FUTURE OF WORK IN THE BRAZILIAN FEDERAL DISTRICT'S EXECUTIVE BRANCH

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In this article, we address the theme 'Future of Work' with focus on the Brazilian Federal District's public sector. Brazil is a federative republic and the federated entity in question has the eighth largest GDP among the 27 Brazilian federated entities (26 states and the Federal District). Since it is the seat of the federal executive branch, the Federal District has the highest GDP per capita, almost twice that of the runner-up, thus justifying the importance of analyzing its governmental structure. To do so, we reproduced the method of Kubota and Maciente (2019) to estimate the tendency to automate occupations, employing the occupation database of the Federal District's executive civil servants. The results showed that jobs that require lower levels of education and involve more routine tasks are more prone to automation. Finally, based on our results, we performed a descriptive statistical analysis of schooling, age, and remuneration of public positions in the Federal District.

Keywords: future of work; automation; machine learning; public sector; Federal District government.

JEL Classification: J01; J45; H11; H83

FUTURO DO TRABALHO NO PODER EXECUTIVO DO DISTRITO FEDERAL BRASILEIRO

No presente artigo abordamos o tema Futuro do Trabalho com foco no Setor Público do Distrito Federal (DF). O Brasil é uma república federativa e o DF, sede dos poderes executivo, legislativo e judiciário federais, tem o oitavo maior PIB entre as 27 unidades federativas, e o maior PIB per capita, quase o dobro do 2º colocado, justificando a importância de analisar sua estrutura governamental. Para tanto, reproduzimos a metodologia de Kubota and Maciente (2019) de estimação da propensão de automação das ocupações, aplicando à base de dados de ocupação dos servidores do Executivo do Distrito Federal. Os resultados apontam que os cargos que necessitam de menores níveis de escolaridade e envolvem tarefas mais rotineiras tendem a uma maior propensão de automação. Por fim, com base em nossos resultados, fazemos uma análise da estatística descritiva da escolaridade, idade e remuneração dos cargos públicos do Executivo do Distrito Federal.

Palavras-chave: futuro do trabalho, automação, aprendizado de máquina, setor público, Governo do Distrito Federal.

EL FUTURO DEL TRABAJO EN EL PODER EJECUTIVO DEL DISTRITO FEDERAL BRASILEÑO

En este artículo abordamos el tema Futuro del Trabajo con enfoque en el Sector Público del Distrito Federal (DF). Brasil es una república federativa y el DF, sede de los poderes ejecutivo, legislativo y judicial federales, tiene el octavo mayor PIB entre las 27 unidades federativas y el más alto PIB per cápita, casi el doble del 2º lugar, lo que justifica la importancia de analizar su estructura gubernamental. Para ello, reproducimos la metodología de Kubota and Maciente (2019) para estimar la propensión a automatizar ocupaciones, aplicándola a la base de datos de ocupación de los servidores del Ejecutivo del Distrito Federal. Los resultados muestran que los trabajos que requieren niveles más bajos de educación e involucran tareas más rutinarias tienden a ser más propensos a la automatización. Finalmente, con base en nuestros resultados, analizamos las estadísticas descriptivas de escolaridad, edad y remuneración de los cargos públicos en el Ejecutivo del Distrito Federal.

Palabras clave: futuro del trabajo, automatización, aprendizaje automático, sector público, Gobierno del Distrito Federal.

1. INTRODUCTION

In economics, one of the most relevant variables for assessing the productive capacity of a country is employment, a fact that makes its comprehension important. This variable is directly related to other important variables, such as inflation and economic growth in the short term, but its composition and characteristics of the labor market can influence other even more important variables, like productivity, that are vital to sustainable growth and the well-being of individuals in the country.

Not only have labor markets changed significantly in recent years, but labor relations and the very concept of work have as well. The way work is performed, the advancement of the means of production and its transformations, the extinction and automation of careers and the creation of new areas and jobs are undergoing a true avalanche of innovations.

People are increasingly experiencing the transition from an economic model of large industries with many employees to companies with few employees, virtual inventories, and even labor without an employment relationship.

The so-called "Uberization of work", a term that refers to drivers and ride sharing, but that encompasses all jobs arising from new technologies, such as delivery drivers (ifood, rappy, etc.), is a reality with no retreat.

Despite the controversial employment relationship due to the lack of formal ties and labor rights previously guaranteed to traditional jobs, modern society has already adapted to the informality and flexibility imposed by this type of commercial relationship.

