

# Salary discrepancy in the Brazilian executive branch: a cluster analysis

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This paper verifies the evolution of the remuneration pattern of different higher-level careers within the Brazilian federal executive branch from 1998 to 2015. In recent years, the differences in remuneration have substantially increased in the Brazilian civil service. However, the results obtained through *cluster* analysis suggest a pattern of greater pay raise for “typical state careers” to the detriment of others. This reveals a pattern of salary appreciation within the executive branch and, especially, an internal distributive conflict, in which those careers closer to the central power and with characteristics of “typical state careers” were gradually benefiting, establishing a major change in the relative remuneration pattern among different careers over the studied period.

**Keywords:** cluster analysis; civil servants salaries; Brazilian federal executive branch; state careers.

## Diferenciais de salários dentro do Poder Executivo Brasileiro: uma análise de *cluster*

O objetivo principal do presente trabalho é verificar como evoluiu o padrão remuneratório das diferentes carreiras com nível superior dentro do Poder Executivo Federal ao longo do período de 1998 a 2015. A justificativa para se estudar esses diferenciais salariais é que, nos últimos anos, se verificou um aumento substancial dos salários do funcionalismo público brasileiro. No entanto, os resultados obtidos pela técnica de análise de agrupamento sugerem que existe um padrão de maior valorização das carreiras chamadas típicas de Estado, em detrimento de outras. Isso revela um padrão de apreciação de salários dentro do Poder Executivo e, principalmente, um conflito distributivo interno, em que aquelas carreiras mais próximas do poder central e com as características de “típicas de Estado” foram sendo gradativamente beneficiadas, estabelecendo uma grande mudança no padrão remuneratório relativo ao longo do período analisado.

**Palavras-chave:** análise de *cluster*; salários públicos; Poder Executivo Brasileiro; carreiras de estado.

## Diferenciales salariales en el Poder Ejecutivo brasileño: análisis de conglomerados

El objetivo principal del presente trabajo es verificar cómo ha evolucionado el patrón retributivo de las distintas carreras con educación superior dentro del Poder Ejecutivo federal durante el período de 1998 a 2015. La justificación para estudiar estos diferenciales salariales es que, en los últimos años, se ha verificado un aumento sustancial de los salarios de los funcionarios públicos brasileños. Sin embargo, los resultados obtenidos por la técnica de análisis de conglomerados sugieren que existe un patrón de mayor apreciación de las carreras denominadas típicas del Estado, en detrimento de otras. Esto revela un patrón de apreciación salarial al interior del Poder Ejecutivo y, principalmente, un conflicto distributivo interno, en que las carreras más cercanas al poder central y con las características de “típicas del Estado” fueron paulatinamente beneficiadas, estableciendo un cambio importante en el patrón de remuneración relativa durante el período analizado.

**Palabras clave:** análisis de conglomerados; salarios públicos; Poder Ejecutivo brasileño; carreras estatales.

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## 1. INTRODUCTION

In recent years, Brazil has been suffering a profound fiscal crisis. In this context, the debate on the compensation of government employees naturally emerges as a relevant theme. The press and other instances of the public debate often criticize civil servants' compensation compared to the earnings of private-sector workers. Also, academic studies on government employees' compensation often emphasize the discrepancy between professionals' compensation in the public and private sector (Barbosa & Souza, 2012; Marconi, 2001, 2014; Moriconi, Moura, Marconi & Arvate, 2009; Souza & Medeiros, 2013; Vaz & Hoffmann, 2007). However, salary difference within the public sector is a less frequent topic in the specialized literature.

Studies on compensation discrepancies usually suggest an advantage of workers in the public sector in relation to private sector employees. For Barbosa and Souza (2012) this phenomenon is common in Brazil and several countries. The authors analyzed the period between 1995 and 2011 in Brazil and observed that the advantage of public sector salaries compared to the compensation of private-sector workers has increased over the years. Marconi (2014) and Vaz and Hoffmann (2007) corroborate these findings. Moriconi (2007) shows that there is not only a significant gap between salaries in the private and public sectors but also great discrepancies within the public sector.

Against this backdrop, this study addresses the discrepancies in salaries within the public sector, more specifically among careers in the Brazilian federal executive branch that require higher education. The objective is to show how the salaries of these different careers evolved from 1998 to 2015. The research demonstrates the differences in the government employees' compensation between the second presidential term of Fernando Henrique Cardoso, the first and second terms of Luís Inácio Lula da Silva, and the first term of President Dilma Vana Rousseff. In addition to the descriptive analysis of data on initial and final salaries for different careers and positions adjusted for inflation, the study conducted cluster analysis to view changes in the relative compensation standard, seeking to find a pattern of relative changes among similar sets of compensation.

The executive branch was chosen because the decision-making process on salaries depends to a significant extent, on only one branch. After identifying the pattern, it is possible to highlight a rationale in the decision-making process, which could be adopted regardless of the changes in executive government over the years. The group studied was homogeneous regarding the education level required to enter the career, a choice made since educational level is a fundamental determinant of compensation in both the public and private sectors worldwide. Another element that influenced the decision to work with a database gathering information from the federal executive branch was the limitations the authors' faced to collect homogeneous information from different federal branches.

This work is motivated by the struggle between state technobureaucracy and the private sector for the appropriation of surplus in the form of compensation, and the internal struggle in the public

sector, in which the different groups of professionals dispute the budget to increase earnings in the form of salaries and benefits. Also, there are bargaining dynamics within the public sector in which the best-paid careers serve as a parameter for the salary negotiations of the lowest-paid careers. Therefore, knowing how discrepancies in compensation have evolved within the public sector may indicate the standards that serve as the basis for the struggle of the lowest-paid careers and suggest the existence of struggles regarding compensation over time.

Two results stand out. First, the evolution of the real value of earnings over time revealed a pattern we called “fall-rise-fall,” encompassing the second term of President Cardoso, the terms of President Lula da Silva and the first term of President Rousseff. The evolution of the salaries real value in some careers escaped this pattern, but, in general, this sequence reflects the history of the real value of the careers and positions studied.

The second result stands out from the cluster analysis. The study revealed a progressive adjustment of the careers analyzed in different clusters, showing how the studied positions in the federal executive branch formed patterns in groups statistically different from the compensation standards. These clusters changed during the period analyzed, showing how certain careers were achieving higher remuneration standards, always approaching the highest paid careers of the federal executive. The cluster analysis also showed that some careers – for example, auditing and management – achieved a compensation standard that at the beginning of the period analyzed, was reached only by the federal chief of police.

The article is organized as follows. The next section analyzes the literature on determining factors of salaries in the public sector. The third section presents and briefly discusses the occurrence of the referred “fall-rise-fall” pattern. Finally, the fourth section shows the cluster analysis briefly presenting the method, followed by the results and discussion on the main patterns observed. The last section presents the conclusion.

## **2. DETERMINANTS OF SALARIES IN THE PUBLIC SECTOR: SALARY NEGOTIATION AND OTHER FACTORS**

The determination of the salary standards within the public administration may have a strong component guided by political forces within the sector. Among these forces are the government, responding to various pressures for the implementation of different public policies, and its employees, i.e., civil servants, divided into several occupations or groups. Elements such as tax collection and the economic situation are crucial factors to determine compensation. However, political dynamics of the negotiations between civil servants and government play an important role in this matter. According to Souza (2005), public employees’ salaries can be studied from the perspective of the political economy, involving purely economic factors and political elements, since there is a clear distributive dispute that depends on power relationships between government and civil servants.

