

The Effects of COVID-19 on Formal Employment: Analysis of Work Occupations in Cities in the Northeast Region of Brazil

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Abstract:

Background: The impacts on employment in the current pandemic crisis are central to changes in the levels of the Brazilian economy and, consequently, in family income. Among the affected Brazilian regions, the Northeast region has the second highest rate of infections in the country, second only to the Southeast region. As it is the second region most affected by the pandemic in the country, it will likely suffer from the economic impacts. Considering the relevance of the topic, this study aims to understand the behavior of jobs in the Northeast region of Brazil during the COVID-19 crisis.

Materials and Methods: The research used in its analysis secondary data from two samples routinely collected by the General Register of Employed and Unemployed (CAGED). Data referring to 1794 municipalities in the Northeast region were used, with a time span from January to October 2019 for one base, and January to October 2020 for the other. From a quantitative analysis through the method of differences in differences (DiD).

Results: Simulating that the other interferences in employability remained constant, it is estimated that there was an approximate average reduction of 842 formal job admissions in northeastern cities, when compared to the period before the pandemic.

Conclusion: As the survey analyzes were carried out during the pandemic, the results can serve as a basis for decision-making by managers, not only in the private sector, but also in public management. Since they can better understand possible changes related to economic recovery, post-pandemic, from policies aimed at job generation.

Key Word: Admissions; Pandemic; Difference in Differences.

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I. Introduction

The current outbreak of the novel coronavirus (COVID-19) has transformed the world economy. Schools and companies changed the way they operated, pushing workers to a residential model of action, some companies were forced to lay off employees. It was clear that the economic shock would be unlike anything the contemporary world had experienced. During the 2008 financial crisis, government agendas in several countries sought to save the economy, with a focus on protecting banks. However, in the current pandemic crisis, as governments seek to protect people, billions of dollars are being spent to rescue businesses and jobs. While every recession is unique, the sharp drop-in economic activity induced by COVID-19 is unprecedented in contemporary history (Demirović Bajrami et al., 2020; Hawkins, 2020; Kickbusch et al., 2020).

The impacts on jobs in the current pandemic crisis are central to changes in the economic levels of the Brazilian Gross Domestic Product (GDP), and, consequently, to family income. To get an idea of the proportion of the problem caused by this crisis, the Brazilian government implemented a program called “emergency aid”, with the aim of combating the possible economic damage caused by the disease. This aid supplies the vulnerable population through monthly payments to citizens who fall into the following groups: low-income, unemployed, informal workers or individual micro-entrepreneurs, according to proof of belonging to one of these groups (BRASIL, 2020b; Luciano, 2020). Such measures were necessary to minimize the damage caused by the pandemic to the economy and the workforce in the country.

Observing the gravity and impacts of the current health crisis in Brazil, the number of cases of contamination is extremely high, being among the three countries with the highest number of infected people, and incidences of death from the disease worldwide. According to data from the Ministry of Health, Brazil has the highest number of infections and deaths in all Latin America, on the American continent second only to the United States of America (USA), which has the highest number of infected and deaths across the globe. Among the affected Brazilian regions, the Northeast region had the second highest rate of infections in the country, behind only the Southeast region (de Paulo Farias & de Araújo, 2020; BRASIL, 2020b). As it is the second

region most affected by the pandemic in the country, it will probably not only suffer from health impacts, but also from economic impacts, and, therefore, changing the behavior of jobs and family income. With this, it is interesting to understand the behavior of employability in the Northeast region of Brazil during the COVID-19 crisis.