Throughout history, the process of creative destruction following technological advances has created enormous wealth, but also unwanted disruptions (Frey and Osborne, 2017).

The First Industrial Revolution was the catalyst for self-sustaining growth. No society before this period possessed the ability to cross the gap from a pre-industrial social structure, poor technology and science, and consequently periodic collapse, starvation and death, imposed on production (Hobsbawm, 2012).

In the mid-1860s, the Second Industrial Revolution took place, mainly involving electricity, steel and important developments in science, based on research in chemistry, use of oil, and communications. Mass production of standardized goods and automated processes also emerged (Dathein, 2003). This was followed by the so-called Third Industrial Revolution, whose central hallmark was the energy network/internet (Rifkin, 2012).

Despite the mass innovation that took place in the first three Industrial Revolutions, nothing seems to be as impactful and challenging as what was brought by the Fourth Industrial Revolution, the "Machine Revolution." Since the mid-1970s, labor relations have been undergoing major changes as a result of technological advances. New means of production have given rise to new forms of work, and the ensuing decades have witnessed the advance of globalization, propitiating even more the decentralization of capital and the means of production.

The Fourth Industrial Revolution includes advances arising from technologies such as IoT (Internet of Things), Big Data, Automation, Artificial Intelligence (AI), Machine Learning, and other tools that have been heavily influencing labor relations and human relations.

Despite the positive effects of the innovations arising from the Fourth Industrial Revolution, there is widespread concern about the possible negative aspects, at least in the short term, regarding the labor market (Schwab, 2018), a concern already demonstrated in 1930 by the economist John Maynard Keynes. He argued that the increase in technical efficiency has been occurring faster than society can deal with the problem of labor absorption (Keynes, 1930).

Along with the challenges arising from the Fourth Industrial Revolution, society is now experiencing the beginning of the so-called Fifth Industrial Revolution, which involves how humanity adapts to all these innovations brought by the Fourth Industrial Revolution.

Such adaptations have affected many sectors, making it a great challenge for society, which at the same time that it uses the benefits derived from innovation, has to overcome the negative impacts caused by it.

One of the areas in which the greatest repercussions are felt, positive or negative, of the advances arising from the Fourth and Fifth Industrial Revolutions, is labor relations. The 2018 World Economic Forum discussed the trend toward automation of less complex jobs, with greater survival of jobs that rely on creativity, persuasion, critical thinking, and negotiations.

The automation of less complex jobs is an increasing reality today. The automation of these jobs has had a direct impact on the increase of labor informality, such as the jobs resulting from the already mentioned "Uberization of work".

The profound transformations in the information and communication technology

(ICT) sector, which accelerated at the end of the 20th century, have caused unemployment in various economic segments, such as automation in banking services, mechanization in the cultivation and harvesting of agricultural commodities, and robotization of the production of vehicles.

In the Brazilian commercial sector alone in 2018, out of a total of 17.2 million workers, 13.3 million were in occupations with high or very high automation risk, with the highest risk being faced by workers with average monthly income below R$1,700, concentrated mostly in the North and Northeast regions of the country (Tepassê & Silva, 2019).

As technologies increase, the cost of their development decreases, providing an exponential increase in the areas with access to such technologies, leading to greater possibility of automation in various sectors.

In recent decades, practically unattainable technologies, such as Artificial Intelligence (AI), have become part of the everyday life of the entire population, present, for example, in household goods such as smart phones and televisions.

In this paper, we deal specifically with the propensity to automate the public offices of the executive branch in the Federal District (DF), Brazil's eighth-largest federated entity in terms of gross domestic product. The focus on the Federal District is due to the unique characteristics of this federative entity and to the fact that the public sector predominates in the local job market, be it in the federal or district government, as well as for its importance in the national scene. The DF, location of the federal capital Brasília, has the characteristics of a state and municipality simultaneously, in addition to a unique relationship with the federal government, as provided in the Federal Constitution.

These characteristics make its labor market unique in Brazil. In this context, the Federal District has the highest average monthly household income in Brazil, with per capita value of R$ 2,460 (CODEPLAN, 2020).

Moreover, the discussion about the impact of innovation in the public sector, of which the Federal District is representative, is necessary because it can serve as a parameter for decisions of public managers on policies and actions concerning the staffing of administrative agencies.

Research results on innovation in the public service can provide support to corporate managers and policymakers, with the findings being used to reshape the selection of candidates, possibly adjusting the competencies required of job aspirants (Albuquerque *et al.*, 2019).