According to Summers (1974), salary negotiation in the public sector must be considered as part of a broad governmental process. Thus, collective bargaining must be assessed as the result of a political process. In the typical view of American pluralist political science, the so-called

*technobureaucratic*<sup>1</sup> class joins other interest groups that dispute parts of national income and, specifically, public revenue. The author argues that the different groups whose income comes from the government will fight for greater budget allocation of government revenues in their sectors. For example, civil servants dispute the budget with government suppliers, with political groups with access to specific funds – unions, political parties, non-governmental organizations – and with politicians and the political class in general.

In this perspective, technobureaucrats have what Bresser-Pereira (1981) characterizes as “a vocation for power,” which is reflected in the control and administration of production as a whole. They compete for spaces of power and, above all, remuneration, using as a bargaining tool spaces to employ their intellectual knowledge and performance at work. In theory, the larger the organization and the more power a bureaucratic employee has, the higher up they will be in the organization’s hierarchy. In this sense, it is possible to suggest that salaries will be higher. However, technobureaucrats in different occupations will almost never work together to increase salaries linearly. The phenomenon of professionals from different groups working together in this sense is an unstable balance because professionals of some groups can reach their goals more readily compared to others due to a particular ability to impose losses for both political agents and users of public services.<sup>2</sup> It is reasonable to assume that losses for political agents are more likely to lead to gains in the bargaining process than losses for the public in general, since the first can respond more directly, with less mediation, to their own losses than to the losses for society, where interests are more diffuse and more difficult to identify.

Thus, employees in some state functions can obtain greater support when it comes to increased compensation. For example, it is possible to assume that employees providing direct services to the population – street-level bureaucrats – may find it easier to obtain support from the population and put more pressure on the government. Summers (1974) considers the possibility of a collaboration between civil servants and the population (voters) in search of better services and better salaries. However, our study shows that the success in salary negotiation has less to do with being close to the population, and more to do with the employees’ position in the organizational hierarchy and the occupation’s role in the state apparatus.

Wellington and Winter (1969) emphasize the advantages of the governmental technobureaucracy in salary negotiations due to the number of professionals. Unlike the situation in the private sector,

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<sup>1</sup> In this work, technobureaucracy is understood as a social class, as well as the proletarian, or working class, or as the so-called bourgeoisie or capitalist class. Technobureaucracy emerges connected to a context and it is a result of the technological revolution brought about by capitalism. The increase in scientific knowledge and the need for the management and application of that knowledge is the element that provides the basis for the emergence of this social class, technobureaucracy (Bresser-Pereira, 1972, 2008; Martins, 1997). Although technobureaucracy is not only public since it includes technicians from different economic activities in the private sector (such as engineers, administrators, health professionals, legal operators), this study explores the technobureaucracy of the public sector. More specifically, the study discusses the public sector technobureaucracy comprising highly specialized civil servants rather than the political class (i.e., holders of elective mandates permanently subjected to some kind of direct democratic control).

<sup>2</sup> As for the object of our work, the so-called National Bureau of Permanent Negotiation (MNNP) was created in 2004 to facilitate salary negotiations between government and civil servants. Discussions in the MNNP mainly emphasize the base salary and benefits. However, it permeates the various debates regarding better working conditions, pay adjustment to avoid civil servants’ loss of purchasing power, permanent salary policies, replacement of salaries for careers with outdated salaries, valorization and qualification of civil servants (Ministério do Planejamento Orçamento e Gestão, 2016).

where this discussion is limited to economic costs, the political issues in the public sector bring to the table both economic and political costs. Given the character of essential goods offered by the public sector, in addition to engendering pressure from the civil servants themselves, striking triggers pressure from the population – another party interested in this process.<sup>3</sup>

Regarding the size of the public bureaucracy, Ventura (2017) found empirical evidence for Brazil that the occupations with more professionals are those in the so-called social areas, i.e., working in universities, hospitals, and technical and administrative support, which are occupations with lower salaries and fewer spaces of power. Careers in finance, controlling, management, auditing, inspection, legal, and police activities count on fewer professionals and offer higher compensation. They are also associated with access to spaces of power. Thus, it is possible to assume that the more professionals in a specific occupation or group in the public sector, the more challenging the salary negotiation with the government. On the other hand, the greater the space of power professionals of a given occupation or group obtain, the easier the salary negotiation.<sup>4</sup>

In addition to personnel expenses and salary negotiations, there are other important factors in determining public salaries outside the scope of these variables. For Ehrenberg (1973), the essentiality of services is an influential factor in the employees' bargaining power. Gregory and Borland (1999), in turn, stress the importance of the institutional environment for establishing salaries in the public sector. According to the authors, government employees can create indirect incentives to earn above a level considered efficient. In addition, while politicians are interested in votes (Borjas, 1980; Bugarin & Souza, 2005; Gregory & Borland, 1999), bureaucrats seek to increase governments' revenue to consequently increase the share of revenue that will be allocated to them (Niskanen, 1971).

In a study on salary discrepancies within the federal public sector, Borjas (1980) offered a model that assumes the state as a maximizer of votes. Among the explanatory factors, the author considers typical variables such as the differences in civil servants' salaries among the different government agencies. The model adopts variables consolidated in the literature for salary levels (schooling, for example) observed together with eminently political variables. One of the hypotheses of the work is that the wages paid to bureaucrats reflect not only market conditions but also the fact that they have the power to control the production of the agencies in which they work. Governments tend to offer higher salaries to civil servants believing these employees can influence public opinion and voters, contributing to improving the incumbent political leaders' image. In this sense, bureaucrats may negatively affect the voters' opinion about the government if they earn a low salary, based on how they decide to conduct their activities while providing a public service. When receiving good compensation, they can positively affect voters by offering good and prompt services. This is the negotiation principle adopted, for example, when customs inspection officials or police officers put pressure on the government by carrying out what is known as a "turtle operation," i.e., officials increase the number of inspections, making it difficult for travelers and goods to enter at ports and airports.

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<sup>3</sup> Strikes in the public sector always seek to increase pressure on the government from the population using the public services affected. Unlike strikes in the private sector, strikes of government employees do not imply cessation of production and profits. They directly harm users of public services causing diffuse damage, more difficult to identify and measure.

<sup>4</sup> The study by Ventura (2018), based on an econometric exercise, reveals that the number of professionals in a given occupation or group is not a relevant variable to explain pay adjustments.

Another variable considered by Borjas (1980) is the budget of the public agency. When it rises, salaries tend to increase, which is reasonable from the point of view of the model's hypothesis. It is natural to think that in periods of economic prosperity, the state raises salaries. According to the author, the salary discrepancies are also explained by the different levels of power of each federal agency. In this way, the agencies with greater relevance concerning their activities within the governmental structure will have a greater share of the state's revenues. Therefore, the salaries of civil servants working in these agencies will be higher.

Bugarin and Souza (2005) and Souza (2005) developed an electoral competition model for the specific case of Brazil, studying the determination of compensation through salary negotiation between the government and employees considering two types of negotiation. Firstly, the government negotiation with the civil servants as a whole, as part of a single group. Secondly, the negotiation with two groups. The first consists of civil servants in typical state careers and the second, other civil servants. The authors conclude that, in the case of Brazil, the state<sup>5</sup> maximizes its probability of winning the elections, by negotiating salaries individually with each group. The government grants differentiated pay increase to professionals of each group, privileging some of them. The authors observed this behavior in the two terms of President Cardoso and the first term of Lula da Silva's administration. The assumption for this process was that the government's preference is related to the number of professionals in that group and its homogeneity in ideological terms, which is reflected in how the professionals of a specific group act collectively when negotiating.