Some studies already point to possible impacts of the pandemic on the workforce. Kim, Kim, Tuttle, & Zhang (2021) sought to examine changes in the work status of Asian Americans (Asians of American descent), verifying the before and after the blockade provided by the COVID-19 crisis. The authors sought to investigate changes in work status before and after the blockade, compared to the work status during the blockade period. The survey used the Current Population Survey – Merged Outgoing Rotation Group (CPS-MORG) database. CPS-MORG conducts monthly surveys of official US employment-related statistics. The study used data from the database covering the months of January to August 2020. The study samples were limited to people who were between 18 and 59 years old. The data were organized into a set of mini panels, where two groups of panel data were built: one called the blocking panel, which incorporated the months before the blockade to the most rigorous month of the blockade. And the other panel called reopening, which incorporated the most rigorous months of the blockade to the months in which the reopening took place.

Among several existing differences between the study by Kim et al. (2021) and the proposed research, the target audience that includes people of all ethnicities and ages present in the Brazilian database is a differential compared to the group that includes only Asian Americans in the study by Kim and the other researchers. The location that will serve as the basis for the research data may also present a reality that may differ or converge with the findings of the study by Kim and the other authors. The study intends to use employability data in the Northeast region of Brazil. Such differences may provide relevant comparisons between both studies.

Another study carried out by Demirović Bajrami et al. (2020), aimed to test how different implications related to the COVID-19 crisis affected work-related actions, such as satisfaction and motivation. The authors also sought to investigate the behavior of worker rotation in the hotel sector. Information such as job insecurity, workers' health complaints during the isolation period, risk in the workplace and the equity of organizational transformations were examined using multiple regression analysis. Such analyzes sought to consider the direct and indirect impacts of the effects of the pandemic along with motivation and satisfaction at work. Data were collected from workers in the hospitality industry in Serbia. The sample used data referring to the months of March and April 2020, a period in which most nations, including Serbia, suffered the impacts of the crisis caused by the pandemic.

One of the distinct points between the study by Demirović Bajrami et al. (2020) and the proposed study, is linked to the objective itself. Even though both dealt with work-related problems during the pandemic crisis. Demirović Bajrami et al. (2020) sought to consider the direct and indirect impacts of the effects of COVID-19 along with motivation and satisfaction at work. This study sought to verify the behavior of employability during the pandemic period.

Another study that also sought to address the impacts of the pandemic at work was that of the authors Dwivedi et al. (2020). The authors presented a collective perspective of the main questions and complications that hit society and organizations from COVID-19. The method they used addressed a technological perspective that was provided from the assessments of twelve invited specialists. Each has articulated their individual judgments through the lens of the current pandemic crisis. Based on a content analysis (qualitative analysis), the experts' perspectives provided an opportune look at the various topics addressed, analyzing key questions and suggestions on the theory and practice of the topic.

Performing a comparison between the methodology adopted by Dwivedi et al. (2020) and the methodology proposed in this research, it is observed that both are different in several aspects. While the authors presented a content analysis based on the opinion of 12 specialists, the current research sought to investigate the behavior of employability in hundreds of cities in the Northeast region of Brazil, using a quantitative analysis of the data. However, it is still possible to perform a subjective analysis regarding the findings by Dwivedi et al. (2020) and the findings of this study, in order to identify possible points of convergence or divergence between both.

In another research, Hodder (2020) sought to understand how the COVID-19 crisis impacted employment and work based on the importance of new technologies that are being used for this purpose. From a bibliographical study (content analysis), the author pondered from a historical position, based on theory, how new technologies impacted the model of performance at work during the pandemic. In his analysis, the author sought a theoretical foundation that addressed the content, one of which he named “Vigilance control on the front line”, this one aimed at workers who worked in the corporate work environment. The other content he named “Control and surveillance working at home”, aimed at professionals who were working from home during the pandemic.

As well as in the comparison of Dwivedi and the other authors. Hodder's study methodologically differs from the current research, when it presents a qualitative approach through a bibliographic content analysis. The proposed study used a quantitative approach. Such differences in the research of the authors, compared to the proposal of the current research, may contribute to an eventual comparison of the study's findings, as well as it may explain probable differences present between them. Differences that can be caused by the sample, the method, the study's target audience, or even referring to the methodological changes used.