With this purpose, this article is structured in five parts: the contextualization of the theme in this introduction; a review of the national and international literature about innovation, technological evolution, and automation of jobs in the second; the methodology and the database, presented in the third section; discussion of the results obtained in the fourth section, especially the propensities for automation of public jobs in the coming years, and our concluding remarks in the fifth section.

2. LITERATURE REVIEW

The automation of activities can enable companies to improve performance by reducing errors, improving quality and speed, and in some cases achieving results beyond human capabilities. It is estimated that automation can increase global productivity growth by 0.8 to 1.4 percent per year (Manyika *et al.*, 2017).

In an analysis of the probability of automation in 702 occupations in the US, as well as the probability of relationships among occupational automation, wages, and education, Frey and Osborne (2017) concluded that 47% of all US jobs would be at risk of automation, for an unspecified number of years (perhaps a decade or two), with evidence of the negative relationship of wages and education with the probability of automation. Thus, as technology advances, low-skilled workers move to tasks that are not susceptible to computerization.

However, when taking a task-based approach, Arntz, Gregory and Zierahn (2016) found, considering the same period of a decade or two, only a 9% probability of job automation, on average, in the 21 OECD countries, thus indicating a much lower risk of automation compared to the occupation-based approach.

Automation increasingly encompasses not only routine tasks, but also abstract tasks, although it is far from replacing people in activities that involve creativity, intuition and imagination (Kovács, 2015).

New and emerging technologies pose a challenge to the future of employment. As machines begin to perform not only routine tasks, but also activities that require skills, including abstract ones, to work in an unstructured environment, concerns arise that automation will do away with many tasks (Sorgner, 2017).

According to Acemoglu and Restrepo (2018), as industrial robots, digital technologies, computer-controlled machines a nd artificial intelligence replace human

workers, new tasks are emerging, ranging from engineering and programming functions to those performed by audiovisual specialists, executive assistants, data administrators, and analysts, planners and social workers.

In an analysis regarding the degree of importance of the internal and external determinants of entrepreneurial innovative capacity within the scope of Portuguese private service firms in the period from 2002 to 2004, Silva, Mainardes, Raposo and Sousa (2011) concluded, using the logistic regression method, that the greater the financial investments in internal research and development activities and the acquisition of external knowledge and marketing activities, the greater the propensity of firms was to innovate in services.

According to Bernardo and Sampaio (2019), among the sectors most impacted by technological unemployment, the service sector is first, followed by the commercial sector, affected by gradual automation and digital commerce, and finally the construction sector, with the increasingly significant development of prefabrication processes. Least affected by advancing automation are sectors with creative and problem-solving jobs, as well as activities related to emotional intelligence, this being one of the most difficult features to automate.

When estimating the probability of automation of occupations in Brazil, Dvorkiin (2016) classified jobs into four types: (i) routine manual; (ii) non-routine manual; (iii) routine cognitive; and (iv) non-routine cognitive. Using this framework, Frey and Osborne (2017) found that the number of routine manual and routine cognitive jobs in the period of 2017 and 2018 was not growing as fast as possible, and Albuquerque *et al.* (2019) found that one explanation for this was that the level of automation is increasing in recent years.

A large percentage of the country's occupations may soon suffer the effects of the diffusion of new technologies according to Kubota and Maciente (2019). Occupations whose tasks are vulnerable to automation still account for a large share of the country's formal employment (about 56.5% of the total) and have accounted for a large share of employment growth over the past 15 years.

It is a fact that technology is increasing employment in some industries and decreasing it in others. The policymaking challenge posed by new technologies may be less related to ameliorating the impacts of mass unemployment and more about helping workers transition from some industries, occupations regions to others (Bessen, 2015).

Moreover, automation complements labor and interacts with supply-side adjustments, so there are strong complementarities between automation and labor, increasing productivity, earnings, and demand for skilled labor (David, 2015).

A shift is needed in the debate about the effects of AI on work, away from the common focus on total automation of many jobs and widespread occupational substitution towards job redesign and business process reengineering (Brynjolfsson, Mitchell & Rock, 2018)

What is certain is that the future of work has to be considered in light of how the transformations of the production process, and people's very lives, are affected by new technologies. To ignore this impact is to close one's eyes to human development itself (Filho & Lent, 2019).

A microeconomic analysis of the impacts of technology on occupation can provide a better way to project the future of work than forecasts of changes in employment levels or occupational shares, and thus serve as a more effective guide to policies that help workers and firms respond to new technologies (Freeman, Ganguli & Handel, 2020).