The level of organization of the different groups of civil servants is important in determining salaries. Well-structured and organized groups may be able to come together in a better way to negotiate with the government. Marconi (2001) points out that cohesive groups are more likely to organize and limit the provision of public services. Additionally, the greater their activities' importance, the greater the workers' power. In this sense, the bargaining power of some groups can be considered a fundamental factor in determining salaries. In theory, police and health professionals, for example, are in a better position to negotiate.

In a study seeking to identify whether all civil servants are homogeneously well paid, Moriconi (2007) analyzes the salaries paid by the Brazilian states. The results reveal that typical state careers state receive higher salaries than those with equivalent positions in the private sector (non-exclusive careers). For the latter, salaries are usually lower. When non-exclusive careers in the government pay more than in the private sector, this difference is relatively low compared to the discrepancy between the salaries of typical state careers and the compensation of workers in the private sector. The author found a pattern of appreciation of some careers over time, also for state civil servants.

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<sup>5</sup> There is no provision in the Brazilian Federal Constitution clearly stating the typical or exclusive careers of the state. Only article 247, included by Constitutional Amendment 19/1998, refers to exclusive careers of the state: "The laws provided for in item III of § 1 of art. 41 and in § 7 of art. 169 establish special criteria and guarantees regarding the maintenance of the position of a tenured civil servant who performs exclusive state activities." In Brazil Fonacate is the permanent forum of typical state careers, this forum has a bill – not yet approved – aiming to define such careers. This study assumed that the typical careers of the state are those with attributions that express the state's power and have no correspondence in the private sector. According to Fonacate, these careers are related to areas such as tax collection, finance and controlling, foreign trade, public defense, regulation, monetary policy, diplomacy, public advocacy, public security, state intelligence, and inspection.

This section offered a brief review of the literature and presented the variables public sector remuneration analysts consider. The next section shows the behavior of the compensation of several careers in the Brazilian federal executive branch, considering positions that require higher education. The analysis observes data from 1998 to 2015 and aims to understand the evolution of salaries in the period.

### 3. DESCRIPTIVE ANALYSIS: THE DEVELOPMENT OF COMPENSATION IN THE FEDERAL EXECUTIVE BRANCH BETWEEN 1998 AND 2015

The study analyzes 32 positions in the Brazilian federal executive branch<sup>6</sup> that require higher education. This option allows comparing careers that require the same level of education since this variable is a strong determinant of compensation in both the public and private sectors (Marconi, 2014). For most of the careers and positions studied, data on compensation were collected from 1998 to 2015.<sup>7</sup> The positions were organized into five areas of activity, seeking to obtain data from representative groups of each of these areas of the federal public service in the executive branch. The five areas are (1) education (higher), (2) management and finance, (3) scientific and technological research, (4) legal, and (5) audit and inspection.

The analysis was eminently descriptive and draws conclusions from examining the observed trends, aiming to identify whether there is a pattern in the evolution of compensation. The study compared the data for the initial and final salaries of each position, assuming that these salaries are the main piece of information sent to the labor market to attract the best available professionals. The labor market may consist of students in higher education institutions, professionals working in the private sector, and professionals who already work in other careers in the public sector. These data are presented in graphs displaying the gross salaries deflated, based on the last year of the series, 2015 (therefore, the salaries are plotted at 2015 values).

Additionally, compensation indices are calculated based on the initial year of the series.<sup>8</sup> These graphs show the evolution of the real value of salaries starting from the same point. While the gross salary deflated is the information sent to the labor market to attract professionals, the indices calculated from the same base ignore the absolute level of the compensation to show the maintenance of their real value concerning the starting point. These data offer an idea of the maintenance, appreciation, or relative devaluation of the career or position earnings over the analyzed period. Likewise, they show the behavior of compensation concerning the provisions in the Brazilian Federal Constitution, regarding annual and general pay adjustments, regardless of the indices adopted (Art. 37, X). It is worth mentioning that this is a constitutional requirement systematically breached by the different

<sup>6</sup> Data used in this study refer to compensation for twenty different careers, reflecting the earnings of professionals in 32 positions within the Brazilian federal government (executive branch), i.e., there are different positions within the same career. Therefore, a career is a hierarchical unit of related positions in the executive government's apparatus. As an example, the career of manager is divided into types of managers: public policy manager, finance and controlling analyst, foreign trade analyst, planning and budget analyst. Likewise, the career of professor in higher education is divided into positions considering the professional academic degrees such as specialization, master, Ph.D.

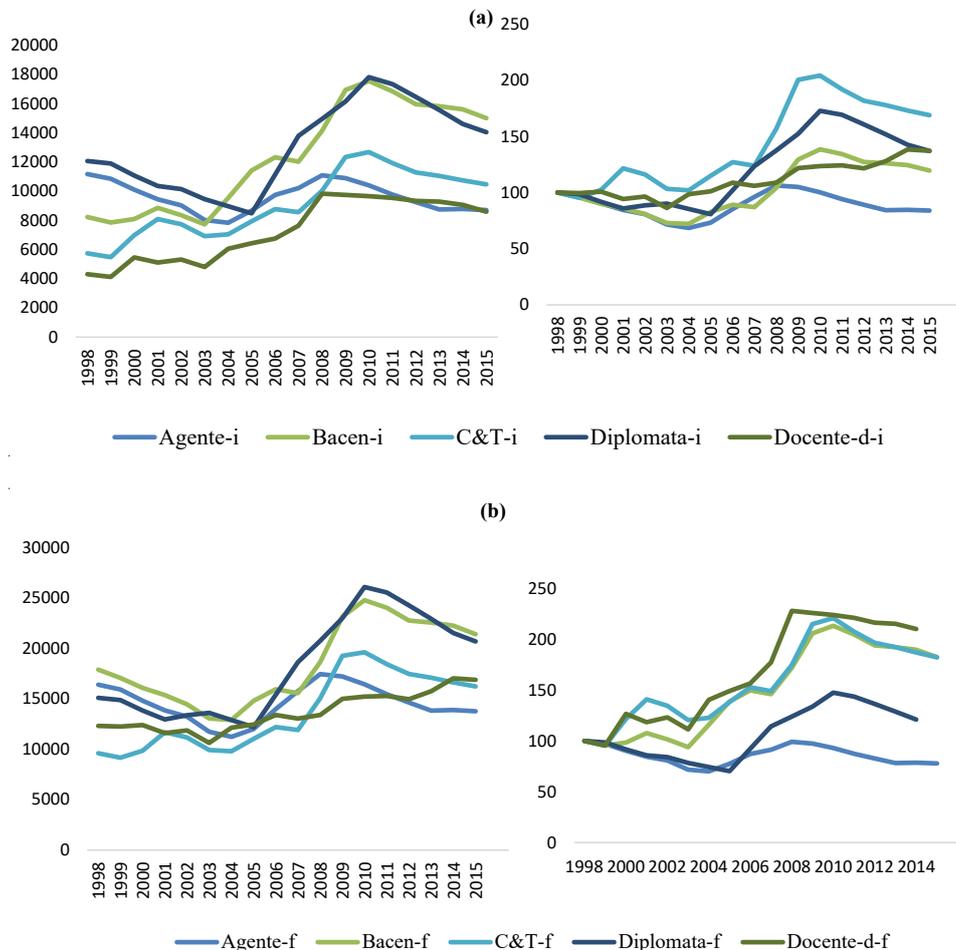
<sup>7</sup> For some careers the data is only available from 2004 (e.g., Brazilian Intelligence Agency – ABIN) and 2006 (e.g., regulatory agencies).

<sup>8</sup> Therefore, the indexes for different careers would be 100 at the first year of the series.

levels of government in Brazil, in practically all states.<sup>9</sup> In each pair of graphs, the left shows the gross salaries and the right shows the salaries in relative terms.