Considering the relevance of the theme, the current study will aim to understand the behavior of jobs in the Northeast region of Brazil during the COVID-19 crisis. It will use as a dependent variable the hiring of workers from January to October 2019, and in the same period in 2020, having as explanatory variables of the model a variable called year2020 that stores information referring to the records of the year 2020, and another variable called positivebalance that stores information regarding records that have more admissions than dismissals. These will be arranged in the database as dummy variables, necessary for using the difference-in-differences methodology between the control and treatment groups, before and after the event, respectively. The explanation of what dummy variables are, the difference-in-differences method, as well as the behavior of each variable, will be elucidated in the following topics.

II. Data

Regarding the structure of the information used in the research, these will use the panel data set, also called longitudinal data. This structure consists of a time for each transverse section record unit present in the database. The essential property of panel data that differs from other structures is that for the same cross-sectional records (organizations, people, countries, states, cities, among others), there are records from more than one time period (Wooldridge, 2016). Thus, this research will use data on employability in the same cities in the Northeast region of Brazil, which comprise two time periods. The first with data on employability from January to October 2019. The option for 2019, in addition to the proximity to the year 2020, is that, without the interference of the pandemic crisis, it is believed that the behavior of employability would suffer few variations, due to the high probability of permanence of federal, state, and municipal managers. The second with data from January to October 2020, an option for current data that represent most of the months that have suffered from the interference of COVID-19 so far.

According to Wooldridge (2016), observing the same groups of units in more than one time period can provide several benefits in relation to cross-sectional data, or even in relation to grouped cross-sectional data. Having different observations on the same attributes may allow the control of certain non-perceptible characteristics of organizations, people, etc. The use of more than one observation may facilitate causal inference in circumstances where inferring causality would be very complex if only a single cross-sectional element were available. Another advantage of panel data, according to the author, is that they usually allow studying the relevance of discrepancies in behavior, helping in decision-making.

The study will use in its analysis secondary data from two samples routinely collected by the General Register of Employed and Unemployed (CAGED). This register is maintained by the Special Secretariat for Social Security and Labor of the Ministry of Economy of the Brazilian government. CAGED was created as a constant record of admissions and dismissals of formal workers governed by the Consolidation of Labor Laws (CLT). This register serves as support for research, programs and projects aimed at the labor market, assisting in decision-making for government actions (BRASIL, 2015).

The two data samples used in the study are available on two separate links. This is because CAGED was updated between 2019 and 2020. The first sample was taken from the database available at <http://pdet.mte.gov.br/images/ftp//dezembro2019/nacionais/6-saldomunicipioajustado.xls>, it presents the balance of formal employment by municipality and sector of economic activity across the country, with adjustments from 2010 to 2019 (BRASIL, 2019). For this sample, only data referring to 1794 cities in the northeast region, present in the base, were used, with temporal coverage from January to October 2019. The temporal cut from January to October was necessary because the 2019 sample, available at the link above, does not present data from November 2019.

The second sample was taken from the database that is available at the link http://pdet.mte.gov.br/images/Novo_CAGED/Nov2020/3-tabelas.xlsx, this database called "Novo CAGED", presents the monthly evolution inventory, admissions, dismissals, and balance by Brazilian municipality with adjusted series. The adjustments mentioned both in the first sample and in the current one, consider the declarations delivered after the deadline (BRASIL, 2020a). For this sample, data referring to the 1794 cities in the northeast region present in the base were used, compatible with the data from the previous sample, with temporal coverage from January to October 2020. The temporal cut from January to October was necessary because the referring data to December 2020 are not yet available in the sample coverage for the year in question.

After processing to unify the sample, without providing any changes to the information for each municipality, it will use 3588 records that include information on the employability of 1794 cities in the Brazilian Northeast region in the years 2019 and 2020. The information contained in the unified database it will present information about: UF (Federative Unit) of the cities, that is, the acronym referring to the state of the federation to which they belong; the Municipality Code, serves as a numeric identifier for each municipality; Municipality, presents the name of each municipality along with its federative unit; Admissions, number of formal admissions in the municipality during the corresponding time period; Dismissals, number of formal dismissals in the municipality during the corresponding time period; Balances, represents the subtraction of admissions by dismissals in each municipality.

