a period of persistent reduction in the concentration of income as measured by the Gini index, the country still presents one of the highest levels of income concentration in the world (UNDP, 2014).

By combining the facts previously presented, it becomes noticeable the importance to further investigate the impacts of Brazilian Social Security over the distribution of income. Following that idea, the present work intends to analyze the connection between the institutional arrangements of Brazilian pension system and income distribution, focusing on the impact of the adoption of municipal civil servant schemes.

To achieve this goal, this essay is organized as follows: section 2.2 presents a general outline of Brazilian Social Security, its legal features and the differences between the retirement schemes for public and private workers; segment 2.3 displays a literature overview on the distributive impacts of Social Security in Brazil (2.3.1), followed by a theoretical proposal and simulation exercise to indicate that the creation of a special regime for public workers will generate income concentration among the richer cohorts (2.3.2); and an empirical investigation was performed to test the theoretical hypothesis (section 2.4). Finally, concluding remarks are presented.

2.2 SOCIAL SECURITY IN BRAZIL

The current section aims to present an overview of the current state of Brazilian Social Security, as well as to indicate some of the impacts that the architecture of the pension scheme produces upon the national economy. A special focus will be given on the difference between pension systems for private and public workers.

2.2.1 Legal Features

Brazilian Social Security system comprises a set of rules which includes constitutional, legal and other normative provisions. Similarly to what has been observed in other nations, the country performed several changes in the system during the past decades.

Pertaining to constitutional rules, one initial remark becomes essential. The term Social Security, as utilized in the economic literature and, therefore, in this essay, comprises security against decreases in individual labor capacities.

Usually, such circumstances result from old age or health conditions. Brazilian Constitution, however, utilizes the term *seguridade social* (literal translation of “social security” to Portuguese) to describe a system including Social Security (*Previdência Social*, as contextually translated), health system and social assistance. Hence, the legal features displayed in this study are related to *previdência social* – not *seguridade social* as defined by Brazilian legal system.

Given the former definition, the national Social Security in Brazil started to take its modern form in 1966, as a result of the unification of several different retirement plans created during the twentieth century. This public PAYG regime was transformed into the current National Social Security Institute (INSS) in the year 1990. The new regime followed the rules inserted in the Brazilian Constitution of 1988, which for the first time predicted a mandatory public retirement system for every private worker in the nation, as well as a means-tested benefit for the poor citizens.

The public employees, in its turn, were granted with a non-contributory pension equivalent to their final pay before retirement (BRASIL, 1966, 1988, and 1990). Each governmental level – federal, state and local – was authorized to maintain a retirement scheme for its own civil servants.

During the late years of 1990 and the beginning of the new millennium, several reforms took place in Brazil, setting the rules which are applied until today. The most important changes were made through Constitutional Amendments 20, 41 and 47, between 1998 and 2005 (BRASIL, 1998, 2003, 2005).

The biggest alterations concerned to civil servants. It is possible to highlight the introduction of contributions (amendment 20), minimum retirement age (amendment 41), and authorization for governments to limit benefits to the same ceiling imposed for private workers, alternatively creating complementary DC schemes (amendment 47). Table 2.1 summarizes the timeline regarding such changes, during the validity of current Brazilian Constitution.

It becomes clear that after Amendment 47 in 2005, which actually returned old rules to civil servants who already occupied their position when Amendment 20 was promulgated, no other relevant reforms were carried out in Brazil. The only noticeable modification in the current decade was the institution of the monetary ceiling for federal civil servants equal to private workers in 2012, as authorized by

Amendment 20. However, these rules only apply to new public employees. It is also worth noting that only seven states and no cities adopted that rules until the end of 2017 (BRASIL, 2017d).

Table 2.1 – Constitutional Retirement Rules in Brazil

Constitutional rule	Mandatory PAYG scheme for private workers	Mandatory PAYG scheme for civil servants
Constitution (1988)	<ul style="list-style-type: none"> i) no minimum retirement age ii) contributory for urban workers iii) 30 working years for women and 35 for men, or 25 and 30 respectively with proportional benefit reduction iv) DB calculated as the average of the last 36 monthly wages, limited to a monetary ceiling 	<ul style="list-style-type: none"> i) no minimum retirement age ii) non-contributory ii) 30 working years for women and 35 for men, or 25 and 30 respectively with proportional benefit reduction iv) final working wage
Amendment 20 (1998)	<ul style="list-style-type: none"> i) same ii) same iii) 30 years of contribution for women and 35 for men iv) DB calculated as the average of the 80 per cent higher contribution wages v) facultative complementary private DC plan 	<ul style="list-style-type: none"> i) minimum retirement age of 55 y.o. for women and 60 for men ii) contributory by a rate at least equal to the tax for private workers iii) minimum 30 (women) or 35 (men) years of contribution; alternatively, minimum 10 as civil servant, 5 in the final position and 20 (women) or 25 (men) years as private worker iv) final working wage for current civil servants; DB calculated as the average of the 80 per cent higher contribution wages for new workers v) authorization to impose a monetary ceiling equal to private workers if an optional DC plan is created
Amendment 41 (2003)	<ul style="list-style-type: none"> i) same ii) same iii) same iv) same v) same 	<ul style="list-style-type: none"> i) same ii) same iii) same iv) DB calculated as the average of the 80 per cent higher contribution wages, limited to the salary of the Supreme Court Judge v) same
Amendment 47 (2005)	<ul style="list-style-type: none"> i) same ii) same iii) same iv) same v) same 	<ul style="list-style-type: none"> i) same ii) same iii) same iv) final working age if already a civil servant before amendment 20; DB calculated as the average of the 80 per cent higher contribution wages if not; both limited to the salary of the Supreme Court Judge v) same

Source: author elaboration based on Brasil (1988, 1998, 2003, 2005).

Apart from modifying specific rules related to pension schemes, Amendment 20 also predicted that Social Security should be financial and actuarial balanced. Nonetheless, both schemes continued to be financed through PAYG arrangements, meaning that financial imbalances impact governmental budgets and the whole society in result. Once Brazilian law authorizes each state and city to create a specific regime for its civil servants, the sustainability of such schemes becomes relevant for the entire population.

Table 2.2 – Population over sixty five years old/Total Population

Country	2010	2015	2020	2025	2030	2035	2040	2045	2050
Argentina	10.7	11	11.7	12.4	13.2	13.9	15	16.8	18.2
Australia	13.9	15.3	16.7	18.2	19.5	20.3	21	21.1	21.5
Austria	17.6	18.5	19.4	21.2	24	26.4	27.4	27.5	27.8
Belgium	17.4	18.4	19.6	21.3	23	24.2	24.6	24.6	24.5
Brazil	6.9	7.8	9.2	10.9	13	14.8	16.6	18.7	21.2
Canada	14.1	15.6	17.4	19.5	21.2	21.7	21.7	21.7	21.9
Chile	9.2	10.3	11.7	13.8	16.1	17.8	19.1	19.6	20.6
China	8.2	9.4	11.5	13.2	15.7	18.8	21.2	21.8	22.5
Denmark	16.7	18.6	19.7	20.6	21.8	22.9	23.6	23.5	22.7
Finland	17.2	19.8	21.7	23	23.8	24.1	23.6	23.6	23.9
France	17	18.4	19.8	21.3	22.5	23.3	23.9	23.8	24
Germany	20.5	20.9	22.1	24	27.1	29.7	30.1	29.8	29.7
Greece	18.3	19.2	20.1	21.6	23	25	26.7	28.2	28.8
Iceland	11.9	12.4	14.2	16.4	18.3	19.8	21	21.9	23.4
India	4.9	5.3	6.3	7.3	8.3	9.4	10.5	11.9	13.5
Ireland	11.3	12.2	13.2	14.3	15.5	16.8	18.5	20.3	21.3
Italy	20.4	21.2	21.9	23	25	27.3	29.3	29.9	29.4
Japan	22.6	25.5	27.1	27.7	28.3	29.5	32	33.5	34.2
Mexico	6.6	7.2	8.6	10.1	11.8	13.9	16.6	18.8	20.2
Netherlands	15.4	17.6	19.3	21.1	23	24.6	25.2	24.9	24.4
New Zealand	13	14.1	15.4	17.1	18.9	20.1	20.5	20.4	20.5
Norway	15	16.5	17.7	18.8	19.9	21.2	22	22	21.8
Paraguay	5.2	5.6	6.4	7.2	8.1	9	9.8	11	12.8
Peru	6	6.6	7.4	8.5	9.9	11.4	12.9	14.6	16.2
Portugal	17.8	18.6	19.7	21.2	23	24.6	26.4	28.1	28.8
Russia	12.9	13.3	14.9	17.3	18.9	19.1	19.6	20.6	22.7
South Africa	4.6	5.3	6.1	6.9	7.4	7.6	7.8	8.3	9.3
Spain	17.2	17.3	17.8	19.2	21.2	23.4	25.6	27.5	28.1
Sweden	18.3	19.8	20.5	20.9	21.6	22.4	22.9	22.9	22.7
Switzerland	17.2	17.9	18.5	19.5	21	22.1	22.4	22.2	22.2
United Kingdom	16.6	17.6	18	18.8	20.2	21.6	22.1	22	22.3
United States	13	14	15.5	17.3	18.6	19.1	19.3	19.4	19.8
Uruguay	13.9	14.1	14.6	15.6	16.7	17.5	18.6	19.9	20.8
Venezuela	5.6	6.5	7.6	8.8	10.2	11.5	12.7	14.1	15.5

Source: Pallares-Miralles, Romero and Whitehouse (2012, p. 99-104), selected by the author.

The subject becomes more relevant when the demographic patterns are considered. By the year 2050, Pallares-Miralles, Romero and Whitehouse (2012, p. 102) indicate that 21.2 per cent of Brazilian population will be over sixty five years old, almost three times the percentage recorded in 2015.

Table 2.2 shows that the participation of individuals over sixty five year old in Brazilian total population, which represented less than half the percentage observed in 2015 in developed countries such as Canada, Denmark, Norway, Sweden, Switzerland, and the United Kingdom, but tend to reach similar figures to those nations by 2050.

These figures indicate that the matter must be a central topic of discussion in the country. In that sense, the next section further analyzes an important feature of Social Security system in Brazil, the separation of regimes between private workers and civil servants. It also displays data to characterize the current fiscal state of the different pension schemes found in the country.

2.2.2 Separated Schemes for Private and Public Workers

As presented in the former segment, Social Security in Brazil comprises two different contributory public pension schemes, in addition to a non-contributory benefit for the military and a means-tested benefit. Among the contributory regimes, the system presents one mandatory national PAYG scheme for private workers (INSS) and separated partially-funded schemes for civil servants, organized by each government level for their own employees (RPPS).

The existence of separated pension systems for private and public workers is not an exclusivity of Brazil. According to Palacios and Whitehouse (2006, p. 11), almost half the world presents such characteristic.

Referring to Brazil, Pallares-Miralles, Romero and Whitehouse (2012, p. 61) state that the country offers separated PAYG contributory pension schemes for central, state and local government civil servants, as well as a non-contributory regime for military personnel with benefits paid from general revenues. Table 2.3 presents relevant data regarding this scheme.

The figures indicate that, while only ten per cent of the beneficiaries are secured by the civil servant regime, total spending in this scheme represents more than forty per cent of the amount paid through the former.

Trying to justify such discrepancies, Palacios and Whitehouse (2006, p. 7) refer that special rules regarding pensions to civil servants could aim to:

- a) secure independency to perform the tasks;
- b) attract labor force to a public career;
- c) shift the cost of remuneration personnel into the future; and
- d) retire civil servants in a politically and socially acceptable way.