Finally, as the combination of all the positions in a single graph would make them less readable, groups of positions were selected to be presented together. Additionally, to be concise in this article, we are not presenting several graphs comparing the 32 positions.<sup>10</sup> Instead, we show here careers and positions in different areas, observing whether there is a general pattern or if the career of a certain area is different from the general behavior identified. The graphs were created by joining typical and non-typical state careers for comparison purposes. Although there is a certain amount of subjective judgment in choosing the graphs shown in this study, we believe that they exemplify the general trends described.

**GRAPH 1** EVOLUTION OF SALARIES, REAL VALUES, FROM 1998 TO 2015. INITIAL SALARIES (A) AND FINAL SALARIES (B)



**Source:** Tables with the compensation of civil servants. Elaborated by the authors.

<sup>9</sup> See, for example, Douglas, Araújo and Chaves (2014).

<sup>10</sup> The complete graphs can be found in Ventura (2018).

Graph 1 shows the initial (a) and final salaries (b) for the positions of agent of the federal police, Central Bank of Brazil (Bacen) analyst, professor with a Ph.D., diplomat, and science and technology (S&T) researchers with a Ph.D. As for initial salaries (a), at the beginning of the period, a greater equality between the positions of professor, diplomat, and Bacen analyst was observed. All of them fell, and during the period, the last two had a significant rise, being the careers with the highest salaries. The peak in the appreciation of compensation is seen from 2006 onwards. When analyzing the graph on the right, in relative terms, professors, S&T researchers, and Bacen analysts experienced greater increases in salaries. Professors had the highest appreciation, which exceeded 200%, in 2008. However, the gross remuneration showed that, despite the relative gains, the salaries of diplomats and Bacen analysts, typical state careers, remain significantly higher. Researchers are also highly valued, but in gross terms there is still a significant difference. It is worth noting that both careers have the additional compensation for the title of Ph.D. In general, all careers had a salary increase, mainly during the government of President Lula da Silva, and then, starting in 2011, they observed a decrease.

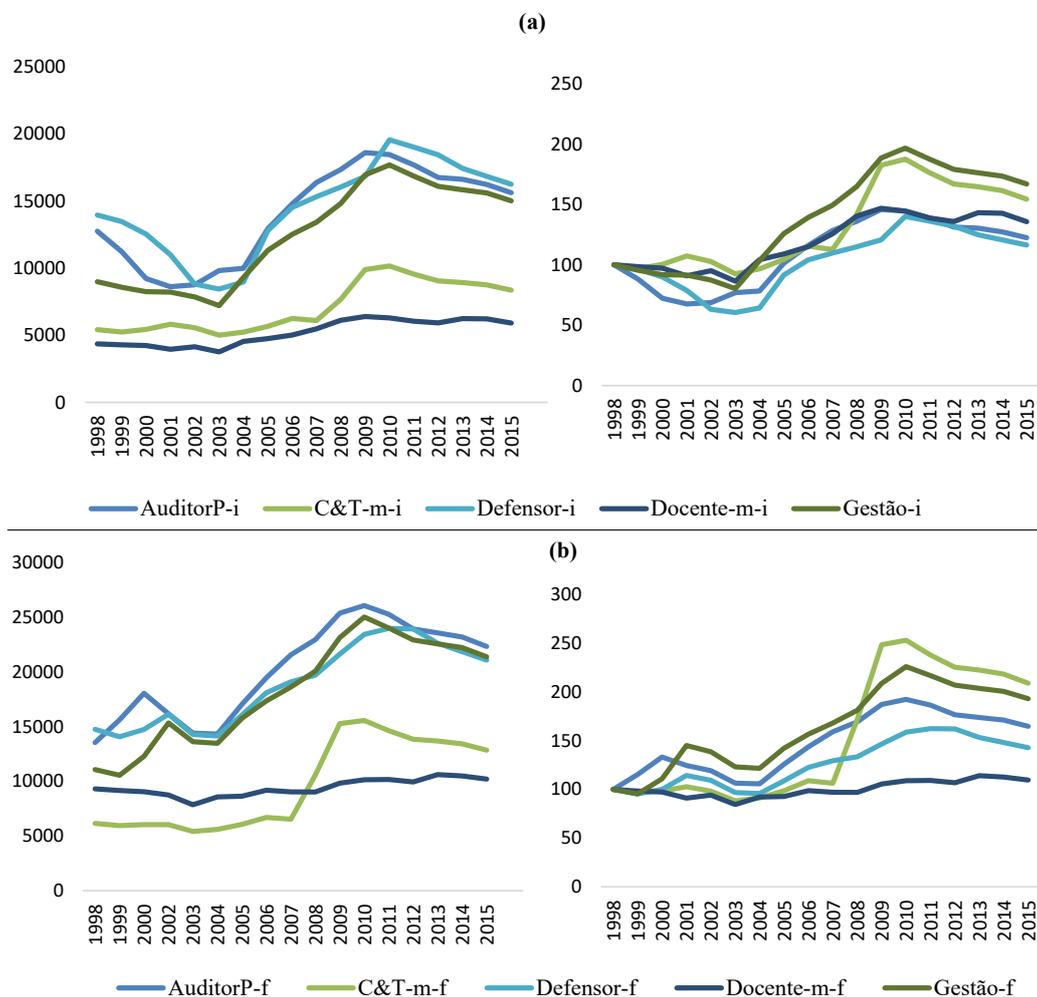
Graph (b) shows the final salaries (ceiling). The movement to achieve these salaries is similar. Initially, all careers had their remuneration reduced and, afterward, they experienced great valorization in the years of the government of Lula da Silva. The positions of researcher and professor underwent an abrupt appreciation from the second term of this government. The graph clearly shows this movement. However, it is necessary to emphasize that the level of salaries for Bacen analysts and diplomats were higher and, therefore, remained substantially higher even though there was a great relative appreciation of other salaries. One hypothesis for increasing only the final remuneration is the attempt to ensure employees in their careers. In the case where a career presents, for example, early retirements or high turnover.<sup>11</sup> However, this work cannot conclude whether this hypothesis is true based only on the data presented. This issue may be further explored in future research.

In the case of professors, the appreciation is significantly higher in initial salaries, which may indicate the attempt of a policy of attractiveness, especially for Ph.D. holders. Other hypotheses can be formulated to explain this difference. One of them is that the number of employees in each career level and its intertemporal discount factor in the perception of income – in general, individuals prefer income in the present instead of expected income in the future. Thus, if the majority of the group is at the initial levels, in the bargain with the government, a proposal that appreciates the initial levels is more likely to attract employees than a proposal that appreciates the final levels – unfortunately, the number of employees at each career level are not available in the transparency instruments of the federal executive. Regarding final salaries, the logic between a typical state career versus a career that requires a Ph.D. is not reversed.

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<sup>11</sup> It is possible that the reform provided by Constitutional Amendment 19/1998 may have encouraged civil servants to leave their careers early (before reaching the last level), which would give rise to a counter-movement by the government in appreciating those who decided to remain until the last level. However, this is just a hypothesis that needs testing with detailed data about that specific career.

**GRAPH 2** EVOLUTION OF SALARIES, REAL VALUES, FROM 1998 TO 2015. INITIAL SALARIES (A) AND FINAL SALARIES (B)



Source: Tables with the compensation of civil servants. Elaborated by the authors.