Research and development-based innovations in machine technology are leading to increased automation and skills. However, they can also lead to greater inequality in income and wealth. More sophisticated technology induces more education, but only to a certain degree, since some individuals will inevitably be left behind because they cannot obtain a college degree or other advanced training due to restricted availability. The characteristic of low-skilled labor not benefiting from automation creates growing inequality, as the wages of the highest skilled workers tend to increase in line with the rate of technological progress (Prettner & Strulik, 2019).

Artificial intelligence does not fit easily into existing analyses of the effect of automation on labor markets. There are three reasons for this. First, prediction is always strictly complementary to other tasks – i.e., decision-related tasks. Second, better forecasting improves decisions - whether made by labor or capital - by allowing more subtle decisions through reduced uncertainty. Finally, it is not yet possible to say whether the net impact on decision tasks - existing or new - is likely to favor labor or capital (Agrawal, Gans & Goldfarb, 2019).

Governments and businesses need to work together to help people adapt to these new technologies through employee retention and career change policies. A culture of

adaptability and lifelong learning will be crucial to spread the benefits of AI and robotics widely through society, particularly with an aging population where people need to work longer (Hawksworth & Cameron, 2018).

Taking such actions will require executives to build their understanding of the economics of automation, the advantages and disadvantages between augmenting and replacing different types of activities with intelligent machines, and the implications for development of human skills in their organizations. The degree to which executives adopt these priorities will influence not only the pace of change in their companies, but also the extent to which these organizations increase or lose their competitive advantages (Chui, Manyika & Miremadi, 2015).

The shift toward a new, desirable "future of work," such as a post-work or full-employment society rather than polarized labor markets, cannot rely solely on more or better reskilling policies. A whole arsenal of innovation, competition, and employment policies will have to be implemented along with forward-looking skill strategies to ensure equitable access of most people to the profits and opportunities of automation (Pouliakas, 2018).

The process of adopting new technologies, however, is likely to be slower than the headline numbers of jobs at imminent risk suggest. This focuses on technical feasibility and does not take into account economic, social, cultural, and political factors that are also included in decisions to automate. Therefore, automation is more likely to be an ongoing process of changing the way people work and job reallocation, rather than an abrupt and imminent elimination of work (Lawrence, Roberts & King, 2017).

Finally, it is worth highlighting the innovative approach produced by Adamczyk, Monasterio, and Fochezatto (2020) when addressing the future of work theme, specifically for the Brazilian public sector. They presented an estimation method entitled Bartik Occupational Tasks (BOT), by considering the automation trends found for occupations in the private sector, and showed that more than 100,000 of the 521,701 public servants in the federal executive branch studied perform occupations that will be highly prone to automation in the coming decades.

 Furthermore, they concluded that the occupations with low propensity to automation are those which, in general, require a high intensity of analytical or slightly repetitive tasks, such as researchers and professionals related to the natural, social and health sciences, among them as engineers, economists, sociologists, geographers, biologists, psychologists, and anthropologists.

3. METHODOLOGY

3.1 Data

For our study, we initially used the database of the compensation of civil servants of the Federal District government (GDF), referring to May 2020, made available at the transparency portal of the GDF, which has data compiled from the Integrated System of Human Resource Management of the GDF (SIGRH), SIAPE (in the case of the Civil Police[1] of the Federal District (PCDF) / Fire Brigade of the Federal District (CBMDF) / Military Police of the Federal District (PMDF)) and proprietary systems of the Energy Company of Brasilia (CEB), Environmental Sanitation Company of the Federal District (CAESB), Development Agency of the Federal District (TERRACAP), Supply Center of the Federal District (CEASA) and the Bank of Brasilia (BRB).

The SIGRH covers the management system for the registration and payment of public servants, employees, retirees, and survivorship beneficiaries of the direct entities, independent agencies and public foundations, as well as of the public companies of the Federal District Government (Glossary of the Secretariat of Economics of the Federal District).

In the initial database comprising the payroll of the GDF for the month of May 2020, we excluded the variables name, CPF (taxpayer enrollment number), function, items referring to remuneration (we kept only the variable gross remuneration), and in the variable "situation" we considered the active employees and tenured employees, excluding survivorship beneficiaries, those on leave for any reason, seconded employees, political appointees and those with no information.

We also disregarded the members of the Federal District Military Police, Federal Distric Fire Department and young apprentices, so from the initial base of a total of 236,718 civil servants, after our filters, 98,687 people remained to be analyzed, with the following variables: occupation, situation, agency, and gross remuneration.