Table 2.3 – Collection of Data on Brazilian Social Security, year 2016

	RPPS				RGPS
	Federal	State	Local	Total	
Beneficiaries	2,213,730	4,915,545	3,243,332	10,372,607	98,361,155
Active	1,231,241	2,607,544	2,600,913	6,439,698	66,775,159
Inactive	981,700	2,308,001	642,418	3,932,119	31,585,996
Dependency Rate	1.25	1.13	4.05	1.64	2.11
Revenue (R\$ mill.)	37,933	57,736	27,909	85,645	361,349
Spending (R\$ mil.)	124,134	131,361	31,151	162,512	394,286
Total Assets (R\$ mill.)	0	152,824	110,360	263,184	0
Assets per capita (R\$ mill)	-	31.08	34.03	25.37	-

Source: Brasil (2017a).

Another possible explanation is proposed by Disney, Emerson and Tetlow (2009, p. 15). The study compares public and private DB schemes in the UK, proposing that generous pensions may help to offset the lower values of cumulated lifetime earnings in a public career, when evaluated alongside private sector workers.

However, these justifications do not hold on Brazilian case. According to Medeiros and Souza (2013, p. 22), the wages and benefits paid for public workers in Brazil account for 24 per cent of total income inequality, whilst representing only 19 per cent of total income in the country. Vaz and Hoffmann (2007) find that there is a wage gap between public and private sector wages, in favor of the former,

even when controlling for productive endowments⁶. These facts contradict the justifications proposed by Palacios and Whitehouse (2006).

On the other hand, Palacios and Whitehouse (2006, p. 8) note that civil service pension schemes tend to have lower funding ratios, resulting in a heavier fiscal burden. The general budget impact is also a consequence of more generous benefit rules usually applied for civil servants in comparison to private-sector workers.

That situation is usually difficult to shift once public workers often own reasonable power to protect their financial interests (PALACIOS; WHITEHOUSE, 2006, p. 6). Nonetheless, OECD (2017) indicates that the current tendency of reforms intends to reduce such disparities, although in Brazil that trend was interrupted by Amendment 47 in 2005, as previously shown in in Table 2.1.

These facts illustrate the proposition of Galasso and Profeta (2001)⁷, which suggests that decisions on social security policy, from the initial design of the system to reforms, must be also investigated in the realm of politics. Galasso and Profeta (2001, p.2) state that “[c]ontributions to political campaigns, lobbying, votes of vested interest groups influence career-oriented policy-makers to sacrifice economic principles for political objectives”.

On that matter, Mulligan, Gil and Sala-i-Martin (2002) find empirical evidence that the size and generosity of Social Security do not correlate with democracy, indicating that majority rules are not the main cause for the existence of the systems. The study concludes that authoritarian and democratic governments are similarly likely to present benefit formulas inducing early retirement and, conditional on GDP per capita, equally likely to maintain retirement with DB schemes rather than DC benefits (MULLIGAN; GIL; SALA-I-MARTIN, 2002, p. 37-39).

Analyzing subnational elections, Bagchi (2014) examine the hypothesis that political competition may offer electoral incentives to underfund public pension. Utilizing data for 2000 local funds in the state of Pennsylvania, US, the work suggests that an increase in political competition is accompanied by less funded

⁶ Similar results were achieved by Emilio, Ponczek and Botelho (2012).

⁷ Galasso and Profeta (2001) provide a broad overview of the political economy of Social Security.

and more generous pension plans. This result indicates that the voting process and majority rules may contribute to long term deficits in the regimes.

With a different focus, works such as Becker and Mulligan (2003), and Mulligan and Sala-i-Martin (1999) – using models of political competition among groups based on Becker (1983) – propose that the existence of Social Security can be derived from the political pressure exerted by interest groups. Although these works focused on the competition across different generations, the same reason can be made for competition intracohort, as between public and private sector workers.

In that sense, Medici (2004) analyzed the political negotiations behind Brazilian Constitutional Amendment 41, which approximated retirement rules for civil servants to those applicable for private workers, as presented in the former section. Medici (2004, p. 19) considered such reform the most difficult task performed by Brazilian newly elected government.

However, as already stated in the former segment, Amendment 47 reintroduced old rules for civil servants hired before Amendment 41, guaranteeing pension equal to the last salary before retirement, among other benefits. These facts help to illustrate the political power exerted by public workers in Brazil, in accordance to the theoretical propositions regarding interest groups and Social Security.

It is important to note that after the Amendment 20⁸ general pension rules in Brazil are dictated by the Constitution. Regarding local regimes, each city is allowed to decide between creating a scheme for its civil servants or to affiliate them to the national PAYG system for private workers. Once the city opts to institute the regime, general rules pertaining to benefits, contributions, and retirement age, among other aspects, must follow the same patterns applied to federal and state civil workers. As of 2018, 2083 from the 5570 cities in Brazil have adopted such a regime.

Among the reasons on why municipal governments would create a local RPPS, Brazilian institutional arrangements may give further incentives other than the political motives previously stated.

⁸ Before 1998, pension schemes for civil servants were not contributory. Each governmental level could formulated general and specific rules for its system.

Analyzing tax implications, the employer contribution applied by INSS is fixed at 20 per cent of the worker wage, limited to a national ceiling. By creating the RPPS, a city must contribute *at least* at the same rate as the Federal government, which currently holds at 11 per cent. Although the INSS ceiling for contribution do not apply, most civil servants in small cities do not receive wages higher than that amount, meaning that the employer social security tax is expected to be lower after the creation of RPPS.

However, the Constitution does not stipulate a grace period between the institution of the scheme and the possibility of current civil servants to retire in the new regime. That fact results in actuarial or financial imbalances even for recently created regimes. In that matter, the Civil Servant Pension Scheme Act – Federal Law 9.717/1998 (BRASIL, 1998) – explicit states that eventual financial imbalances must be equalized by the general budget of the state level which created the regime. The actuarial deficits, in their turn, should be offset by exceptional contributions, an exceptional measure that has become the rule (BRASIL, 2016a). Both facts indicate that the short term fiscal incentives quickly become a burden for other citizens.

The following table summarizes the current actuarial state of the municipal pension schemes, segregating the regimes instituted according to the current constitutional rules.

Table 2.4 – Actuarial State of Municipal RPPS

Group	Active		Actuarial Deficit	Individual
	Workers	Retired	(R\$ million)	Deficit (R\$)
	(a)	(b)	(c)	c/(a+b)
All cities	2,423,871	612,453	769,288	253,362
RPPS created between 1999-2010	330,619	38,243	22,799	61,808

Source: MPS (BRASIL, 2017a), calculated by author.

Given the current fiscal burden represented by the federal and state schemes, it is difficult to picture a significant reduction in the actuarial deficit of municipal pension plans, once it would require an increase in present budget disposals.

Keeping current trends, even new regimes tend to become financial imbalanced in the short term. This fact calls for further investigation on economic justifications for the fiscal effort needed to maintain separated schemes for civil servants. Theory suggests that Social Security can contribute for the society as a policy to redistribute income. The next chapter will further explore these aspects, focusing on the Brazilian system.

2.3 DISTRIBUTIONAL EFFECTS OF BRAZILIAN SOCIAL SECURITY

The current section initially presents an overview of past studies on the impact of pensions on income distribution in Brazil. The complete list of works analyzed is found in Table 2.5. The second segment proposes a theoretical analysis and a simulation exercise to investigate the impact of the institution of a local pension scheme for civil servants in the distribution of income.

2.3.1 Literature Overview

The first economic studies on the redistributive aspects of Brazilian Social Security date from the beginning of the current century. Most works present empirical evidence that the public pension scheme contributes to increase overall income inequality in the country, as measured by the Gini coefficient, as shown in Table 2.5.

Hoffmann (2003) utilizes decomposition of the Gini index to evaluate how the components of household income affect the distribution of *per capita* income in Brazil. The work uses data from the Brazilian National Sample Survey of Households (PNAD) of 1999. The results show that pension, in general, contribute to income concentration in favor of the rich. This effect is especially strong in metropolitan regions, but can also be verified in rural areas.

Hoffman (2003, p. 771) states that such result is of great importance since pensions represent 17.8 per cent of total household income, being its second most relevant component. The most representative part of household income derives from the main occupation (75.5 per cent), but presents a lesser concentration

ratio then total income. These facts indicate that pensions may be *the most important* component of income inequality in Brazil.

Table 2.5 – List of studies linking Brazilian Social Security to redistribution

Author(s)	(a) Method; (b) data; (c) results; (d) remarks
Hoffmann (2003)	(a) decomposition of Gini index; (b) PNAD, 1999; (c) social security is regressive; (d) stronger regressive aspects in urban scheme.
Afonso and Fernandes (2005)	(a) internal rate of return (IRR) ; (b) PNAD, 1976-1999; (c) PAYG for private workers is progressive, RPPS regressive (d) highlights that PNAD data do not segregate source of pension income; progressivity in the general regime results from rural workers and means-tested benefits.
Ferreira (2006)	(a) decomposition of Gini index; (b) PNAD, 1981-2001; (c) social security is regressive (d) regressivity was reduced from 1993 on.
Ferreira and Souza (2008)	(a) decomposition of Gini index; (b) PNAD, 1998-2003; (c) social security is regressive; (d) contribution to total income inequality is substantial.
Hoffmann (2009)	(a) decomposition of Gini index; (b) PNAD, 2001-2007; (c) social security is regressive; (d) regressivity was reduced in the period.
Ragel (2011)	(a) simulation of Gini index after reducing income from pensions to INSS ceiling; (b) PNAD, 2009 (c) RPPS is regressive; (d) the exercise disregards vested rights.
Moura et al. (2013)	(a) Gini and Theil indexes based on two Kernel estimations of income distribution; PNAD, 1987-1996 (counterfactual) and 1997-2006 (factual); (c) social security was progressive for elderly until 1996, neutral for other cohorts in both periods; (d) study estimated the impact resulted from demographic changes.
Caetano and Monasterio (2014)	(a) OLS, dep. var.: net municipal revenue with social security, ind. var.: local PIB and percentage of elderly ; (b) IBGE and MPS, 2010; (c) national PAYG correlates to regional progressivity; (d) analyses did not evaluate individual or household income distribution.
Medeiros and Souza (2014)	(a) decomposition of Gini index; (b) POF, 2008-2009; (c) pension income surpassing the INSS ceiling contributes to 4% of income inequality; (d) counterfactual disregards vested rights.
Freitas and Barbosa (2015)	(a) OLS, dep. var.: net municipal revenue with social security, ind. var.: local PIB and local per capita PIB, percentage of elderly, city population; (b) IBGE and MPS, 2010; (c) national PAYG correlates to regional progressivity; (d) analyses did not evaluate individual or household income distribution.
Rangel and Saboia (2015)	(a) decomposition of Gini index; (b) PNAD, 2011; (c) imposition of pension ceiling equal to INSS would improve redistributive aspects of RPPS; (d) considering vested rights, the impact would be small.
Afonso (2016)	(a) internal rate of return (IRR) ; (b) microdata from Ministry of Social Security 1980-2006 (c) social security is progressive (d) analyses did not include civil servants.

Source: author elaboration (2018).

Ferreira (2006) utilizes the same method and data source to evaluate the distributional effects of Brazilian Social Security between 1981 and 2001. The conclusions are similar to Hoffmann (2003), showing that the income concentration is stronger among pension in comparison to income from work. This relation was more robust during the 1990 decade, whilst income concentration from private work reduced after 1993.