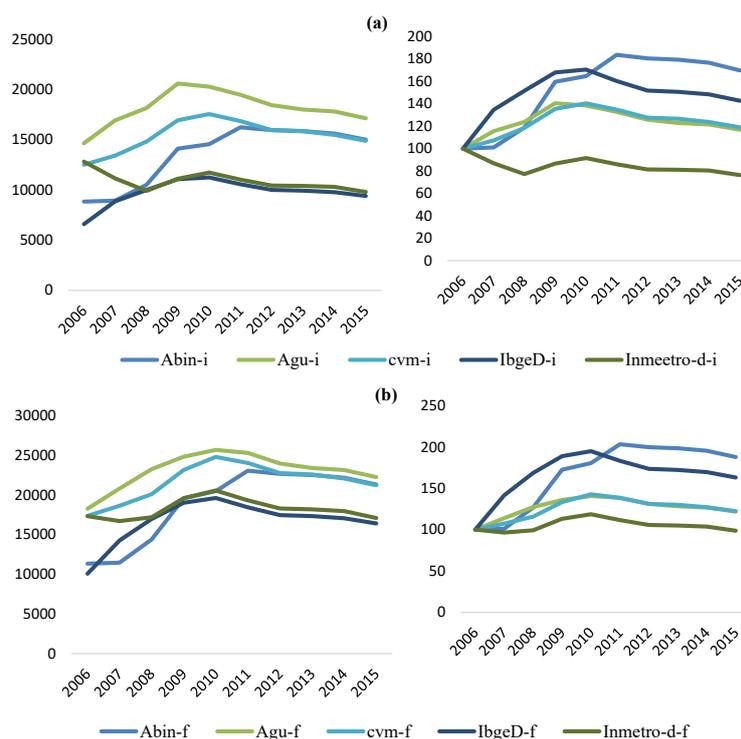
Graph 2 shows the remuneration for the positions of social security auditor, federal defender, manager, professor, and S&T researcher with a master’s degree. Graph 2(a) shows that the salary level of defenders, managers, and auditors is the highest, emphasizing the former. The drop in salaries at the beginning of the period is also observed, as in Graph 1 above. Regarding the salary level in general, it is clear that professors and S&T researchers have substantially lower salaries than professionals in other positions. Regarding the relative gains, managers had the biggest gains, followed by researchers and professors, also from the second term of President Lula da Silva’s government. This appreciation has fallen since 2011. Graphs 1 and 2 show that university degrees are not relevant for the salary level in the public sector.

Graph 2(b) shows the final salaries and the changes are similar to the evolution of the initial earnings. An exception is a salary peak for the position of S&T researchers in 2008, which guaranteed them a greater relative variation. However, as already mentioned, the salary level of this career is

significantly lower, i.e., the appreciation, in gross terms, is low. All salaries initially showed an upward trend, with a tendency to increase, falling after 2010. The pattern shows an increase during the government of Lula da Silva and fall in the government of Rousseff. The pay adjustment during Rousseff’s government, therefore, is systematically below inflation.

Graph 3 shows the positions of federal attorney, Inmetro<sup>12</sup> specialists with a Ph.D., analysts from the Brazilian Securities and Exchange Commission (CVM), IBGE specialists<sup>13</sup> with a Ph.D. and officers of the Brazilian Intelligence Agency (ABIN). IBGE and the remuneration of Inmetro employees comprised a basic salary plus bonus for specific activities of both agencies,<sup>14</sup> in addition to benefits based on the degrees held. The position of federal attorney, from 2006, started to receive via subsidy, and the same happened with the CVM employees from 2008. Graph 3(a), shows that the highest salaries are for the typical state careers, CVM analysts, federal attorney, and officers of the ABIN. At the beginning of the period, these positions had an increase in compensation, which softened after 2011. Relatively, CVM analysts and ABIN officers received the highest increase during this period, while Inmetro analysts had the lowest appreciation.

**GRAPH 3** EVOLUTION OF SALARIES, REAL VALUES, FROM 2006 TO 2015. INITIAL SALARIES (A) AND FINAL SALARIES (B)



Source: Tables with the compensation of civil servants. Elaborated by the authors.

<sup>12</sup> Researcher-Technologist in Metrology and Quality, and Analyst in Metrology and Quality – Inmetro.

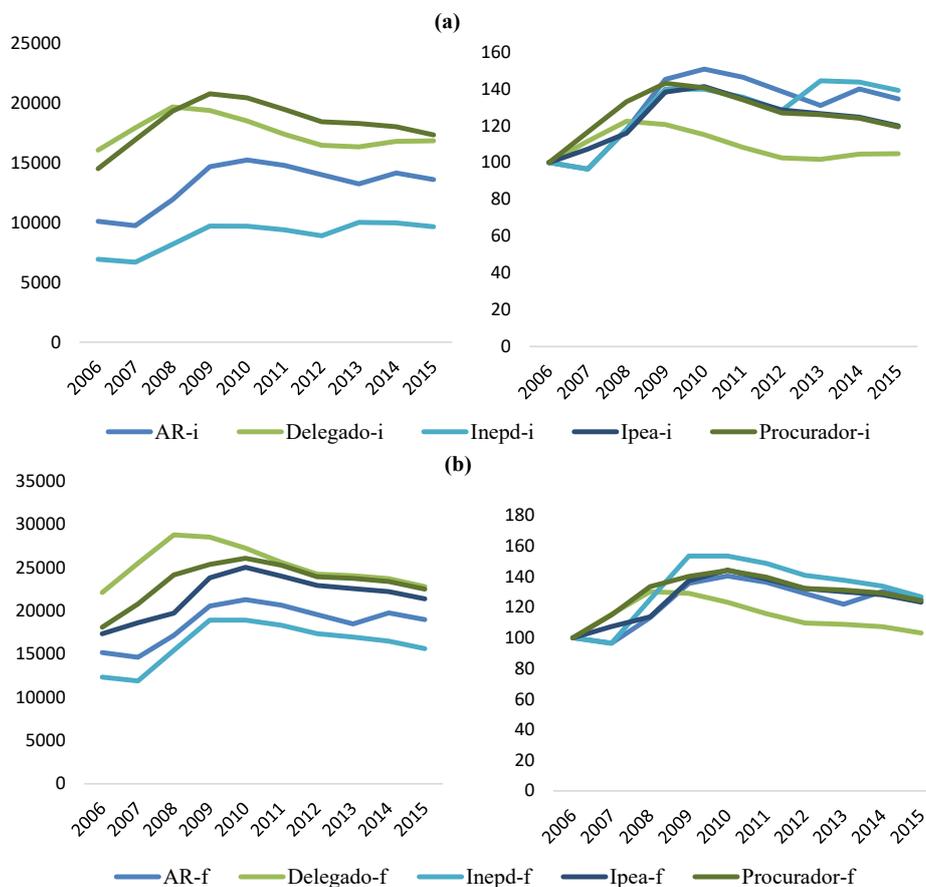
<sup>13</sup> Researchers and technologists from IBGE.

<sup>14</sup> Performance bonuses can vary from 80 to 100 points, 80 points being granted according to the agency’s productivity as a whole, and the other 20 points granted based on the professional’s performance. A survey exploring the employees’ scores reveals that the majority of civil servants achieve 100 points. This suggests that the part of the compensation connected to performance is not applied efficiently.

As for the salary ceilings (Graph 3b), there is a smaller discrepancy between typical and non-typical state careers regarding the salary level compared to the previous graphs. Starting in 2006, these graphs show more clearly the general appreciation that occurred in the second term of Lula da Silva’s government. However, from 2011, salaries fell in real value and remain unchanged, with no gains since that period.

Graph 4 shows the salaries of researchers from the National Institute of Educational Studies and Research Anísio Teixeira (INEP), holding a Ph.D., federal prosecutor, federal chief police officer, and specialist working in regulatory agencies, and research technicians from the Institute for Applied Economic Research (Ipea). All careers tend to increase salaries until 2010 when real earnings started to fall. The pattern of increase in Lula da Silva’s government and fall in Rousseff’s government is repeated. The career of federal chief police officer had the highest salary in all periods, followed closely by treasury prosecutor and Ipea employees. From Graph 4, it is possible to see that the salary for the position of Ph.D. researchers from INEP and regulatory agencies is substantially lower than the salary for other typical state careers.