Additionally, of the 885 initial occupations we compiled and unified, 368 occupations remained. This reduction was because the database does not follow standardization in terms of code, description, or spelling, and thus there are positions with the same nature but with different nomenclatures.

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[1] The Civil Police are the investigatory force, while the Military Police are the uniformed constabulary.

Finally, to support the descriptive statistical data regarding the age and education of the public servants of the Federal District's executive branch, we used the data posted at the site "Transparency portal of the GDF - Profile of Public Servants," which has as parameters the data registered in the SIGRH. However, unlike our initial base, the data on age and education consider a total of 187,979 civil servants between active and retired, and do not allow segregation as done previously. This new sample aimed to present a broader panorama of the age and education of the public servants of the executive branch of the Federal District.

3.2 Parameters of the job automation propensity calculation

Our analysis of the propensity to automate the occupations of the Federal District executive branch utilized a parameter taken from the study of Kubota and Maciente (2019), who ranked the occupations of the Brazilian labor market, regarding the potential for automation, in addition to quantifying and classifying formal jobs in Brazil in terms of automation risk.

To this end, the they used as a source for the development of their studies the construction of a database with automation probability of jobs, using data from the Occupational Information Network (O*NET), developed under the sponsorship of the United States Department of Labor, and the Annual Social Information Report (RAIS) from the Ministry of the Economy (ME). Thus, they developed an innovative approach to classify occupations at higher risk of automation, by considering the importance (given by frequency) and relevance of the exercise of the tasks performed in each occupation (Kubota & Maciente, 2019).

By building a dictionary of keywords, a task-based approach was used, considering the most disaggregated information available for each occupation, which enables a detailed analysis of tasks described in the O*NET database (Kubota & Maciente, 2019).

For each task a summation was calculated, based on the keywords not associated with automation and those associated with automation. The keywords were assigned the value -1 in the case of actions considered not automatable, and 1 otherwise. Thus, if the sum is less than or equal to zero, the task was classified as non-automatable, with the dummy variable taking the value 0. Otherwise, the task was classified as automatable, taking a value of 1.

This dummy variable was multiplied by the importance, from lowest to highest (scale from 1 to 5) and by the relevance (scale from 0 to 100) of the task, according to the O*NET database, resulting in a score ranging from 0 to 500 for each task. The sum of the scores multiplied by the automation dummy was divided by the sum of the scores without multiplication by the dummy, generating a value between 0 and 1, indicating the percentage of automatable tasks of each occupation, already weighted by the importance and relevance of each task (Kubota & Maciente, 2019).

As a reference in the construction of these keywords, the classification of Spitz-Oener (2006) was used, which classifies the automation of tasks as: i) non-routine analytical; ii) non-routine interactive; iii) routine cognitive; iv) routine manual; and v) non-routine manual, and considers consolidated technologies likely to be implemented from a regulatory point of view within five years.

After comparing each position and assignment of the executive branch of the Federal District Government (GDF) with the occupations described in the O*Net database, and having as reference the database of propensity to automation of occupations, we built a database with the main occupations of the GDF executive branch, as well as the propensity to automation of each of these occupations.

Thus, in the next section, we discuss the results. To this end, we present, preliminarily, a descriptive statistical analysis with the age and education of the civil servants contained in the "transparency portal of the GDF," combined with the database built from the crossing of data from SIGRH, referring to May 2020, with the base of propensity to automation of Maciente and Kubota (2019), showing the percentage of civil servants occupying positions and the propensity to automation of these positions. We ranked the positions in descending order of propensity to automation, determined the number of civil servants of each one and their average salaries, as well as the positions with a lower propensity to automation, and finally ascertained the positions with the highest number of civil servants and their propensity to automation.
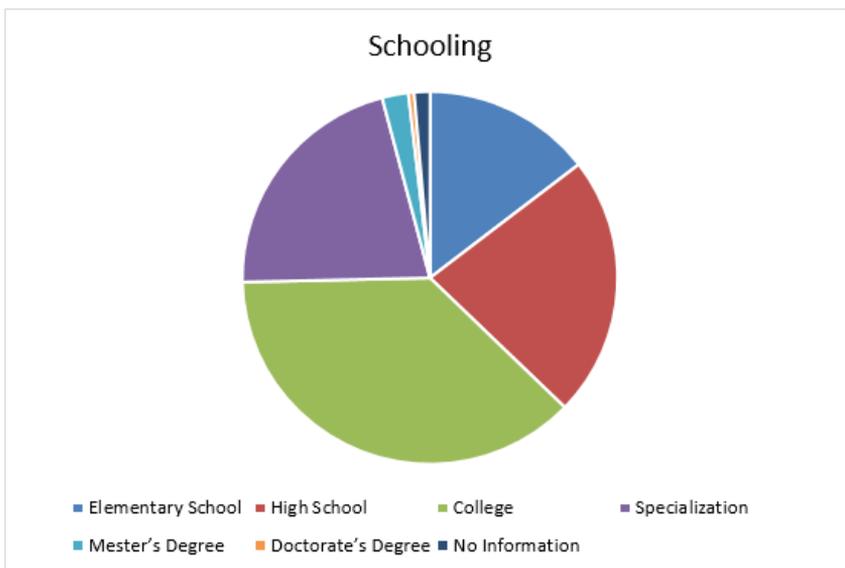
4. RESULTS