Both studies stress the fact that public pension is an income component which is mostly determined by legal and normative aspects. The realization that pensions are contributing to income concentration should call for an immediate response from the incumbent government (HOFFMANN, 2003, p. 771-772; FERREIRA, 2006, p. 259).

Following the same method, Ferreira and Souza (2008) replicate the analysis for the period between 1998 and 2003. The study shows substantial contributions of pensions for inequality, as measured by the Gini index of the *per capita* household income distribution in Brazil.

Hoffmann (2006) analyzes the contribution of government social spending in the reduction of inequality observed in Brazil between 1997 and 2004. The work utilizes the same method and data source as the previous studies. The main result concerning Social Security is that, differently than other income components, pensions presented a higher Gini index than the average national measurement, especially after 1999.

Intending to investigate methodological problems on measuring progressivity or regressivity in a component of income, Hoffmann (2009) utilizes data from 2001 to 2007 to evaluate the participation of each component in the variation of the Gini index. The author proposes that the difference between overall Gini index and the concentration measured for a specific income component in an appropriate progressivity measure. The empirical investigation concludes that pensions can be considered regressive in comparison the other income components, according to Hoffmann (2009, p. 229).

It is important to note that the data presented in the PNAD do not discriminated if the pensions are paid through the scheme for private workers of for civil servants. Nonetheless, Ferreira (2006, p. 259) and Hoffmann (2009, p. 224) propose that the difference in the rules regarding retirement systems in favor

of the public workers is an important factor conducting to the regressive aspect of public pension in Brazil.

Using different method, Moura et al. (2013) investigate the distributional aspects of Brazilian Social Security using a semiparametric procedure (Kernel) to estimate densities in two different situations, using data collected from PNAD for the years 1987 to 2006. The method aims to provide a representation on how specific institutional arrangements impact the density of distribution, comparing two sets of years – 1987-1996 and 1996-2006 – to indicate what the density of wages would have been in the later if the share of beneficiaries and taxpayers had remained at the level found in the former period. The results were different in comparison to previous studies, proposing that Social Security was progressive until 1996 for the elderly and become neutral for all cohorts in Brazil in the period between 1996 and 2006.

Trying to investigate the implications resulted from the existence of two separate pension schemes, Rangel (2011) simulates the effects of the institution of a monetary ceiling to contributions and benefits in the civil service pension system equal the existing limit for private workers. Using data from the PNAD/2009, the author recalculated the Gini index reducing the income from pensions when the amount exceeded the private workers scheme ceiling, proposing four different counterfactuals. The results supported the propositions that the benefits paid for civil servants enhance income inequality in Brazil.

Rangel and Saboia (2015) also investigate the distributional impact expected after the imposition of a ceiling on pension of civil servants equal to the existing limit valid for the general scheme for private workers. Using data from PNAD/2011 and applying the decomposition of Gini index, the study concludes this provision should improve the redistributive aspects of Social Security in Brazil, although the expected impact is small.

Medeiros and Souza (2014) perform a similar study using data from the Family Budget Survey (POF) related to the years 2008 and 2009. The work utilized the decomposition of the Gini index to calculate the contribution in inequality of pension which surpassed the ceiling imposed for private workers benefits. The results show that this income component contributes to four per cent of total income inequality in Brazil.

Another study by Medeiros and Souza (2013), with the same data source and applying similar method, calculate the Gini index for civil servants pension at .943, much higher than the result for private workers (.474). They conclude (2013, p. 22) that the salaries and benefits paid by the State produce a higher level of inequality than the wages paid by the private court.

Afonso and Fernandes (2005) produced the first study indicating that Social Security in Brazil presents progressive impacts. Measuring the internal rate of return (IRR) of expected benefits flows, the authors concluded that groups with lower education levels achieve the highest returns over their contributions. The progressive feature in the system would result especially from the means-tested benefits and the non-contributory pension for rural workers. The authors (2005, p. 322) recognize, however, that the IRR for civil servants are higher than for private workers.

Afonso (2016) further investigates that relation utilizing microdata from the Ministry of Social Security, analyzing only the general regime for private workers and the means-tested benefit. The IRR found was higher for the older generations, women, cohorts with lower education and lower wages. The author, following these results, concluded the the PAYG system for private workers produces progressive effects on the distribution of income.

Still considering only the general scheme for private workers, Caetano and Monasterio (2014) concluded that the pensions paid through INSS correlate with reducing regional inequalities in Brazil. Freitas and Barbosa (2015), investigating the same relationship and using similar models, found similar results estimating the impact of transfer across cities in the country. These studies, however, did not evaluate the impact of Social Security in the household income, investigating the effects at aggregate levels.

The works exposed in the present section indicate that Social Security in Brazil does not manage to produce one of the most important economic effects concerning its justification: redistribution of income. According to the data presented in the introductory part of the current work, Brazilian pension schemes account for approximately fifteen per cent of the nation GDP. As Medeiros and Souza (2014, p. 618) summarize, these facts imply that Brazilian state is inadvertently producing public policies which increase income inequality.

The major engine for this result appears to be the generous rules pertaining to the retirement scheme for civil servants, although there are no empirical studies specifically investigating that relationship. The main reason stated by the authors is the inexistence of information on the source of retirement income in the PNAD, calling for alternative ways to investigate those effects other than decomposition of the Gini index.

It is also worth to highlight the inexistence of theoretical studies regarding such relationship. The next section presents an alternative approach to that matter, using simulation of income distribution estimators.

2.3.2 Local Pension Scheme Impact on Income Distribution

Intending to indicate the distributional consequences of creating a special retirement scheme for civil servants, this work proposes a theoretical approach to evaluate the alteration in the Gini index resulting from the institution of a retirement plan according to Brazilian rules. In the absence of a formal theoretical model to dictate such impact, a simulation exercise will be executed intending to estimate the expected result of such policy.

As first proposed by Atkinson (1970), in order to obtain a ranking of distributions we must make assumptions regarding the form of the utility function which describes the socially desired distribution. To formally present this idea, let y be the individual income and $f(y)$ be its frequency distribution. If we denote W as the social welfare function of individual incomes and assume that it would be additively separable and symmetric, ranking income distributions would act as follows:

$$W \equiv \int_0^{\bar{y}} U(y)f(y)dy \quad (2.1)$$

The problem with this approach, according to Atkinson (1970, p. 245), would appear when trying to compare the welfare results of changes in the distribution pattern. The difficulty that arises from (2.1) is a definition on the form of

$U(y)$, representing the desired income distribution of the society. The author illustrates the matter as follows.

Assuming only that $U(y)$ is increasing and concave, which would be equivalent as the reasonable supposition that less inequality would be preferable, a distribution $f^*(y)$ will return a higher utility in comparison to $f(y)$ according to (2.1) for all $U(y)(U' > 0, U'' \leq 0)$, if and only if

$$\int_0^{y_1} (F(y) - F^*(y))dy \leq 0 \text{ for all } y, 0 \leq y_1 \leq \bar{y} \quad (2.2)$$

Where

$$F(y) = \int_0^{\bar{y}} f(y)dy \text{ and } F^*(y) \neq F(y) \text{ for some } y$$

Supposing the distributions with different means are being compared, it becomes easier to see the interpretation of the condition (2.2) in terms of the Lorenz curve, which can be defined as

$$\Phi(F) = \frac{1}{\mu} \int_0^{y_1} yf(y)dy, \quad F = \int_0^{y_1} f(y)dy$$

Integrating the former expression results in

$$\mu\Phi(F(y_1)) = y_1F(y_1) - \int_0^{y_1} F(y)dy \quad (2.3)$$

Let us assume μ represents the mean of distribution $f(y)$, μ^* the mean of $f^*(y)$, and the following

$$\mu^* \geq \mu \quad (2.4)$$

Comparing the Lorenz curves resultant of the two distributions at a point $\bar{F} = F(y_1) = F^*(y_1^*)$ leads to

$$\begin{aligned} \mu^*(\Phi^*(\bar{F}) - \Phi(\bar{F})) &= (y_1^* - y_1)\bar{F} - \left(\int_0^{y_1^*} F^*(y)dy - \int_0^{y_1} F(y)dy \right) \\ &= - \int_0^{y_1} (F^*(y) - F(y))dy + \left(\int_{y_1^*}^{y_1} F(y)dy + (y_1^* - y_1)F^*(y_1^*) \right) \end{aligned} \quad (2.5)$$

Utilizing the first mean-value theorem for definite integrals, the second term results non-negative. Therefore, considering condition (2.4), the result in (2.5) satisfy second-order stochastic dominance proposed in (2.2), where

$$\int_0^{y_1} (F^*(y) - F(y))dy \geq 0 \text{ for all } y, 0 \leq y_1 \leq \bar{y} \quad (2.6)$$

which means that the Lorenz curve pertaining to $f^*(y)$ lies inside the curve corresponding to $f(y)$. This implies that condition (2.2) is satisfied and, as both Lorenz curves do not intersect, it is possible to rank the distributions based only in the assumptions that $U(y)$ is increasing and concave⁹.

Keeping the same functional form for $f(y)$ and $f^*(y)$ may appear a strong proposition. Several studies investigate the subject, presenting mixed results related to the pertinence of utilizing parametric and/or non-parametric estimates for income distribution. They are briefly presented as follows.

Regarding economic works on that matter, Cowell (2000) displays an overview on income distribution modeling studies, which date from as late as the eighteenth century after the seminal work of Vilfredo Pareto. The author states that the appropriate functional form depends on the definition and particular part of the income distribution in which the study is interested. Generally speaking, Cowell (2000, p. 146) refers that the Pareto model seems to be appropriate for analyzing upper incomes, whilst lognormal distributions depict individual earnings in

⁹ Atkinson (1970) further evaluates income transfer inside a given distribution, showing that the initial conditions do not hold as the shape of $f(y)$ and $f^*(y)$ modify. In the present study, it will be assumed that the function form for income distribution does not vary, bypassing this relevant discussion. For a more recent study in this subject, see Atkinson (2008).

homogeneous populations, and gamma models describe data in the center of the distribution.

In that sense, Boccanfuso, Decluwé and Savard (2008) compare lognormal, Pareto, and beta distributions, as well as kernel methods, and find evidence that there is no more appropriate single form for all analysis. Boccanfuso, Richard and Savard (2013) explore a larger set of functions and simulations, providing evidence that non-parametric estimators may present advantage in small groups. In contrast, no definite outcome was achieved on the advantages of more flexible functions over parametric estimations.

Conversely, even considering that lognormal distribution, gamma family, and two parameter models in general are limited in the variety of shapes of income distribution possibly described, Cowell (2000, p. 146) argues that bigger flexibility may impose a greater burden in terms of interpretation and computation, failing to offer comparative gains¹⁰.

It is possible to observe that there is no consensus on the most appropriate estimation method to achieve an income distribution function. Given that fact, the current work will utilize a parametric function aiming to enable a bigger range of analysis and subsequent results.

Following Harrison (1981) and Montroll and Shlesinger (1982), Bourguignon (2003) states that lognormality assumption in income distribution may be the most standard approximation of empirical distributions utilized by economic studies¹¹. In a study using approximately eight hundred country-year observations, López and Servén (2006) concluded that the null hypothesis that *per capita* income follows a lognormal distribution could not be empirically rejected. Therefore, the present analysis will assume lognormal distributions of income for different cohorts in Brazil.