**GRAPH 4** EVOLUTION OF SALARIES, REAL VALUES, FROM 2006 TO 2015. INITIAL SALARIES (A) AND FINAL SALARIES (B)



Source: Tables with the compensation of civil servants. Elaborated by the authors.

All careers tend to increase salaries until 2010 when real salaries started to fall (repeating the pattern Lula Da Silva, increase; Rousseff, fall). The career of federal chief police officer had the highest salary in all periods, followed closely by the position of treasury prosecutor and Ipea's employee. From Graph 4, it is possible to see that the salary of Ph.D. researchers working at INEP and in regulatory agencies is substantially lower than positions in typical state careers.

Regarding the salary variation during the entire period, the position that most observed a relative increase was that of specialists from regulatory agencies, which shows systematic appreciation. The starting salaries in this position are similar to the other two. This may be part of a deliberate policy of attraction since the big increases were observed specifically in the years 2007 and 2008. Another hypothesis is that the increase was the result of a negotiated restructuring,<sup>15</sup> which would show that the specialists in regulatory agencies were successful in taking their career – inspection – to the same level of typical state careers. These graphs reveal, for both initial and final salaries, the appreciation of the inspection career and the position in an advisory agency close to the Ministry of Planning (Ipea), demonstrating that the careers' location and function in the state structure are more determinant to salaries than the level of education.

The analysis presented suggests that there was a substantial appreciation of government employees during President Lula da Silva's government, while the inflation eroded the salaries value during President Rousseff's first term. The exception in this pattern is the compensation of professors, which were appreciated throughout President Rousseff's government (although not in the case of initial salaries). It is important to point out that letting the civil servants' salary erode by inflation is the only way that the government has to reduce these salaries since the Brazilian Federal Constitution provides, in Article 37, item XV, for the nominal irreducibility of salaries.

The analysis demonstrates that typical state careers usually offer higher salary levels than non-typical state careers. Likewise, careers that have activities more directly linked to the federal executive branch decision-making processes offer higher salary levels – such as the career of Ipea. In many cases, the variation over time in relative salaries is greater for non-typical careers. However, the pay adjustments are not enough to say that these positions' salaries are at the same levels as the typical state careers, even though adjustments were higher. This phenomenon is clearly demonstrated in the cluster analysis below.

When observing the periods, salary restructuring through subsidies seems to be decisive for pay adjustments. It is possible that when offering compensation in the form of subsidies, benefits that were hidden from the data of the Ministry of Planning were incorporated into the remuneration of civil servants. In addition, few careers have escaped the fall-rise-fall pattern that, roughly speaking, correspond to the governments of President Cardoso (fall), President Lula da Silva (rise), and President Rousseff (fall). It is clear that factors related to the situation of the national economy – growth/stagnation – and its impact in state revenues must explain this pattern to a large extent. In

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<sup>15</sup> In July 2008, the career of civil servants in the regulatory agencies was restructured, including salary adjustments, based on Law 11907 of February 02, 2009 (the provisional measure before the referred legislation was not found). The law removed the individual pecuniary advantage of these employees, and the scoring system was implemented through the performance bonus applied to the special plans of positions at the regulatory agencies.

addition, ideological inclinations, pretensions of election and reelection, and different characteristics of the chief executive and the first echelon contribute to explain the pattern. Several hypotheses can be tested and analyzed, perhaps based on case studies emphasizing specific careers based on these exploratory data.

Finally, careers that require professionals to hold a Ph.D. or a master's degree, even though they have experienced an appreciation in the period, remain with salary levels well below careers such as that of federal attorney and federal prosecutor. Therefore, the educational level, considered a traditional explanatory variable for salaries in the private sector, is not decisive to determine salary levels in the public sector.

The next section presents the cluster analysis to verify the behavior regarding salary homogeneity. The clusters were formed by the salaries of 32 positions during the period studied.

#### 4. METHOD: CLUSTER ANALYSIS

The cluster analysis methodology seeks to verify, based on observations, whether there are similar characteristics that justify grouping these observations into a finite number of sets. In this research, the analysis aims to verify the existence of statistical similarity among salaries for different positions in the public sector, particularly the federal executive branch in Brazil, observing data from 1998 to 2015, divided in political cycles. The methodology seeks to form clusters based on the homogeneity of certain variables. In this case, the variable is the salaries paid to positions in the Brazilian executive (Fávero & Belfiore, 2015; Kaufman & Rousseeuw, 1990).

A cluster is formed when the observations in the same group are relatively (regarding all observations) and statistically similar within the group and, at the same time, different from the observations belonging to other clusters. In this study, the analysis was performed considering different periods to show if there is variation in the clusters' configuration over time. Cluster analysis is a different method from those conventionally used for classification since its application does not require previous hypotheses about the formation of groups. The method does not have a predictive nature, applied to observations outside the sample, and, therefore, it is only an exploratory and descriptive data analysis technique.

As previously mentioned, the analysis considered different periods, using the average of the initial and final deflated salaries for each position in each period. The frequency chosen to analyze the clusters was the political cycles, coinciding with the presidential mandates from 1998 to 2015: the second mandate of President Fernando Henrique Cardoso, first and second mandates of President Luís Inácio Lula da Silva, and the first term of President Dilma Vana Rousseff. Although many variables influence the salaries of government employees, it is expected, especially regarding careers' appreciation, maintenance, or devaluation, that the president – as chief of the executive branch, having decision-making power, and exercising it – promotes changes when appreciating the positions (more or less), leading them to move from one cluster to other over time. In addition, we carried out cluster analysis considering the average of initial and final salaries for the entire period.

There are two methods for cluster analysis. The first is the **hierarchical method**, where data can behave randomly and it is possible to freely identify the ordering and allocation of observations

(Fávero & Belfiore, 2015). Based on this method, a hierarchical structure is established to form the clusters. Initially, the number of groups follows the number of observations, and subgroups are formed according to the similarities of the characteristics. Within the hierarchical method, it is possible to apply the agglomerative or divisible method (Kaufman & Rousseeuw, 1990).

The second is the **non-hierarchical method**. It consists of maximizing similar characteristics among the observations within a given group and preliminarily defining the number of clusters to be formed. In this study, the hierarchical method was initially applied to observe how the data would behave, as well as the number of clusters that would be formed. After this analysis, we adopted the non-hierarchical method, defining the final number of clusters based on the clusters formed when applying the first method.

As for the characteristic of the data, there are two possible methods of analysis. The first method is based on the study of similarity behavior (similarity measures), used when the variables are binary, and the important information is the frequency of the convergent response pairs. The second method consists of defining the distance (dissimilarity), applied when the variables are essentially metric. Because the variables used to form the clusters are the salaries of the different categories, we applied the latter method of dissimilarity measures.<sup>16</sup>

The literature presents some dissimilarity criteria to group the variables. For the purposes of this analysis, all these criteria were tested, and we chose only one of them for the metric variables, the common distance, called Euclidean. It is the most common distance, measuring the geometric distance between two observations of size  $n$ , where  $x=[x_1, x_2, \dots, x_n]$ , and  $y=[y_1, y_2, \dots, y_n]$ . Therefore:

$$d_{xy} = \sqrt{\sum_{i=1}^p (xi - yi)^2}$$

Box 1 shows the careers and the respective clusters. The analysis using the silhouette method showed that the optimal number of clusters is three. The position of federal chief police officer is a little distant from the other positions in cluster 3, which makes sense since the salary of chief police officers in real terms is the highest and, over the years, it has lost purchasing power significantly. Currently, the salary is comparable to that of other careers. This cluster is made up almost entirely of typical state careers, with the exception of the position of specialist in regulatory agencies.<sup>17</sup> In addition to not being a typical state career, the remuneration of regulatory agencies is not in the form

<sup>16</sup> We first conducted cluster analysis considering the number of employees in the positions. However, data was not found for the career of officer at the ABIN. Also, when observing the clusters formed, the weight given to the number of civil servants was high, minimizing the importance of salaries, which were the focus of the study. To include the number of employees, it was necessary to standardize the data. After applying the methodology, two groups were formed, one containing only professors and another with all other positions. This occurred because of the large number of professors. However, as we will present in this study, the number of professionals may not be a determinant variable for salary determination, and, therefore, this factor was removed from the cluster analysis.