In addition to this information, it will be necessary to create three more fields in the unified database, where two of these will serve as explanatory variables (independent) in the study. The first field refers to the year of the survey. In this, the records of 2019 and 2020 will be identified. The second and third will correspond as explanatory variables of the study, will be named as year 2020 and positive balance. Both explanatory variables using a binary system, in econometrics binary variables are commonly called dummy variables, these are usually presented with binary data, where the relevant knowledge can be obtained by simply defining a variable that presents the values zero or one (Wooldridge, 2016).

The dummy variable year2020 will present the value 1 for records with data from cities in the year 2020, and the value 0 for records from the year 2019. The variable Positivebalance will present the value 1 for balances with values greater than 0, and the value 0 for balances with amounts less than or equal to 0. The following table will present the fields that must compose the study's database.

Table no 1: Description of the elements present in the research database.

Field Name	Data Type	Description
UF	Text	Federative unit of municipalities. Regarding the state of the federation to which they belong.
City Code	Numeric	This serves as a numeric identifier code for each municipality.
City	Text	Name of each city along with its federative unit.
Admissions	Numeric	Number of formal admissions (hiring) of workers registered in the city.
Shutdowns	Numeric	Number of dismissals and formal dismissals of workers registered in the city.
Balance	Numeric	Subtraction of admissions by dismissals for each City. Ex.: Admissions – Dismissals = Balance.
Year	Numeric	Identification of records by year, either 2019 or 2020. Each City will present two records, one for each reference year.
year2020	Binary or dummy	Displays the value 1 for records with data from cities in the year 2020, and the value 0 for records for the year 2019.
positivebalance	Binary or dummy	Displays the value 1 for balances with amounts greater than 0, and the value 0 for balances with amounts less than or equal to 0.

Note. Prepared by the authors based on data contained in BRASIL (2020a).

After a brief understanding of the data that will be used in the study, its sources, and its structuring proposal. The method proposed for this research will be presented below, as well as the results and possible limitations of the research.

III. Method and results

To reach the objective of the research, the difference in differences (DiD) method was used. This method of quantitative analysis is usually used in research where the data derive from a natural experiment, also known as a “quasi-experiment”. A natural experiment happens when a certain exogenous event modifies the environment in which organizations, people, entities, or Cities act. For a natural experiment to occur, the existence of a control group is necessary - such a group cannot be affected by the changes to which the experiment is submitted - and a treatment group, this must be affected by the actions proposed in the experiment (Delgado & Florax, 2015; Wooldridge, 2016).

According to Wooldridge (2016) it is called a group A which will represent the control group, and a group B which will represent the treatment group. Using binary data, decide dB equal to 1 for the data of the treatment group (group B), consequently the value 0 will be assigned to the data of group A. It is also defined d2 as a temporal dummy variable, which will be assigned value 1 for the data of the second period (data that suffer the interference of the experiment), being the value 0 assigned to the data of the first period (period that precedes the experimental interference). The abbreviation for other factors presents in the equation is OF. The equation of interest proposed by the author is.

$$y = \beta_0 + \delta_0*d_2 + \beta_1*dB + \delta_1*d_2*dB + OF \tag{1}$$

The variable y is the dependent variable of the study. Beta zero (β_0) represents the estimator of the control group in the period prior to the experiment. The delta zero (δ_0) is the difference of the estimator of the control group, where the results of the period of the experiment are subtracted from the results of the period that precedes the experiment (period after – period before the experiment). The beta one (β_1) is the difference of the estimator of the treatment group by the control group (treatment – control). Delta one (δ_1) measures the effect of the decision of the experiment, without the interference of other variables in the regression, this will be the effect estimator or average differentiation in the treatment, as it adjusts the effect with the treatment in the average measurement of y (Wooldridge, 2016).