¹⁰ One alternative way that has gained ground in the past decades is the use of non-parametric methods through kernel estimators bounded for $[0, +\infty)$. Bouezmarni and Scaillet (2005) propose two methods (asymmetric kernel and smoothed histogram) and prove that both are consistent. Cowell, Ferreira and Litchfield (1998) fit the shape of Brazilian income distribution using kernel density estimation, but had to separate the upper tail using Pareto functions, resulting in less attractive analytical properties.

¹¹ Clementi and Gallegati (2005), Lambert (2009), and Chakrabarti and Chakrabarti (2010) utilize the lognormal distribution as representative of the income distribution of the 97 to 99 per cent less rich in a society. The top 1 to 3 per cent would follow a Pareto distribution. For a counter view, see Bresson (2009).

Therefore, in order to investigate the impact of creating a pension scheme for civil servants following Brazilian rules let $Y_{c,t} \sim LN(\mu_c, \sigma^2)$, $Y_{p,t} \sim LN(\mu_p, \sigma^2)$, $Y_{r,t} \sim LN(\mu_r, \sigma^2)$, and $Y_{s,t} \sim LN(\mu_s, \sigma^2)$ be lognormally distributed independent variables with same variance but different mean. $Y_{c,t}$, $Y_{p,t}$, $Y_{r,t}$, and $Y_{s,t}$ are, respectively, the income of civil servants, private workers, retired individuals in the general regime, and beneficiaries of the special regime. According to the results presented in Vaz and Hoffmann (2007, p. 214), it can be assumed that

$$\mu_s > \mu_c > \mu_p > \mu_r > 0, \text{ for all } y. \quad (2.7)$$

Now let us consider

$$Y_0 = Y_{c,0} + Y_{p,0} + Y_{r,0}$$

as the income distribution in the society before the institution of a pension scheme for civil servants, and

$$Y_1 = Y_{c,1} + Y_{p,1} + Y_{r,1} + Y_{s,1}$$

the distribution of income after the creation of such regime.

Considering the simplifying assumption that the variables present the same variance and applying the Fenton-Wilkinson method (FENTON, 1960; BEAULIEU; ABU-DAYYA; MCLANE, 1995; COBB; RUMI; SALMERÓN, 2012), it is possible to propose that the distribution of income in t can be approximated by

$$Y_t \sim LN(\mu_t, \sigma_t^2)$$

where, in $t = 0$

$$\sigma_0^2 = \ln \left((e^{\sigma^2} - 1) \frac{(e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r})}{(e^{\mu_c} + e^{\mu_p} + e^{\mu_r})^2} + 1 \right) \quad (2.8)$$

And

$$\mu_0^2 = \ln(e^{\mu_c} + e^{\mu_p} + e^{\mu_r}) + \frac{1}{2}(\sigma^2 - \sigma_0^2).$$

Equally, in $t = 1$

$$Y_1 \sim LN(\mu_1, \sigma_1^2)$$

With

$$\sigma_1^2 = \ln\left((e^{\sigma^2} - 1) \frac{(e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r} + e^{2\mu_s})}{(e^{\mu_c} + e^{\mu_p} + e^{\mu_r} + e^{\mu_s})^2} + 1\right) \quad (2.9)$$

And

$$\mu_1^2 = \ln(e^{\mu_c} + e^{\mu_p} + e^{\mu_r} + e^{\mu_s}) + \frac{1}{2}(\sigma^2 - \sigma_1^2).$$

Let $f_{Y_t}(y)$ be the probability density function and $F_{Y_t}(y)$ be the cumulative distribution function of Y_t . If φ denotes the probability density function of the normal distribution $N(0,1)$ with $\varphi_t(y) = \text{prob}(Y_t < y)$, Cowell (1995) has shown that the Lorenz curve associated with the lognormal distribution at point y_1 is defined by

$$\Phi(F_{Y_t}) = \varphi_t(\varphi_t^{-1}(y_1) - \sigma_t), \quad F_{Y_t} \int_0^{y_1} f_{Y_t}(y) dy \quad (2.10)$$

Cowell (1995) highlights that such Lorenz curves do not intersect, and both the curves and the Gini coefficient depend only on parameter σ (the dispersion of the lognormal distribution). These properties would guarantee that condition (2.2) holds independently of the specific form of $U(y)$ in (2.1), considering only that $U(y)$ is increasing and concave.

Therefore, the income distribution in $t = 0$ would be preferably in comparison to $t = 1$ if and only if $\sigma_0 < \sigma_1$. From (2.8) and (2.9), that would hold if

$$\frac{e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r}}{(e^{\mu_c} + e^{\mu_p} + e^{\mu_r})^2} < \frac{e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r} + e^{2\mu_s}}{(e^{\mu_c} + e^{\mu_p} + e^{\mu_r} + e^{\mu_s})^2} \quad (2.11)$$

Isolating μ_s in (2.11) results in the following (demonstration in Appendix B):

$$\mu_s > \ln \left(\frac{2(e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r})(e^{\mu_c} + e^{\mu_p} + e^{\mu_r})}{(e^{\mu_c} + e^{\mu_p} + e^{\mu_r})^2 - (e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r})} \right)$$

or

$$\begin{aligned} \mu_s > \ln(2(e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r})(e^{\mu_c} + e^{\mu_p} + e^{\mu_r})) \\ - \ln((e^{\mu_c} + e^{\mu_p} + e^{\mu_r})^2 - (e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r})) \end{aligned} \quad (2.12)$$

Aiming to find a general result, we can rewrite (2.7) as follows without altering the central argument of the study:

$$\mu_s > \mu_c = \mu_p = \mu_r = \mu_a > 0, \text{ for all } y. \quad (2.7b)$$

Applying (2.7b) in (2.12) results in (demonstration in Appendix C)

$$\mu_s > \mu_a + \ln 3 \quad (2.13)$$

The result presented in (2.13) can be read as indicating that *if* the average income of the cohort created in $t + 1$ is higher than the average income of preexisting cohorts by a given margin ($\ln n$, where n is the number of cohorts in t), *than* the Gini Index in $t + 1$ will be higher than in t .

In order to indicate the expected impact of the adoption of a separated pension scheme in Brazilian cities, the following exercise was made based on the assumption of lognormality distribution of income presented in the current segment using software *R*. The commands are displayed in Appendix D.

Considering cohorts proportions as presented in Brasil (2017) and average earnings based on Vaz and Hoffmann (2007), we simulated a local population of

ten thousand individual divided in private workers, civil servants, retirees in the general regime, and beneficiaries of the special scheme. In t , the city did not have a separate scheme for its civil workers, hence only the three first groups were presented. Conversely, in t the special regime was created and, in the lapse between t and $t + 1$, ten per cent of the population retired.

The distributions of income were defined as lognormally distributed with different means but same variance, following (2.7). The parameters were adjusted according to a plausible range so that the results would approximate the mean and median as described in Vaz and Hoffmann (2007, p. 214).

Intending to isolate the impact of the modification in the Social Security system, a *ceteris paribus* assumption is made by considering a closed population – without deaths, newborns, or individuals changing cities. Also aiming for simplicity, informal sector workers and individual without income were not included, as they would remain unchanged in both periods.

The exercise investigates the shifts in income distribution supposing that one per cent of the population retires every year. Therefore, given the former assumptions, the original proportions of the working population are reduced by 10 per cent, whilst the participation of retirees increases at the same rate.

Table 2.6 presents the descriptive statistics of the population in $t = 0$ and $t = 1$, as well as the average income presented in Vaz and Hoffmann (2007, p. 214) or Brasil (2017). In the sequence, Chart 2.1 and Chart 2.2 show the approximated distribution curves of the simulation, pre and post RPPS institution, and the lognormality assumption means that the resulting Lorenz curves do not intercept, as shown Chart 2.3.

The results indicate that the institution of a pension scheme for civil servants according to Brazilian rules would result in an increase in the Gini index for the population, if the income is distributed lognormally with the same variance across the cohorts.

These findings give support to the hypothesis formulated in many of the works displayed in the former section. As summarized by Medeiros and Souza (2013, p. 29), the segmented pension scheme for civil servants appears to have regressive properties sufficiently strong to offset the progressive effects observed

in the general PAYG system and especially in the non-contributory rural pension and in the means-tested benefit.

Following current rules, these aspects will continue to affect society for decades even after the reforms which took place in the country from 1998 until 2005. Civil servants hired before these acts were granted future pensions according to former rules, such as benefit calculated as the final pay and the possibility of earlier retirement.

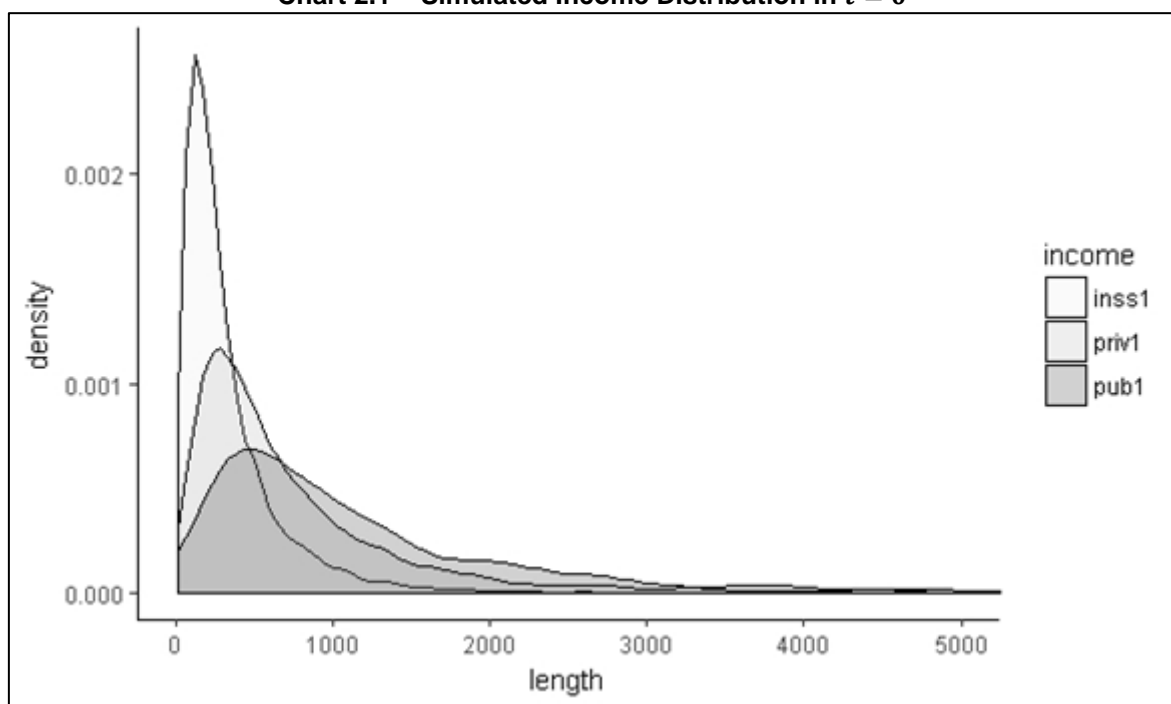
However, the assumption that income in Brazil is distributed lognormally bears no empirical consensus, demanding further investigation on the subject. Also, in order to test the theoretical and simulated effects, empirical analyses on the hypothesis become essential. Taking this into account, the next chapter intends to explore the resulting distributional consequences of creating a municipal pension scheme for civil servants.