4.1 Descriptive statistics of the occupations of the Federal District executive branch

Table 1 shows the descriptive statistics regarding the schooling level of the public servants of the Federal District. This table was constructed with data available at the

transparency portal of the Federal District Government, concerning the month of October 2020.

As can be seen in Figure 1, the average schooling level of the public servants is 14.3 years, and most of them have completed college education (37.40%), followed by high school (22.66%), specialization (21.25%), elementary school (14.57%), master's degree (2.27%) and doctorate (0.49%), as well as some pooled (1.36%) with no schooling information.

Figure 1 – Distribution per level of schooling of the public servants of the Federal District

Source: Elaborated by the authors.

When compared to average number of years of study of the federal executive civil servants, 15.35 years, according to Adamczyk, Monasterio, and Fochezatto (2020), we found an average of one year less. We also found a relevant discrepancy about the number of PhDs, since at the national level, Ph.D. holders represent 19% of the total number of public servants, while the figure among the public servants of the GDF is only 0.49%. However, some parity is maintained to the percentage of civil servants with higher education, which is 36% in the federal public sector.

Table 1 - Descriptive statistics of the schooling of the public servants of the GDF executive branch

Variable	Mean	SD	Minimum	Maximum
Years of study	14.83	4.70	8.0	21

Schooling	Quantity	%
Elementary School	27395	14.57
High School	42601	22.66
College	70311	37.40
Specialization	39947	21.25
Master's Degree	4261	2.27
Doctorate Degree	915	0.49
No information	2549	1.36
Total	187979	100

Source: Elaborated by the authors based on Transparency Portal/GDF – 10/2020

Table 2 shows the data regarding the age range of these employees, which varies between 18 and over 60 years old, where most of them are over 40 years old, which is in line with the federal executive's average of 46.7 years old (Adamczyk, Monasterio & Fochezatto, 2020).

Table 2 – Age of the Executive Branch of the DF

Age Group	Quantity	%
18 - 29	9975	5.31
30- 39	34241	18.22
40 - 49	40865	21.74
50 - 59	43713	23.25
≥60	59185	31.48
	187979	100

Source: Elaborated by the authors based on Transparency Portal/GDF (10/2020).

The average monthly salary of GDF employees is R$9,053, about 9% lower than the average monthly salary of the federal executive branch, which is R$9,913 (Adamczyk, Monasterio & Fochezatto, 2020).

The body with the highest average salary, excluding public companies not dependent on the GDF, is the Attorney General's Office of the Federal District, with an average salary of R$17,111 (Table 3), and the highest average salary, by position, is for public defenders, a special class, with an average salary of R$42,607.

Table 3 – Bodies with the highest average salaries – base SIGRH – May de 2020

ORGAN	Number of Civil Servants	Gross Payroll Total R$	Average Salary R$
FD Attorney General	635	10,866,029.66	17,111.86
FD Secretariat of Urban Protection - FD Legal	801	12,340,771.78	15,406.71
FD Public Defender's Office	855	13,138,049.00	15,366,14
FD Sec. of the Economy	2381	33,964,079.38	14,264.63
Comptroller General of the FD	326	4,620,486.54	14,173.27
Planning Company of FD - CODEPLAN FD	491	6,418,159.17	13,071.61
Sec. of Transport and Mobility	439	5,347,462.14	12,181.01

Source: Elaborated by the authors based on SIGRH/GDF (May 2020).