Since we seek to understand the behavior of jobs in the Northeast region of Brazil during the COVID-19 crisis. An equation capable of measuring DiD can be modeled, with the aim of implementing it with the research data. Retrieving the fields from the research database, the d2 that represents the temporal dummy variable of the equation can be replaced by the year2020 field. dB, which is also a binary variable, can be replaced by the positivebalance field. The y that represents the dependent variable of the study can be replaced by the admissions field. The abbreviation for other factors presents in the equation is OF. Arriving at the following equation

$$\text{admissions} = \beta_0 + \delta_0*\text{year2020} + \beta_1*\text{positivebalance} + \delta_1*\text{year2020}*\text{positivebalance} + OF \tag{2}$$

With the proposed model elaborated, the data need an organization to carry out the analyses. For data organization, the study used Microsoft Excel 365 software. The information bases collected in CAGED are compatible with this software, facilitating data organization. Complementing the organization and consequently performing the data analysis, the research will use the Rstudio software. This is an open-source tool used worldwide by data scientists and professionals from various fields. The software uses the R programming language on an integrated development platform, suitable for graphing and performing statistical calculations (Wickham & Grolemund, 2017).

After organizing the data and implementing the proposed equation with the software. The following return was obtained:

Table no 2: Results of the model implemented in Rstudio.

Predictors	Estimates	std. Error	CI	Statistic	Admissions	
					p	df
(Intercept)	39.88023	176.18444	-305.55158 – 385.31204	0.22636	0.821	3584.000
year2020	1257.89498	239.12073	789.06864 – 1726.72132	5.26050	<0.001	3584.000
positivebalance	97.23512	224.89775	-343.70527 – 538.17551	0.43235	0.666	3584.000
delta1	-841.53659	314.43697	-1458.02992 - -225.04326	-2.67633	0.007	3584.000
Observations	3588					
R ² / R ² adjusted	0.011 / 0.010					

Note. Std. Error=standard error, CI=confidence interval, p=P value, df=data frame. Prepared by the authors based on the results of the Rstudio tool in 2020.

It is observed that the determination coefficients R2 and adjusted R2 did not present a satisfactory level of explanation for the model, only 0.011 for R2 and 0.010 for adjusted R2. Despite the t statistics and the p-value of the independent variables year2020 and delta1 show significance at a 1% level (0.01>0.001 and 0.01>0.007). The independent variable positivebalance is not statistically significant at a 10% level (0.666>0.10). It is necessary to carry out a global F test (together with all explanatory variables), to identify the presence, or not, of heteroscedasticity (Wooldridge, 2016). After carrying out the F test with heteroscedasticities, the following result is obtained:

Table no 3: Heteroscedasticity F test

Linear hypothesis test					
Hypothesis:					
year2020 = 0					
positivebalance = 0					
delta1 = 0					
Model 1: restricted model					
Model 2: Admissions ~ year2020 + +positivebalance + delta1					
Note: Coefficient covariance matrix supplied.					
Res.	Df	Df	F	Pr(>F)	
	176	3587			
2	3584	3	25.752	< 2.2 ⁻¹⁶ ***	

Note. Signify. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1. Prepared by the authors based on the results of the Rstudio tool in 2020.

Checking the F-statistic and p-value results, statistical significance is identified at a 1% level (0.01>2.2-16). Thus, the null hypothesis that there is homoscedasticity is rejected, assuming that there is strong evidence that the model is heteroscedastic. As the database used presents a significant number of observations (3,588 observations), the use of robust standard errors is suggested, which enable heteroskedastic inference, validating the t-test asymptotically (Wooldridge, 2016). After using the robust standard error, we obtained:

Table no 4: Estimating the model with robust standard error implemented in Rstudio.

t test of coefficients:					
	Estimate	std. Error	t value	Pr(> t)	
(Intercept)	39.8802	9.5701	4.1672	3.157 ⁻⁰⁵	***
year2020	1257.8950	321.1170	3.9172	9.124 ⁻⁰⁵	***
positivebalance	97.2351	17.3160	5.6153	2.111 ⁻⁰⁸	***
delta1	-841.5366	332.8194	-2.5285	0.0115	*

Note. Signify. Codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1. Prepared by the authors based on the results of the Rstudio tool in 2020.