Table 2.6 – Simulation Data Description

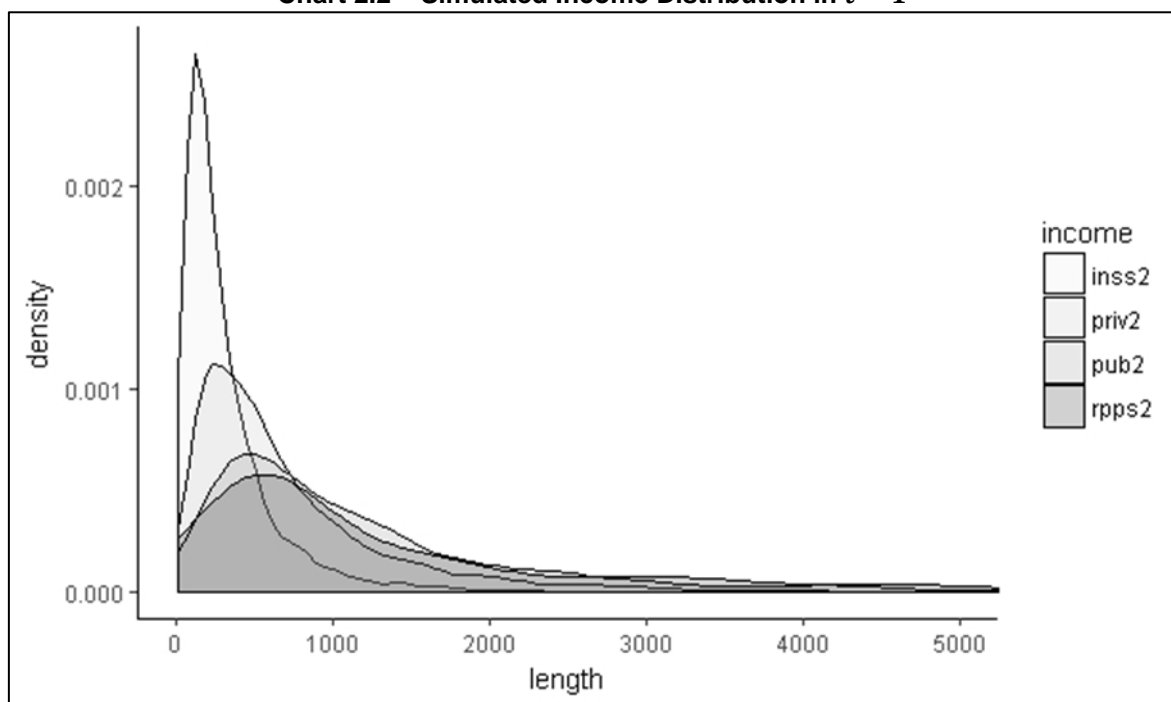
	t=0 (pre-RPPS)			t=1 (post-RPPS)			Calculated	
		Simulated average income (R\$) ¹	Simulated median income (R\$) ¹		Simulated average income (R\$) ¹	Simulated median income (R\$) ¹	Calculated average income (R\$) ^x	Calculated median income (R\$) ^x
	N			N				
Private workers	6,000	791.20	512.60	5,400	791.10	512.60	793.76	513.68
Civil Servants	1,200	1,286.00	877.90	1,080	1,379.00	881.60	1,330.14	886.10
General regime beneficiaries	2,800	331.00	226.30	3,400	338.30	219.20	-	y
Special scheme beneficiaries	0	-	-	120	1,347.00	833.80	z	z
Population	10,000	721.72	-	10,000	691.15	-	-	-
Simulated Gini index		0.525			0.537			

Sources: (1) author simulations; (2) Vaz and Hoffmann (2007); (3) Brasil (2017)

Notes: (x) regarding the year 2000; (y) there is no information in Brasil (2017); (z) PNAD does not discriminate income origin.

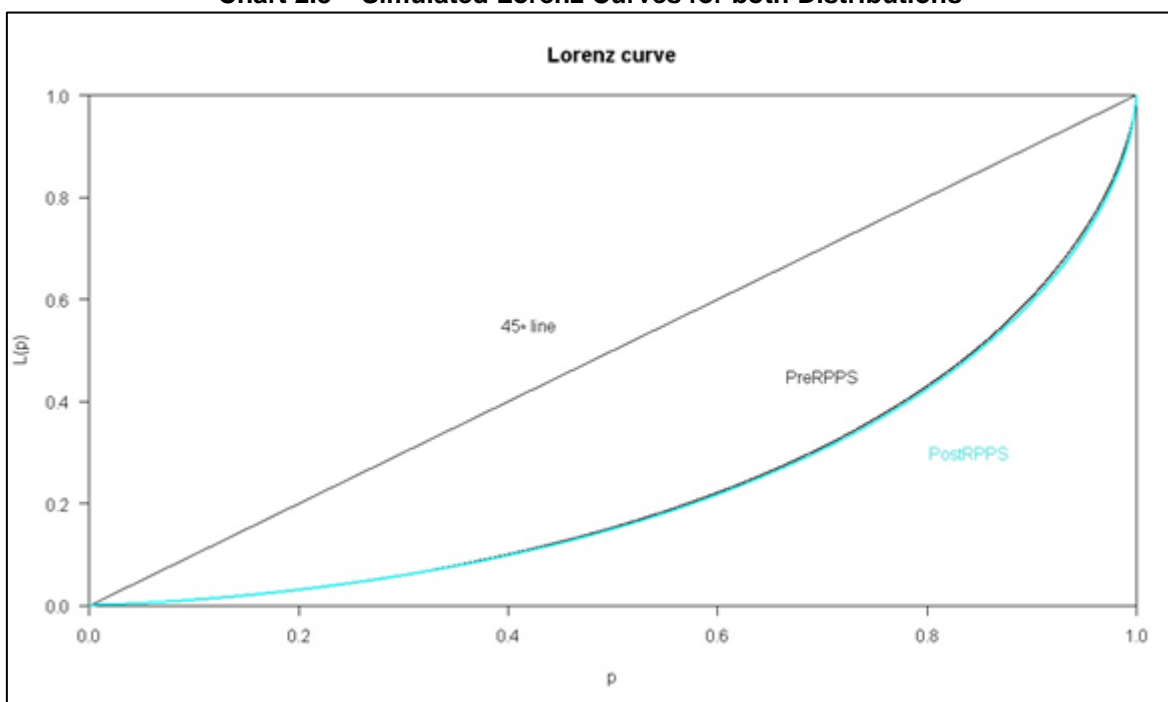
Chart 2.1 – Simulated Income Distribution in $t = 0$ 

Source: author calculation (2018)

Chart 2.2 – Simulated Income Distribution in $t = 1$ 

Source: author calculation (2018).

Chart 2.3 – Simulated Lorenz Curves for both Distributions



Source: author calculation (2018).

2.4 EMPIRICAL STRATEGY

Intending to present an alternative approach in comparison to past studies presented in section 2.3.1, the current section aims to perform an empirical investigation on the causal effect of the creation of local pension regimes for civil servants on the distribution of income in Brazilian cities.

However, such an analysis faces the *Fundamental Problem of Causal Inference* raised by Holland (1986, p. 947-948), once it is evidently impossible to observe simultaneously the following two situations: a city *exposed and not exposed* to a specific policy in order to compare outcomes.

This problem will be addressed following the general ideas presented in Rubin (1974, 1977). The basic point will be to study the *effects of causes* rather than the *cause of a given effect*. For instance, it seems clear that income distribution in a given city can be explained by several different variables. Conversely, the present work does not evaluate what causes the current observed distribution, but it assesses the effects of creating a special pension scheme for civil servants on local income distribution.

On that regard and considering Holland aforementioned proposition, investigating causality demands a comparison between one group that has been subject to the policy – *treated* group – and another who could but has not – *control* group. In a controlled experiment, both groups could be randomized in a way that the expected average characteristics of the components of each group would be equivalent. Therefore, the future state of the control group could be understood as the expected state of the treated group would have if its components have not been exposed to the treatment. In this way the difference between both would result in the effect caused by the treatment.

Nonetheless in social sciences it is usually not possible to employ randomized experiments, as stated by Athey and Imbens (2017). One alternative is to apply *ex post* analyses with quasi-experimental methods such as *difference-in-differences* (diff-in-diff or DiD), gathering available data to design a *valid* nonrandomized control group. In this method, the identification assumption would mean that if the treatment group had not created a special regime for its employees the intrinsic differences in the trajectory of the income distribution among both groups would be equivalent.

Following these propositions, the analysis performed in the current study will utilize data from Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* – IBGE) to compare the impact on the income concentration index measured for cities in the Brazilian census pertaining to the years 2000 and 2010¹². As mentioned earlier, the chosen method for the proposed investigation is diff-in-diff, considering the cities which created a special retirement regime for its servants as the treated group, and those which maintained the filiation to the general regime as control group. In order to check the robustness of the results, the cities that already had RPPS in 2000 will also be used as an alternative control group.

Considering that the cities are individually identified, a dummy variable categorizing each city is included to explicitly control for intrinsic individual fixed effects that could explain the different tracks registered in the panel data set

¹² The next section will present the complete data used in the models as covariates and respective sources.

(WOOLDRIDGE, 2002, p. 265-269; ANGRIST; PISCHKE, 2009, p. 165-169). Therefore, the basic model is formally described as follows:

$$Y_{i,t} = \beta_0 + \beta_1 P_t + \gamma_1 DD_{i,t}^{[1]} + \gamma_2 DD_{i,t}^{[2]} + \gamma_3 DD_{i,t}^{[3]} + \alpha_i + \varepsilon_{i,t}, \quad t = 0, 1, \quad i = 1, \dots, \quad (2.14)$$

Where $Y_{i,t}$ is the income concentration index for city i in year t ; P_t is a dummy representing the year, with $2000 = 0$ and $2010 = 1$; $DD_{i,t}^{[j]}$ is the set of $j = \{1, 2, 3\}$ variables of interest, a dummy where $DD_{i,t}^{[j]} = 1$ only if $t = 1$ and city i created RPPS in j , where $j = 1$ represents the years 2001 until 2003, $j = 2$ denotes 2004-2006, and $j = 3$ is 2007-2009; β_0 is the intercept; β_0 a linear coefficient; γ_j is another set of linear coefficients indicating the distributive impact of a city creating a special retirement regime in period j ; α_i is a set of time invariant effects for city i ; and $\varepsilon_{i,t}$ is an error term for city i in year t .

The central theoretical hypothesis is that γ_j will present positive and significant values. It is also expected that γ_1 will display a higher value than γ_2 , which is expected to be higher than γ_3 once the earlier creation of RPPS allows for a bigger impact. This strategy follows the approach presented by Rocha e Soares (2010).

Intending to facilitate the computational estimation of the model, the *fixed effects transformation* – or *within transformation* – is recommended according to Wooldridge (2002, p. 267). Considering a modified version of (2.14) with only $DD_{i,t}^{[j]}$ and α_i for demonstration purposes, the modification is obtained by averaging the equation over $t = 0, 1$ for each city i , as described below.

$$Y_{i,t} = \sum_{j=1}^3 \gamma_j DD_{i,t}^{[j]} + \alpha_i + \varepsilon_{i,t} \quad (2.14b)$$

$$\bar{Y}_i = \gamma_1 \overline{DD}_i^{[1]} + \gamma_2 \overline{DD}_i^{[2]} + \gamma_3 \overline{DD}_i^{[3]} + \alpha_i + \bar{\varepsilon}_i \quad (2.15)$$

Where $\bar{Y}_i = 2^{-1} \sum_{t=0}^1 Y_{i,t}$; $\overline{DD}_i^{[j]} = 2^{-1} \sum_{t=0}^1 DD_{i,t}^{[j]}$; $\bar{\varepsilon}_i = 2^{-1} \sum_{t=0}^1 \varepsilon_{i,t}$.