<sup>17</sup> Government employees working in regulatory agencies receive a bonus for qualification, obtained by attending training opportunities offered by the agency itself. This bonus may be 10% to 20% of the highest basic salary for the occupations in the agency. The average salary used for the cluster analysis was that of the employees who receive a bonus of 20%.

of a subsidy. The position of planning and research technician at Ipea is also not a typical state career, although professionals receive subsidies and the average salary is similar to those in state careers.

**BOX 1 CLUSTER ANALYSIS (1998-2015)**

Cluster 1	Cluster 2	Cluster 3
Inmetro – Ph.D.	S&T	Federal attorney
IBGE – Master	Professor – Master	Federal prosecutor
S&T – Ph.D.	S&T – Master	Federal defender
Agent of the federal police	Professor – Undergraduate degree	Treasury prosecutor
Inmetro – Master	Professor – Education improvement	Revenue auditor
IBGE – Specialization	Professor – Specialization	Social security auditor
INEP – Specialization		Bacen analyst
INEP – Master		Regulatory agency
Professor – Ph.D.		Manager
Ipea		Research technician – Ipea
INEP – Ph.D.		Securities and Exchange Commission – CVM
IBGE – Ph.D.		Diplomat
		Federal Chief Police Officer
		Brazilian Intelligence Agency

Source: Data processed on software R. Elaborated by the authors.

Box 2 below shows the average initial and ending salaries for each cluster. Cluster 2 has the lowest averages, and the difference with the others is substantial. This group includes the positions of professor (except professors holding a Ph.D.) and S&T researchers. Cluster 1 includes positions in research institutes such as INEP and IBGE and professors holding Ph.D. degrees. In research institutes (except Ipea), the compensation changes based on the academic degree the professionals hold. However, the salaries in these agencies are still lower than that of typical state careers (cluster 3).

**BOX 2 AVERAGE SALARIES (1998-2015)**

Cluster	Initial salary	Final salary
1	8,797.38	14,543.42
2	4,847.84	8,013.00
3	13,883.28	19,155.77

Source: Data processed on software R. Elaborated by the authors.

As the data collected informs the salaries applied over a period of 17 years, the average for the period as a whole was used. In addition, analysis separating the data according to the political cycle was performed. The decision to separate in political cycles was made because, in the last years of each cycle, the executive branch undergoes pay adjustments and turnover. In addition, the period studied witnessed changes in the presidency three times, which implied different government agendas and political inclinations.<sup>18</sup> Therefore, relations and political contexts may have reflected on the behavior of salaries in the public sector. Thus, the analysis allows verifying whether the salaries and the clusters change during different political cycles or whether the pattern remains the same.

As for the context, during the first political cycle, Brazilian public administration underwent a managerial state reform. When applying the non-hierarchical method, it was observed that an ideal number would be three clusters. The position of chief police officer stands out, which presents a significant discrepancy from the others and is positioned, alone in cluster 2 for the political cycle from 1998 to 2002. Based on this configuration, it is possible to notice that the typical state careers and the positions of researchers and professors (holding different academic degrees) form another two groups (clusters 3 and 1, respectively). The fact that cluster 1 gathers professors and researchers holding different degrees is explained since at that time, there was no policy for appreciating the professionals by offering better salaries according to academic qualification.

Box 3 shows the positions and the respective clusters.<sup>19</sup>

**BOX 3 CLUSTER ANALYSIS: POLITICAL CYCLE 1 (1998-2002)**

Cluster 1	Cluster 2	Cluster 3
S&T – Ph.D.	Federal Chief Police Officer	Federal attorney
S&T		Federal prosecutor
Professor – Master		Federal defender
S&T – Master		Treasury prosecutor
Professor – Undergraduate degree		Revenue auditor
Professor – Education improvement		Social security auditor
Professor – Specialization		Bacen analyst
Professor – Ph.D.		Regulatory agency
		Manager
		Research technician – Ipea
		Securities and Exchange Commission – CVM
		Diplomat
		Agent of the federal police

Source: Data processed on software R. Elaborated by the authors.

<sup>18</sup> For an in-depth analysis, see Ventura (2018).

<sup>19</sup> It is worth mentioning that the compensation was not available for all positions in political cycle 1 (1998-2002). In those cases, the analysis was conducted for only 22 positions.

Box 4 below shows the average salaries of each group.

**BOX 4 AVERAGE SALARIES: POLITICAL CYCLE 1**

Cluster	Initial salary	Final salary
1	3,978.40	6,959.40
2	8,425.72	13,483.90
3	12,044.05	17,039.98

Source: Data processed on software R. Elaborated by the authors.

The process of clustering the positions considering political cycle 2 (2003-2006) was not very different from the process adopted above. However, there were data available for other positions, and they were incorporated. The non-hierarchical analysis led to forming four clusters. The position of chief police officer was no longer alone, being part of a cluster with other typical state careers, which have the highest average salaries (cluster 4). Cluster 3 was formed of typical state careers and positions in Ipea. Cluster 1 consists of positions in IBGE, INEP, ABIN, and S&T researcher, considering professionals with Ph.D. degrees. Finally, cluster 2 includes the positions of professors and S&T researchers with bachelor and master’s degrees, with the lowest average wages. Box 5 shows the positions and their respective clusters.

**BOX 5 CLUSTER ANALYSIS: POLITICAL CYCLE 2 (2003-2006)**

Cluster 1	Cluster 2	Cluster 3	Cluster 4
Brazilian Intelligence Agency	IBGE – Master	Federal attorney	Treasury prosecutor
IBGE – Master	S&T – Master	Ipea	Revenue auditor
INEP – Ph.D.	S&T	Federal defender	Social security auditor
Professor – Ph.D.	INEP – Master	Regulatory agency	Federal Chief Police
Agent of the federal police	INEP – Specialization	Manager	Officer
S&T – Ph.D.	Professor – Specialization	Research technician – Ipea	Inmetro – Ph.D.
IBGE – Ph.D.	Professor – Undergraduate degree	Securities and Exchange Commission – CVM	Bacen analyst
IBGE – Specialization	Professor – Education improvement	Diplomat	Inmetro – Master
	Professor – Master		Federal prosecutor

Source: Data processed on software R. Elaborated by the authors.

Box 6 shows the average salaries for each cluster. Cluster 4 has the highest averages and is essentially composed of typical state careers, and presents a substantial difference from cluster 2 that gathers professors and S&T researchers with bachelor and master's degrees. It is important to remember that typical state careers currently receive subsidies, which means that their earnings through salaries is only part of the compensation. In political cycle 2, the remuneration did not consist of a single installment and there was no extra compensation for obtaining additional qualification. This change indicates an appreciation of the position itself and little appreciation based on academic training.