4.2 Propensity to automation in the occupations of the Federal District executive branch

In this section, we analyze the propensity to automate of occupations in the executive branch of the Federal District. We point out that the result of automation propensity of occupations, as in other works on the subject, should be read as an ordinal, not cardinal, scale. Thus, the automation propensity of occupation does not represent the probability itself but rather orders the occupations from highest to lowest automation propensity (Arntz, Gregory & Zierahn, 2016; Frey & Osborne, 2017; Kubota & Maciente, 2019; Adamczyk, Monasterio & Fochezatto, 2020).

After applying the filters described in subsection 3.1 to the general remuneration base of SIGRH, we were left with 98,687 civil servants, distributed in 368 positions, to be analyzed.

Of the positions analyzed, we found that 70.4% of the civil servants occupy positions in which the tasks can be classified as low automation-prone, while 24.1% of the positions have medium automation propensity, and 5.5% of the positions are occupied by civil servants performing tasks classified as high automation-prone (Table 4).

Table 4 – Percentage of automation propensity by number of civil servants

Automation Propensity	Number of Civil servants	%
0 | —— 0.25	69462	70.4
0.25 | —— 0.50	23754	24.1
0.50 | —— 0.72	5471	5.5
Total	98687	100

Source: Elaborated by the authors based on the database of Kubota and Maciente (2019) and SIGRH/GDF.

Among the positions analyzed, the position with the highest number of employees, 7.2% of the total, and significant propensity to automation, are nursing assistants, with a total 7,092 employees and average propensity to automation of 0.36, while the average monthly salary of such employees is R$ 7,246.00 and most of them work for the Federal District Secretariat of Health.

When analyzing the distribution of public servants in positions with a high propensity to automation, i.e., between 0.50 and 0.72, we found a total of 5,471 positions, which represents 5.5% of the total of 98,687 public servants analyzed, distributed in 24 positions (Table 5).

Table 5 – Positions with propensity to automate above 0.50

Position	Automation Propensity	Number of Civil Servants	Average Salary in R$
Seamstress	0.72	9	6,772.75
Foundry worker	0.67	1	5,764.24
Art. civil works/stonemason	0.67	28	7,309.93
Conservation and cleaning	0.66	1897	6,311.23
General services	0.66	1955	7,050.62
Operational services	0.66	496	8,764.22
Repair technician	0.62	4	5,035.04
Locksmith	0.62	3	4,517.21
Welder	0.62	6	12,575.39
Butcher	0.62	8	4,015.32
Carpenter	0.60	18	7,427.70
Mechanic	0.60	85	12,074.47
Storekeeper	0.58	4	22,692.14
Warehouse worker	0.58	12	7,693.30
Warehouse clerk	0.58	12	4,118.72
Inventory supervisor	0.58	28	4,481.57
Tow truck operator	0.57	1	4,564.44
AOSD-Hospital laundry	0.55	234	6,142.33
Data processing clerk	0.53	78	10,222.34
Typist I	0.53	6	4,143.33
Typist II	0.53	89	11,124.58
Painter	0.52	3	4,512.32
Plumber	0.52	396	12,426.34
Upholsterer	0.51	2	3,402.12
Telephone operator	0.51	83	7,961.65
Teledigrapher	0.51	13	13,342.48

Source: Elaborated by the authors.

Thus, in Table 5 we show in descending order the positions with a high propensity to automation, above 0.50, as well as the number of employees and the average gross remuneration for each of these positions.

We observe that of the positions described in Table 5, the four positions of warehouse keeper stand out for the high value of the average gross remuneration, which can be explained by the fact that they are former employees of CAESB, an autonomous public company.

Moreover, we have the positions of welder, mechanic, plumber, data processing assistant, typist, and telegrapher, all of them earning above the average salary of R$ 9,053.

Among the three positions with the highest propensity to automation are the positions of seamstress (0.72), foundry worker (0.67), and bricklayer (0.67). However, these are positions with few employees, with the most relevant of these being in the bricklayer position, with 41 employees and an average salary of R$ 7,309.00.

The average salary for bricklayers in the public sector of the federal executive branch is R$ 4,189.00 (Adamczyk, Monasterio & Fochezatto, 2020).

Concerning the positions with the highest number of civil servants with a high propensity to automation, we have the positions conservation and cleaning (1,897 civil servants), general services (1,954), operational services (452), plumbers (396), and hospital laundry workers (234). However, these positions are held by longtime employees, since the Federal District Government has been outsourcing such occupations in recent years.