Subtracting (2.15) from (2.14b) results in the following.

$$Y_{i,t} - Y_i = \gamma_j \left(DD_{i,t}^{[j]} - \overline{DD}_i^{[j]} \right) + (\varepsilon_{i,t} - \bar{\varepsilon}_i)$$

which can be written as

$$\dot{Y}_{i,t} = \gamma_j \dot{DD}_{i,t}^{[j]} + \dot{\varepsilon}_{i,t} \quad (2.16)$$

with $\dot{Y}_{i,t} = Y_{i,t} - \bar{Y}_i$; $\dot{DD}_{i,t}^{[j]} = DD_{i,t}^{[j]} - \overline{DD}_i^{[j]}$; and $\dot{\varepsilon}_{i,t} = \varepsilon_{i,t} - \bar{\varepsilon}_i$. Equation (2.16) represents the time demeaning of (2.14b) and can be estimated by pooled ordinary least squares (OLS), once α_i is no longer explicitly specified. Wooldridge (2002, p. 268) shows that such estimation – known as the *fixed effects estimator* (FE) – is consistent given the assumption that $\mathbb{E} \left(\dot{DD}_{i,t}^{[j]'} \dot{\varepsilon}_{i,t} \right) = 0$. Equivalent transformations will be performed in respect to the next equations.

Aiming to further accommodate heterogeneity in the groups, other models will be evaluated. The next equation indicates the inclusion of characteristics of cities.

$$Y_{i,t} = \beta_0 + \beta_1 P_t + \sum_{k=2}^K \beta_k X_{i,t}^{[k]} + \sum_{j=1}^3 \gamma_j DD_{i,t}^{[j]} + \alpha_i + \varepsilon_{i,t} \quad (2.17)$$

Where $X_{i,t}^{[k]}$ is a set of K covariates indicating municipal features for city i in year, such as year of city creation, average *per capita* income, Human Development Index, and political party of the mayor, along with geographic and demographic variables. The vector of liner coefficients for this specification is β_k , $k = (2, \dots, K)$.

Other important source of heterogeneity in data from Brazilian cities is regional differences. Following the procedure adopted by Rocha and Soares (2010), the next equation includes state-specific time dummies to deal with this problem.

$$Y_{i,t} = \beta_0 + \beta_1 P_t + \sum_{k=2}^K \beta_k X_{i,t}^{[k]} + \sum_{j=1}^3 \gamma_j DD_{i,t}^{[j]} + \alpha_i + \beta_s \rho_s P_t + \varepsilon_{i,t}$$

Where ρ_s represents 26 dummies assuming 1 for the specific state S , zero otherwise. The coefficient β_s is intended to capture state trends for variation in the income concentration index.

The last procedure to be considered is the stratification of the analyses among the geographic regions in Brazil. As shown by Baer (2012) and stressed by Resende (2014, p. 11), it is now consensual that the effect of public policies in the country must be investigated regionally. With that in mind, every model previously described will be reevaluated according to northern (North and Northeast) and southern (Center-West, South, and Southeast) Brazilian regions.

Lastly, whilst estimating fixed effect models with panel data, Bertrand et al. (2004) suggest the use of robust variance matrix in order to account for possible serially correlated and heteroskedastic errors. That will not be the case in the current study once the data comprises only two time periods, as justified by Wooldridge (2002, p. 274).

The present segment will proceed with a description of the data. Subsequently, the empirical results will be presented, followed by a discussion regarding the findings.

2.4.1 Data Description

The data utilized in the present study comprises official information produced by Brazilian governmental bodies. Among the most important data collected, the Gini index segregated by city refers to the national Census performed by IBGE in the years 2000 and 2010, while the data of creation of RPPS was presented by the Ministry of Social Security (*Ministério da Previdência Social* – MPS). Intending to compare the results, the same models previously described will be estimated using the Theil-L index for income concentration as the dependent variable.

The treated group is comprised of the 350 cities which created the special retirement plan for civil servants between 2001 and 2009. However, once the institutional changes need time until the theoretical effects on income distribution can be observed, the impact will be evaluated in three different groups of cities,

sorted according to the date of institution of RPPS (2001-2003, 2004-2006, and 2007-2009).

On the other hand, the control group *a* is constituted of the set of cities that maintained its civil servants affiliated to the national PAYG retirement system for private workers until 2010. It contains a larger number of cities (3,664) and the descriptive statistics are shown as follows.

Aiming to check the robustness of the impact of creating a special retirement regime for civil servants, another control group *b* was utilized, considering the 1475 cities that already possessed RPPS in the year 2000.

Table 2.7 presents some descriptive statistics referring to the three mentioned groups, including the non-categorical covariables used in equations (2.17) and (2.18). In addition to the variables presented in the table, which were assembled by IBGE, model (2.17) also comprises a dummy variable indicating the political party of the incumbent city mayor, while (2.18) adds 26 state-time dummies. The complete list of variables and sources is presented in Appendix E.

Observing the former tables allows for a non-statistical comparison of the data. The first noticeable feature is that, even if both control groups are constituted of a much larger number of cities, the average figures of the variables are similar. The bigger differences are noted in the average size of population, with control 1 comprising smaller cities, while control 2 presents an average population more than four times bigger. Regarding the dependent variables, the data show a reduction in the income concentration index regarding every group, except for the Theil-L index measured for the NE-NO regions in the control group 1.

As mentioned earlier, the central hypothesis of the current study, supported by the theoretical proposition formulated, is that the creation of RPPS would result in a higher income concentration index for the city. The raw data presented in this segment are not able to indicate whether this is the case. Next section will apply a causal inference method to empirically evaluate this observation.

Table 2.7 – Summarized Descriptive Statistics

Variables	Treated Group (RPPS 2001-2009)			Control Group 1 (INSS until 2010)			Control Group 2 (RPPS pre 2001)			
	Geographic Regions			Geographic Regions			Geographic Regions			
	Brazil	CO-SE-SU	NE-NO	Brazil	CO-SE-SU	NE-NO	Brazil	CO-SE-SU	NE-NO	
N	350	149	201	3664	1932	1732	1475	1182	293	
Gini Index (2000)	Av.	0.577	0.555	0.593	0.555	0.537	0.574	0.548	0.540	0.580
	SD	0.066	0.069	0.059	0.069	0.068	0.065	0.066	0.065	0.059
Gini Index (2010)	Av.	0.518	0.534	0.564	0.505	0.472	0.541	0.494	0.482	0.544
	SD	0.059	0.150	0.127	0.067	0.059	0.056	0.064	0.061	0.051
Theil Index (2000)	Av.	0.522	0.493	0.543	0.511	0.497	0.526	0.516	0.508	0.550
	SD	0.059	0.061	0.047	0.135	0.141	0.127	0.134	0.134	0.128
Theil Index (2010)	Av.	0.489	0.424	0.537	0.462	0.393	0.539	0.433	0.408	0.534
	SD	0.118	0.107	0.101	0.133	0.107	0.117	0.122	0.112	0.102
Year of city creation	Av.	1963	1966	1960	1963	1962	1964	1958	1959	1955
	SD	22.353	23.769	20.898	21.620	21.185	22.045	20.377	20.718	18.699
Human Development Index	Av.	0.566	0.635	0.514	0.577	0.640	0.507	0.633	0.659	0.527
	SD	0.111	0.086	0.099	0.113	0.083	0.100	0.100	0.078	0.107
Population over 65	Av.	0.067	0.070	0.066	0.075	0.080	0.068	0.075	0.077	0.066
	SD	0.023	0.028	0.020	0.023	0.023	0.021	0.025	0.025	0.021
Total Population	Av.	37,328	31,852	41,388	17,010	15,873	18,277	69,085	65,414	83,907
	SD	108,006	62,908	131,683	29,496	33,580	24,076	363,816	386,238	253,679
Urban Population	Av.	0.597	0.679	0.537	0.584	0.646	0.515	0.695	0.718	0.604
	SD	0.222	0.214	0.209	0.220	0.221	0.197	0.229	0.226	0.221
Formal Private Sector Employees	Av.	0.226	0.313	0.162	0.250	0.338	0.151	0.328	0.359	0.199
	SD	0.161	0.160	0.128	0.173	0.173	0.108	0.170	0.162	0.140
Public Employees	Av.	0.069	0.076	0.064	0.064	0.064	0.065	0.068	0.068	0.068
	SD	0.039	0.042	0.036	0.045	0.044	0.046	0.039	0.039	0.035
Income Per Capita	Av.	383.254	546.580	262.181	383.528	511.992	240.230	527.494	587.774	283.867
	SD	224.363	227.749	121.535	208.403	198.093	95.727	243.452	221.858	161.050

Source: author elaboration (2018).

2.4.1 Main Results

Following the method and models already described and using the data presented in the former section, the results are shown in the next tables. Table 2.8 displays the effects found through models 1, 2 and 3 considering the Gini index as the dependent variable and the control group comprising the cities that maintained its employees secured by the national PAYG system for private workers.

The main result presented through the empirical strategy adopted in this study is that the estimated values for γ_1 , γ_2 , and γ_3 did not result positive, as can be observed in the tables displayed through the next pages. While this effect may indicate the incorrectness of the central hypothesis of this study, some remarks must be done. First, in order to observe the robustness of the findings, Table 2.8 presents the results obtained when comparing the treated groups to control group *b*, constituted by the cities that already possessed RPPS in the year 2000.

The comparisons between treated groups and both control groups appear to indicate that the short term impacts of the creation of a special retirement regime for civil servants following Brazilian rules reduces local income concentration. This effect, however, was not observed in the cities which adopted the policy earlier (2001 to 2003) or later (2007 to 2009).

To further analyze the robustness of the results, the effect of the creation of RPPS on Theil-L index of income concentration was also estimated, which displayed similar results.

The analyses performed, although do not corroborate with the central hypothesis that the creation of a local RPPS would result in a higher income concentration for that city, are not able to fully disregard the theoretical and simulated outcomes either. On top of that, the results allow for relevant discussions.

Pertaining to the distributive consequences of Brazilian Social Security, the results show that, in the ten years between the Census of 2000 and 2010, local governments which created the special retirement plan for civil servants did not experienced a lesser reduction in the local Gini index (positive coefficient) when compared to the cities that maintained the affiliation to the national system for private worker nor to those which already possessed special regime.

Table 2.8 – Effect of the creation of RPPS on the Gini index, control group a

		Model 1 (balanced)	Model 2 (unbalanced)	Model 3 (unbalanced)
Brazil				
Impact	2001-2003	-0.00157142	1.3337e-03	2.0229e-03
	<i>SD</i>	(0.00478646)	(4.9906e-03)	(5.2432e-03)
	2004-2006	-0.02181826***	-1.6498e-02*	-1.9947e-02
	<i>SD</i>	(0.00818823)	(8.8083e-03)	(8.4703e-03)
	2007-2009	-0.00010842	-7.7458e-03	-3.4685e-03
	<i>SD</i>	(0.00902970)	(9.1392e-03)	(8.5933e-03)
	R²	0.34788	0.49497	0.57445
N	4014	3874	3874	
Regions: CO-SE-SU				
Impact	2001-2003	0.0108702	8.5884e-03	8.5455e-03
	<i>SD</i>	(0.0069795)	(6.8098e-03)	(6.8948e-03)
	2004-2006	-0.0183383	-5.6108e-03	-1.4137e-02
	<i>SD</i>	(0.0121437)	(1.3117e-02)	(1.3080e-02)
	2007-2009	0.0034757	-1.8401e-02	-1.8757e-02
	<i>SD</i>	(0.0147167)	(1.4295e-02)	(1.4036e-02)
	R²	0.48365	0.65253	0.68035
N	2081	1997	1997	
Regions: NE-NO				
Impact	2001-2003	-0.0163894***	-8.5259e-03	-6.7060e-03
	<i>SD</i>	(0.0062761)	(6.9245e-03)	(7.9649e-03)
	2004-2006	-0.0299747***	-2.7197e-02**	-2.3137e-02**
	<i>SD</i>	(0.0105871)	(1.1471e-02)	(1.1344e-02)
	2007-2009	-0.0107426	-6.6669e-03	3.2547e-03
	<i>SD</i>	(0.0109878)	(1.1553e-02)	(1.1064e-02)
	R²	0.21377	0.34443	0.42706
N	1933	1877	1877	
Individual Fixed Effects	Yes	yes	yes	
Covariables	No	yes	yes	
State-time Dummies	No	no	yes	

Source: author elaboration (2018).