### BOX 6 AVERAGE SALARIES: POLITICAL CYCLE 2 (2003-2006)

Cluster	Initial salary	Final salary
1	7,130.40	11,026.92
2	4,560.83	7,399.42
3	10,025.16	14,473.72
4	12,639.74	16,871.60

Source: Data processed on software R. Elaborated by the authors.

Box 7 presents the results of clustering the positions for political cycle 3, which represents the second term of Lula da Silva's government (2007-2011). Four clusters were formed according to the average salaries, showing differences from the groups presented in Box 5 (political cycle 2). As observed below, there are two clusters with positions of high salaries and typical state careers (clusters 1 and 2). The position of public defender is the only typical state career out of these two clusters. It is allocated in cluster 3, which is formed in large part by careers linked to the area of research and education, considering professionals with a substantial qualification. Again, the agglomerative method proved to be better than the divisible one in this first analysis.

Based on groups formed using the hierarchical method, we conducted the non-hierarchical analysis. The silhouette analysis suggested that separation into four clusters was the most appropriate measure, maintaining the groups obtained in the hierarchical method. Cluster 3 has the third-highest average, with careers from IBGE, Inmetro, professor holding a Ph.D., S&T researcher holding a Ph.D., federal defender, and agent of the federal police. The analysis shows that positions in the Inmetro and IBGE are more appreciated than those of INEP and the position professor holding degrees lower than Ph.D.

**BOX 7 CLUSTER ANALYSIS: POLITICAL CYCLE 3**

Cluster 1	Cluster 2	Cluster 3	Cluster 4
Federal attorney	Brazilian Intelligence Agency	Agent	INEP – Master
Chief Police Officer	Bacen analyst	S&T – Ph.D.	INEP – Specialization
Revenue auditor	Regulatory agency	Federal defender	Professor – Master
Social security auditor	Research technician – Ipea	Professor – Ph.D.	Professor – Undergraduate degree
Federal prosecutor	Ipea	IBGE – Ph.D.	Professor – Specialization
	Diplomat	IBGE – Specialization	S&T – Master
	Securities and Exchange	IBGE – Master	Professor – Education
	Commission – CVM	INEP – Ph.D.	improvement
	Treasury prosecutor	Inmetro – Ph.D.	S&T
	Manager	Inmetro – Master	

Source: Data processed on software R. Elaborated by the authors.

Box 8 shows the average salaries in each cluster. Clusters 1 and 2 have the highest average salaries and are formed of typical state careers. This pattern is constant over time. These careers have the highest salaries, even though pay adjustments have been made for careers in general. Therefore, salary increase was not enough to reduce compensation discrepancies, even considering careers that equally require higher education levels.

**BOX 8 AVERAGE SALARIES: POLITICAL CYCLE 3 (2007-2010)**

Cluster	Initial salary	Final salary
1	18,771.31	25,244.14
2	15,353.35	21,091.70
3	9,987.20	16,094.74
4	5,861.74	9,765.45

Source: Data processed on software R. Elaborated by the authors.

Finally, the last political cycle covering the period of President Rousseff’s first term (2011-2015) was examined. In this analysis, the typical state careers converge, forming a single cluster. Thus, over the cycles, these careers, although not the most appreciated,<sup>20</sup> continued with the highest average

<sup>20</sup> This phenomenon can be observed in the previous section’s graphs comparing careers.

salaries, indicating the importance of these positions for state operation. The non-hierarchical analysis suggests that the best distribution of positions are in three clusters.

Box 9 shows the positions and their respective clusters. Box 10 presents a fall in the average salaries during President Rousseff’s term due to the economic crisis, and there were no pay adjustments to maintain purchasing power in the face of inflation. In 2015, Brazilian inflation was above previous years, reaching 10.67%.

**BOX 9 CLUSTER ANALYSIS: POLITICAL CYCLE 4 (2011-2015)**

Cluster 1	Cluster 2	Cluster 3
Inmetro – Ph.D.	S&T	Federal attorney
IBGE – Master	Professor – Master	Federal prosecutor
S&T – Ph.D.	S&T – Master	Federal defender
Agent of the federal police	Professor – Undergraduate degree	Treasury prosecutor
Inmetro – Master	Professor – Education improvement	Revenue auditor
IBGE – Specialization	Professor - Specialization	Social security auditor
INEP – Specialization		Bacen analyst
INEP – Master		Regulatory agency
Professor – Ph.D.		Manager
Ipea		Research technician – Ipea
INEP – Ph.D.		Securities and Exchange Commission – CVM
IBGE – Ph.D.		Diplomat
		Federal Chief Police Officer
		Brazilian Intelligence Agency

Source: Data processed on software R. Elaborated by the authors.

**BOX 10 AVERAGE SALARIES: POLITICAL CYCLE 4 (2011-2015)**

Cluster	Initial salary	Final salary
1	8,791.377	14,543.42
2	4,847.84	8,013.00
3	13,883.271	19,155.77

Source: Data processed on software R. Elaborated by the authors.

Cluster analysis for the period and the political cycles separately show that typical state careers have higher average salaries than the other positions. This phenomenon indicates that these careers may have greater bargaining power in salary negotiation with the government (Ventura, 2018).

When comparing the typical state careers with those related to research and education, there is some level of appreciation of the former and little appreciation of the educational level, which is not considered as important as the position's role in state operation. For the position of professors, it is worth noting that those with a Ph.D. belong to a separate cluster, indicating the appreciation of this position in a different way when compared to other careers. However, even if a Ph.D. degree is necessary, the salary level for professors is below the compensation observed for typical state careers and for some not typical, such as that of Ipea and regulatory agencies.

## 5. CONCLUSION

This study showed the segmentation of salaries within the Brazilian federal executive branch in the various activities of public administration. The results demonstrated that some positions are valued over others, benefitting specific careers with higher salaries. In theory, this conflict over distribution has two motivations. The first one is the distributive political relations within the executive branch. The second is that such relations must deal with the state's limitation of resources, more specifically with the revenues from tax collection. This results in an intra-government bargaining process. In this process, the results show that some careers and positions have greater bargaining power with the government. This study focused on the relative patterns and sets of the salaries evolution. Future research can explore further particular conclusions and analyses on bargaining powers, perhaps using case studies.

The analysis and results demonstrating the existence of salary groups formed during the period and the general pattern of fall (government of President Cardoso), rise (government of President Lula da Silva), and fall (President Rousseff), offer subsidies for the following conclusions.

The graphs in section 2 show that careers and positions considered typical of the state have higher salary levels. Regarding pay adjustments for inflation, it was observed that the salary variation, that is, the gains of non-typical careers, were greater than that of other careers. However, the salary level of the typical careers of the state is always higher.

Also, the analysis of the graphs shows that positions such as researchers and professors, which require additional degrees (master, Ph.D., for example), do not have the highest salaries. Therefore, in the case of Brazil, the relation between salaries and education level is not that clear. Further research would be needed to analyze the bargaining power of professionals in these positions.

The cluster analysis corroborated the trends observed in the graphs. The careers linked to management – which are closer to the government's decision-making processes are, in general, considered careers typical of the state – are grouped in the same clusters. This occurs both in the analysis of the period as a whole and in the political cycles. Likewise, these positions have the highest salaries, and the differences between them and the groups reach more than 70%. In this sense, the study showed a very clear pattern of appreciating these activities, essential for state operation (such as revenue auditors), and relatively little appreciation for positions that require higher qualifications.

The general data and the database produced for this study may be used in future research to explore the historical evolution of the negotiations between the federal executive branch and government employees of several careers and positions. For example, careers in the areas of science and technology, health, and education, apparently pay less than careers related to inspection. Therefore, this work establishes some general milestones, adopting a methodology that, to the best of our knowledge, has not been used in similar analysis. This contribution represents a starting point for future studies on salaries based on the patterns identified.

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