Furthermore, when analyzing the automation propensity of these positions (Table 5), we found that the positions with the highest propensity to automation are precisely the ones that demand a lower level of education and involve routine manual tasks, such as seamstresses, foundry workers, bricklayers, general services, laundry workers, clerks, etc., which is in line with the findings of other studies, indicating a greater impact of automation on lower-skilled and routine manual occupations (Arntz, Gregory, & Zierahn, 2016; Frey & Osborne, 2017; Albuquerque *et al*., 2019; Adamczyk, Monasterio & Fochezatto, 2020).

For a demonstration of the positions with average automation propensity, within the range of 0.25 to 0.49, we listed only the positions with more than 100 civil servants, given the large number of positions in these conditions.

Therefore, in Table 6 we report the propensity to automation of the positions with over 100 employees, organized in increasing order, identifying the number of employees and their average pay.

We observe that among the positions with the highest average remuneration is that of the treatment plant operator, with a total of 300 employees, automation propensity of 0.26, and gross average remuneration of R$ 17,270.00, which can be explained by the fact that they are employees of a public company that does not depend on the GDF, which tend to have higher salaries.

Of the positions listed in Table 6, the positions of agent, assistant and administrative support, metro-rail driver, and metro-rail transport operator are above the average salary of the GDF civil servants of R$ 9,053.00.

The metro rail driver and metro-rail transport operator positions, with 188 and 124 civil servants respectively, are the ones with the highest propensity to automation, with a value of 0.42.

Moreover, we observed the predominance of administrative, technical, support, assistants and other positions that tend to involve routine cognitive activities, which explains the medium propensity to automation of these occupations.

Table 6 – Medium automation-prone positions with over 100 civil servants

Position	Automation Propensity	Number of Civil Servants	Average Salary
Treatment plant operator	0.26	300	R$ 17,270.33
Police clerk	0.29	593	R$ 7,787.26
Station agent	0.29	207	R$ 8,314.72
Administrative technician	0.30	2933	R$ 6,613.26
Administrative support worker	0.30	2577	R$ 7,309.22
Administrative officer	0.30	388	R$ 10,718.86
Administrative assistant I	0.30	498	R$ 14,052.84
Administrative assistant II	0.30	190	R$ 8,435.91
Administrative support worker	0.30	122	R$ 10,036.93
GRS agent (administrative support)	0.30	1182	R$ 5,734.21
Driver	0.30	936	R$ 7,063.94
Dental technician – THD	0.32	598	R$ 4,550.21
Collector	0.34	148	R$ 3,366.52
Caterer	0.34	960	R$ 5,593.88
Environmental health agent	0.37	637	R$ 5,527.56
Nursing assistant	0.37	7092	R$ 7,246.57
Nursing technician	0.37	3308	R$ 4,104.98
Metro-rail driver	0.42	188	R$ 11,139.11
Metro-rail transport operator	0.42	124	R$ 9,498.84

Source: Elaborated by the authors.
Note: Propensity to medium automation, positions with more than 100 civil servants.

Regarding the activities with low propensity to automation, we emphasize that, according to Kubota and Maciente (2019), managerial tasks, such as supervision and coordination, are classified as non-routine interactive tasks, which makes them not subject to automation in the coming years.

Managerial positions such as bank president, directors, officers, superintendents, doctors, lawyers, administrators, higher education professors, etc., were classified as have zero automation propensity.

Thus, from the database built and comparing it with the base of propensity to automation developed by Kubota and Maciente (2019), we found that 29.6% of the civil servants of the Federal District executive branch occupy positions with medium or high propensity to automation. Corroborating other research regarding the automation of occupations, the occupations with lower propensity to automation are those related to higher educational level and higher average salary (Frey & Osborne, 2017).

5. CONCLUSION

In an innovative way, following the example of Adamczyk, Monasterio, and Fochezatto (2020), who estimated the propensity of automation of occupations in the federal executive branch of Brazil, we focused on the Federal District.

This discussion about the future of work in the public sector is extremely relevant, since it can support decisions regarding future hiring and job creation, as well as hiring for positions that will become obsolete in the medium and long term.

We found that about 30% of the public servants of the executive branch of the Federal District occupy positions with medium or high propensity to automation. However, we emphasize that the results presented here are only a management tool, and not a prediction or direct recommendation regarding what should be done.

Despite the limitations imposed by the lack of detailed information, our findings are consistent with research on the propensity of automation in the private sector, which indicates that occupations with lower levels of education are more prone to automation.

Finally, we stress the need for and importance of new research on the future of work, especially in the federal and state public sectors, as this can enable the adaptation of the public labor force, as in the private sector, so that occupations are in conformity with the digital transformations and innovations society is experiencing.

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