Notes: (i) dependent variable: municipal Gini index; independent variables: diff-in-diff dummies, year dummy, IDH-M, total and urban population, year of creation of city, political party of mayor, private sector workers, public sector employees; (ii) standard errors between parenthesis; (iii) significance codes: 0 '****' 0.001 '***' 0.01 '**' 0.05 '*' 0.1 '.' 1; (iv) F-test for individual effects, alternative hypothesis: significant effects.

Table 2.9 – Effect of the creation of RPPS on the Gini index, control group *b*

		Model 1 (balanced)	Model 2 (unbalanced)	Model 3 (unbalanced)	
Brazil					
Impact	2001-2003	0.0027585	3.8149e-03	1.0635e-03	
	<i>SD</i>	(0.0044390)	(4.4038e-03)	(4.4927e-03)	
	2004-2006	-0.0174883**	-7.1659e-03	-1.4907e-02**	
	<i>SD</i>	(0.0073983)	(7.2020e-03)	(7.0187e-03)	
	2007-2009	0.0042215	3.0607e-04	1.5412e-03	
	<i>SD</i>	(0.0081384)	(7.6018e-03)	(7.6493e-03)	
	R²	0.44062	0.58312	0.63167	
	N	1825	1810	1810	
	Regions: CO-SE-SU				
	Impact	2001-2003	0.0041440	4.7919e-03	1.0458e-02*
<i>SD</i>		(0.0064460)	(5.7928e-03)	(5.7240e-03)	
2004-2006		-0.0250645**	-5.1926e-03	-1.4816e-02	
<i>SD</i>		(0.0111043)	(9.9114e-03)	(9.7763e-03)	
2007-2009		-0.0032505	-1.0461e-02	-9.1665e-03	
<i>SD</i>		(0.0134359)	(1.1852e-02)	(1.1672e-02)	
R²		0.48201	0.65248	0.67747	
N		1331	1321	1321	
Regions: NE-NO					
Impact		2001-2003	-0.0123306*	-5.8175e-03	-1.0497e-02
	<i>SD</i>	(0.0064849)	(7.0205e-03)	(7.5176e-03)	
	2004-2006	-0.0259159**	-1.3809e-02	-1.4604e-02	
	<i>SD</i>	(0.0100356)	(1.0862e-02)	(1.0738e-02)	
	2007-2009	-0.0066837	-3.8101e-03	7.5202e-03	
	<i>SD</i>	(0.0103772)	(1.0434e-02)	(1.0759e-02)	
	R²	0.34017	0.48549	0.52355	
	N	494	489	489	
	Individual Fixed Effects	Yes	yes	yes	
	Covariables	No	yes	yes	
State-time Dummies	No	no	yes		

Source: author elaboration (2018).

Notes: (i) dependent variable: municipal Gini index; independent variables: diff-in-diff dummies, year dummy, IDH-M, total and urban population, year of creation of city, political party of mayor, private sector workers, public sector employees; (ii) standard errors between parenthesis; (iii) significance codes: 0 '****' 0.001 '***' 0.01 '**' 0.05 '*' 0.1 '.' 1; (iv) F-test for individual effects, alternative hypothesis: significant effects.

Table 2.10 – Effect of the creation of RPPS on the Theil-L index, control group a

		Model 1 (balanced)	Model 2 (unbalanced)	Model 3 (unbalanced)	
Brazil					
Impact	2001-2003	-0.0075042	7.6804e-04	3.2132e-03	
	<i>SD</i>	(0.0106516)	(1.0498e-02)	1.1012e-02	
	2004-2006	-0.0500461***	-3.0279e-02	-2.9426e-02*	
	<i>SD</i>	(0.0182217)	(1.8528e-02)	(1.7790e-02)	
	2007-2009	0.0122326	-1.2930e-02	6.3316e-03	
	<i>SD</i>	(0.0200943)	1.9224e-02	(1.8049e-02)	
	R²	0.098041	0.34432	0.44917	
	N	4014	3874	3874	
	Regions: CO-SE-SU				
	Impact	2001-2003	0.0116450	1.0068e-02	2.3592e-02
<i>SD</i>		(0.0146073)	(1.4464e-02)	(1.4501e-02)	
2004-2006		-0.0654418	-3.8431e-02	-3.3597e-02	
<i>SD</i>		(0.0254151)	(2.7860e-02)	(2.7511e-02)	
2007-2009		0.0015321	-4.5821e-02	-2.7936e-02	
<i>SD</i>		(0.0308003)	(3.0361e-02)	(2.9520e-02)	
R²		0.35771	0.54517	0.58971	
N		2081	1997	1997	
Regions: NE-NO					
Impact		2001-2003	-0.0403735***	-1.0810e-02	-2.3017e-02
	<i>SD</i>	(0.0134974)	(1.4255e-02)	(1.6685e-02)	
	2004-2006	-0.0581964**	-3.0631e-02	-2.9402e-02	
	<i>SD</i>	0.0227687	(2.3615e-02)	(2.3765e-02)	
	2007-2009	-0.0128498	-5.3584e-03	2.1682e-02	
	<i>SD</i>	(0.0236304)	(2.3784e-02)	(2.3178e-02)	
	R²	0.011205	0.16943	0.24838	
	N	1933	1877	1877	
	Individual Fixed Effects	Yes	yes	yes	
	Covariables	No	yes	yes	
State-time Dummies	No	no	yes		

Source: author elaboration (2018).

Notes: (i) dependent variable: municipal Theil-L index; independent variables: diff-in-diff dummies, year dummy, IDH-M, total and urban population, year of creation of city, political party of mayor, private sector workers, public sector employees; (ii) standard errors between parenthesis; (iii) significance codes: 0 '****' 0.001 '***' 0.01 '**' 0.05 '*' 0.1 '.' 1; (iv) F-test for individual effects, alternative hypothesis: significant effects.

Table 2.11 – Effect of the creation of RPPS on the Theil-L index, control group *b*

		Model 1 (balanced)	Model 2 (unbalanced)	Model 3 (unbalanced)
Brazil				
Impact	2001-2003	0.0270835**	1.3645e-02	1.7175e-03
	SD	(0.0098012)	(9.7066e-03)	(9.8582e-03)
	2004-2006	-0.0154584	-8.9671e-03	-2.5804e-02.
	SD	(0.0163351)	(1.5874e-02)	(1.5401e-02)
	2007-2009	0.0468203**	1.7748e-02	1.5029e-02
	SD	(0.0179693)	(1.6756e-02)	(1.6784e-02)
	R²	0.26042	0.46052	0.52762
N	1825	1810	1810	
Regions: CO-SE-SU				
Impact	2001-2003	0.0080365	5.6394e-03	1.8054e-02
	SD	(0.0137746)	(1.2751e-02)	(1.2666e-02)
	2004-2006	-0.0690503**	-3.3238e-02	-4.5485e-02*
	SD	(0.0237289)	(2.1817e-02)	(2.1632e-02)
	2007-2009	-0.0020764	-1.6757e-02	-7.9138e-03
	SD	(0.0287112)	(2.6090e-02)	(2.5826e-02)
	R²	0.37989	0.56796	0.59483
N	1331	1321	1321	
Regions: NE-NO				
Impact	2001-2003	-0.0124285	1.6060e-03	-1.6819e-02
	SD	(0.0141546)	(1.4721e-02)	(1.5890e-02)
	2004-2006	-0.0302514	6.0122e-03	7.5924e-04
	SD	(0.0219046)	(2.2776e-02)	(2.2697e-02)
	2007-2009	0.0150952	1.5566e-02	3.2108e-02
	SD	(0.0226504)	(2.1879e-02)	(2.2742e-02)
	R²	0.02856	0.30066	0.37834
N	494	489	489	
Individual Fixed Effects	Yes	yes	yes	
Covariables	No	yes	yes	
State-time Dummies	No	no	yes	

Source: author elaboration (2018).

Notes: (i) dependent variable: municipal Theil-L index; independent variables: diff-in-diff dummies, year dummy, IDH-M, total and urban population, year of creation of city, political party of mayor, private sector workers, public sector employees; (ii) standard errors between parenthesis; (iii) significance codes: 0 '****' 0.001 '***' 0.01 '**' 0.05 '*' 0.1 '.' 1; (iv) F-test for individual effects, alternative hypothesis: significant effects.

Conversely, the coefficient obtained for the group of municipalities that created RPPS from 2004 to 2006 experienced a reduction in the income concentration measured by both indices in comparison to both control groups in most specifications.

One possible explanation for the results is the fiscal impact of the institution of RPPS. As shown in section 2.2.2, there is a short term fiscal gain in creating the special regime, once the employer social security tax owed to the national general system is almost twice as high as the minimum rate prescribed for RPPS (11% to 20%). This reduction tends to have a significant short term impact in the city budget once approximately fifty per cent of local revenues are directed to government worker payroll (BRASIL, 2017e, p. 43). Hence, local governments would be able to increase expenditure in social programs – directly reducing income concentration – or investments – generating economic growth and indirectly affecting income concentration.

However, given that municipal governments are responsible for eventual deficits in its RPPS and the legal rules allows for servants to retire according to the new scheme immediately after the creation of the regime, this short term gains disappear quickly as actuarial deficits call for increases in employer contributions, as displayed in Table 2.4. Therefore, the direct impact theoretically proposed in the former section could be strong enough to offset the initial indirect redistributive impacts.

This new proposition is corroborated by the results obtained through the empirical investigation performed, once the coefficient obtained measuring the impact of the creation of RPPS from 2001 to 2003 was not significant in the majority of the models. Conversely, if the coefficient was also negative and stronger for this group, the results would indicate that the institution of the special regime presented the causal effect of redistributing income in the city.

Once the outcomes show non-significant impacts for the adoption of RPPS between 2001-2003 for every model apart from the regional analysis regarding the northern regions of Brazil, it indicates that the policy do not appear to have a linear impact on local income distribution, possibly due to direct and indirect effects acting in opposite directions.

Regarding the theoretical proposition, the simulated results had already showed that the impact in the Gini index would be small. On top of that, the *ceteris paribus* proposition may be excessive unrealistic for a number of reasons:

- a) a retired civil servant, especially from a small city, could move to a different location after retirement, erasing the proposed impact at municipal level;
- b) the shifts in income distribution occasioned by the modifications in the working population between the two measures are likely to have a bigger impact in the Gini index than the creation of RPPS;
- c) the level of regional, state and individual heterogeneity observed in the Brazilian territory mean that any of the former facts would affect the cities in diverse ways.

Another possible explanation for the results is that the legal modifications achieved by the constitutional amendments of 1998, 2003 and 2005 were in fact able to reduce the regressive nature of Brazilian retirement schemes for civil servants. Even if the rules pertaining to public employees are still more generous in comparison to private workers, the resulting retirement income is not sufficiently different to impact the municipal income distribution in the first decade of institution of RPPS.

In spite of the empirical results, it is important to note that, even if the theoretical hypothesis was not corroborated by the proposed empirical analysis, it does not imply that the creation of RPPS following Brazilian rules do not impact income distribution. As showed in the literature review presented earlier, the retirement rules regarding civil service appear to have a strong regressive impact in the society. The lack of information on the source of pension income in the PNAD calls for alternative forms for empirically evaluating the redistributive aspects of Social Security in Brazil, and the current analyses were designed with this objective.

2.5 CONCLUDING REMARKS

This study intended to evaluate the economic effects of Social Security in Brazil, focusing on the impact of the creation of a separated pension schemes for the municipal civil servants on the income distribution in the cities. To do so, an overview of legal features and economic studies was displayed. Later, a theoretical approach was proposed and followed by a simulation exercise, providing the bases for the hypothesis that creating RPPS in a given city would increase the income concentration among the local population.

In short, even though the empirical results do not corroborate the theoretical proposition, they also do not indicate that it should be disregarded. The fact that the coefficient was significantly negative for the cities that created a special regime between 2004 and 2006 should not be interpreted as disproving the hypothesis. In order to allow for this interpretation, the effect should also be negative yet stronger for the institution of RPPS from 2001 to 2003, which was not the case.

The empirical finding can be regarded as robust. Three models were developed considering two different independent variables: Gini and Theil-L indexes. Each model was tested regarding two different control groups. Every model was also segregated by Brazilian geographic regions and rerun, resulting in similar outcomes for most specifications.

It is important to note that this can be considered the first direct empirical analysis of the distributional impacts of Brazilian RPPS. As shown in the literature overview, most studies approached the problem through decomposition of the Gini index, utilizing data from Brazilian PNAD. However, once the survey does not discriminate whether the retirement income is provided by the INSS, any RPPS, or a private financial institution, it is not possible to directly investigate the effect of RPPS on income distribution.

Regarding the chosen method and the reliability of the empirical findings, one aspect that was not tested was the possible existence of selection bias. Once Brazilian Constitution authorize cities to create RPPS at any time, it can be possible that a local government aiming to improve income distribution in the city through other policies would also opt not to institute the special regime, creating endogeneity problems. However, considering that Social Security is not

consensually viewed as a public mechanism for income redistribution, the odds of such problem can be regarded as slim.

Nevertheless, future studies using other quasi-experimental statistical methods could further evaluate this possibility, as well as provide comparative results for the central hypothesis.

Additionally, affecting income distributive patterns of a city can take longer than ten years to produce the theoretical effects. Therefore, considering that new measurements will be available after the 2020 Census, new studies comprising future data can produce further and more robust indications on the impact of such policy.

Finally, the current work was intended to add information to the relevant discussion on the future of public retirement schemes in Brazil. The absence of empirical corroboration for the theoretical proposition can be seen as yet another indication on the complexity of this system, demonstrating the necessity of further studies to produce reliable evidence to give support to the constant debates regarding Social Security.

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APPENDIX A – List of Terms Related to Social Security

Term	Definition
Accrual rate	The amount of pension earned for each year of contributions
Contributory basic pension	A pension paid, often at a flat rate, to a person with a full record of contributions, or pro rata to a person with an incomplete contributions record
Defined-benefit (DB) pensions	A pension plan with a guarantee by the insurer or pension agency that a benefit based on a prescribed formula will be paid. Such plans can be fully funded or unfunded
Defined-contribution (DC) pensions	A pension plan in which the periodic contribution is prescribed and the benefit depends on the contribution plus the investment return on accumulated contributions. Typically, such plans are fully funded
Dependency rate	The number of current workers in comparison to pensioners
Fully funded pensions	The accumulation of pension reserves that total 100 percent of the present value of all pension liabilities owed to current members
Means-tested benefit	A benefit that is paid only if the recipient's income falls below a certain level
Noncontributory or social universal pension	beneficiaries are defined based on years of residence in the country
Notional accounts	A defined-benefit plan that mimics the structure of funded defined contribution plans but remains unfunded (except for a potential partial reserve fund)
Notional defined-contribution (NDC)	Pensions are financed on a pay-as-you-go or partially funded basis, with individual pension bearing a quasi-actuarial relationship to his or her lifetime pension contributions
Old-age dependency rate	The ratio of older persons to working-age individuals. The old-age dependency rate is defined as the number of persons older than age 65 divided by the number of people age 15 to 64
Replacement rate	The ratio of the average pension retirees to average wages for the cohort of workers close to retirement
Partially-funded pensions	Benefits paid both from accumulated assets and from current contributions. These systems are also referenced as partially-PAYG or simply PAYG
Pay-as-you-go (PAYG) pensions	Benefits are paid out of current revenue (usually by the state, from tax revenue) rather than out of accumulated funds. Partially-funded pensions are often referred to as PAYG
Pension system dependency rate	The ratio of persons receiving pensions from a certain pension scheme divided by the number of workers contributing to the same scheme in the same period
Points schemes	Workers earn pension points based on their earnings each year. At retirement, the sum of pension points is multiplied by a pension-point value to convert them into a regular pension payment

Sources: Barr and Diamond (2009); Pallares-Miralles, Romero and Whitehouse (2012); and Whitehouse (2016).

APPENDIX B – Result (2.12) Demonstration

Starting from (2.11)

$$\frac{e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r}}{(e^{\mu_c} + e^{\mu_p} + e^{\mu_r})^2} < \frac{e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r} + e^{2\mu_s}}{(e^{\mu_c} + e^{\mu_p} + e^{\mu_r} + e^{\mu_s})^2} \quad (2.11)$$

In order to isolate μ_s , we can define

$$e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r} = a \quad (B.1)$$

and

$$e^{\mu_c} + e^{\mu_p} + e^{\mu_r} = b \quad (B.2)$$

That allows for rewriting (2.11) as

$$\frac{a}{b^2} < \frac{a + e^{2\mu_s}}{(b + e^{\mu_s})^2}$$

which results in

$$\frac{a}{b^2} < \frac{a + e^{2\mu_s}}{b^2 + 2be^{\mu_s} + e^{2\mu_s}}$$

Now, it is possible to isolate μ_s :

$$ab^2 + 2abe^{\mu_s} + ae^{2\mu_s} < ab^2 + b^2e^{2\mu_s}$$

$$2abe^{\mu_s} < b^2e^{2\mu_s} - ae^{2\mu_s}$$

$$2abe^{\mu_s} < (b^2 - a)e^{2\mu_s}$$

$$\frac{2ab}{(b^2 - a)} < \frac{e^{2\mu_s}}{e^{\mu_s}}$$

$$e^{\mu_s} > \frac{2ab}{(b^2 - a)}$$

$$\mu_s > \ln\left(\frac{2ab}{(b^2 - a)}\right) \quad (\text{B.3})$$

Substituting (B.1) and (B.2) in (B.3) results in

$$\mu_s > \ln\left(\frac{2(e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r})(e^{\mu_c} + e^{\mu_p} + e^{\mu_r})}{(e^{\mu_c} + e^{\mu_p} + e^{\mu_r})^2 - (e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r})}\right)$$

or

$$\begin{aligned} \mu_s > \ln(2(e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r})(e^{\mu_c} + e^{\mu_p} + e^{\mu_r})) \\ - \ln((e^{\mu_c} + e^{\mu_p} + e^{\mu_r})^2 - (e^{2\mu_c} + e^{2\mu_p} + e^{2\mu_r})) \end{aligned} \quad (2.12)$$

■

APPENDIX C – Result (2.13) Demonstration

If (2.7) is redefined as

$$\mu_s > \mu_c = \mu_p = \mu_r = \mu_a > 0, \text{ for all } y. \quad (2.7b)$$

It is possible to express

$$3e^{2\mu_a} = a \quad (C.1)$$

and

$$3e^{\mu_a} = b \quad (C.2)$$

Rewriting (B.3) considering (C.1) and (C.2) leaves

$$\mu_s > \ln\left(\frac{2(3e^{2\mu_a})(3e^{\mu_a})}{((3e^{\mu_a})^2 - 3e^{2\mu_a})}\right)$$

$$\mu_s > \ln\left(\frac{18e^{3\mu_a}}{6e^{2\mu_a}}\right)$$

$$\mu_s > \ln(3e^{\mu_a})$$

$$\mu_s > \ln 3 + \ln(e^{\mu_a})$$

Which results in

$$\mu_s > \mu_a + \ln 3 \quad (2.13)$$

■

APPENDIX D – Simulation Exercise

```

# Censo 2000 antes da criação do RPPS
> priv1 <- rlnorm(6000, log(520), log(2.5))
> pub1 <- rlnorm(1200, log(870), log(2.5))
> inss1 <- rlnorm(2800, log(220), log(2.5))
> summary(priv1)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 21.49 276.70  512.60  791.20  945.10 12290.00
> sd(priv1)
[1] 925.0264
> summary(pub1)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 25.44 452.00  877.90 1286.00 1627.00  9321.00
> sd(pub1)
[1] 1303.865
> summary(inss1)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 14.83 122.60  226.30  331.30  409.30  4420.00
> sd(inss1)
[1] 351.742
> gini1 <- c( priv1, pub1 , inss1 )
> ineq(gini1 ,type="Gini")
[1] 0.5250428
# Censo 2010 após a criação do RPPS
> priv2 <- rlnorm(5400, log(520), log(2.5))
> pub2 <- rlnorm(1080, log(870), log(2.5))
> inss2 <- rlnorm(3400, log(220), log(2.5))
> rpps2 <- rlnorm(120, log(1000), log(2.5))
> summary(priv2)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 13.27 277.20  512.60  791.10  957.80 15370.00
> sd(priv2)
[1] 910.6675
> summary(pub2)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 37.51 465.10  881.60 1379.00 1715.00 16280.00
> sd(pub2)
[1] 1518.77
> summary(inss2)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  5.948 117.700  219.200  338.300  406.200 5905.000
> sd(inss2)
[1] 393.4038
> summary(rpps2)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 104.0  508.1  833.8 1347.0 1827.0  6522.0
> sd(rpps2)
[1] 1295.723
> gini2 <- c( priv2, pub2 , inss2 , rpps2 )
> ineq(gini2 ,type="Gini")
[1] 0.5370047

```


APPENDIX E – List of Variables and Data Source

Variable	Definition	Source
CITY	Official city code	IBGE
GINI	Municipal Gini index	IBGE, calculated by the UN
THEIL.L	Municipal Theil-L index	IBGE, calculated by the UN
CREATIONRPPS	Year when a city removed its civil servants from INSS affiliation. After 1998, it also indicates the creation of a local RPPS.	MPS
REGION	Geographic region where the city is located	IBGE
STATE	State where the city is located	IBGE
CITY.DATE	Year when the city was founded or emancipated	IBGE
IDHM	Municipal Human Development Index	UN
POP.65	Proportion of the city population who are 65 y.o. or older	IBGE
POP.TOTAL	Total number of inhabitants in a city	IBGE
POP.URBAN	Proportion of the city population living in urban areas	IBGE
PRIV.SECT.FORMAL	Proportion of the city population which had a formal job in the private sector	IBGE
PUB.SECT	Proportion of the city population employed by the government (federal, state or local)	IBGE
PC.INCOME	Average <i>per capita</i> income of the city population	IBGE
MAYOR.PARTY	Political party of the incumbent mayor	TSE, disclosed by IPEA

Source: Author elaboration (2018).