With the inference of the model using robust standard errors, it is observed that the explanatory variables year2020 and positivebalance present statistical significance levels at 1%. The explanatory variable delta1 (year2020*positivebalance) has a statistical significance level of 5% (0.05 > 0.0115). All explanatory variables, together with the intersection coefficient, have satisfactory statistical significance (Wooldridge, 2016). Using the data and analysis, the following equation is estimated:

$$\begin{aligned}
 \widehat{\text{admission}} &= 39.88 + 1257.90*\text{year2020} + 97.24*\text{positivebalance} - 841.54*\text{year2020*positivebalance} \\
 &\quad (176.18) \quad (239.12) \quad (224.90) \quad (314.44) \\
 (3) \quad & \quad [9.57] \quad [321.12] \quad [17.32] \quad [332.82] \\
 N &= 3.588, R^2 = 0.011, R^2 \text{ adjusted} = 0.010
 \end{aligned}$$

If the other interferences on employability remained constant. The interaction term coefficient estimates that, due to the pandemic period caused by the COVID-19 crisis, there was an approximate average reduction of 842 admissions to formal jobs in northeastern cities when compared to the period before the pandemic. Thus, as the decline in Asian American jobs found during the COVID-19 period in the study by Kim et al. (2021), there is a negative effect of formal jobs in cities in the Northeast region. Despite the difference in location and target audience, both studies showed a similar effect regarding employability during the COVID-19 crisis.

IV. Conclusion

The research by Demirović Bajrami et al. (2020) found that job uncertainty perceived by respondents emerged as a serious predictor of satisfaction and motivation at work, converging along with turnover intentions. The study showed that the uncertainty related to staying in the job, provoked by the pandemic crisis, can change the motivational levels of hospitality employees. Despite not dealing with motivation and satisfaction, the current research shows some negative effects on job retention, not only for workers in the hotel sector, but for all groups of workers present in the CAGED database.

Since the survey analyzes were carried out during the pandemic, the results can serve as a basis for decision-making by managers, not only in the private sector, but also in public management. Since they can better understand possible changes related to economic recovery, post-pandemic, from policies aimed at job creation.

Comparisons with other surveys carried out nationwide may corroborate the study's findings. It should be noted, however, some limitations of the research. Despite corrections on heteroscedasticity, a low explanatory power was observed for the determination coefficients, not presenting a satisfactory level of explanation for the model. Some modifications to the model could minimize such effects, such as the use of a log-level model that could suppress or alleviate possible problems with outliers, which could guarantee the normality of the error term.

The use of more Brazilian regions, or even all Brazilian cities, not just the northeastern cities, could present new explanations about the studied phenomenon. Other explanatory variables not considered, such as gender, education level, among others, could optimize inferences about the effect of the pandemic on employability. Other methods such as two-period panel data analysis could present results different from the current ones. It is important to initiate other studies that can identify or analyzing the effects of the pandemic on employability, since it is believed that there is no organization, private or public, that has not suffered the inherent impacts of the effects of the COVID-19 crisis.

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References

- [1]. BRASIL. (2015). *Cadastro Geral de Empregados e Desempregados (CAGED)*. Ministério da Economia. <https://www.gov.br/trabalho/pt-br/assuntos/empregador/caged>
- [2]. BRASIL. (2019). *BRASIL - Saldo do emprego formal por município e setor de atividade econômica, com ajustes*. Ministério do Trabalho. Programa de Disseminação das Estatísticas do Trabalho. <http://pdet.mte.gov.br/images/ftp/dezembro2019/nacionais/6-saldomunicipioajustado.xls>
- [3]. BRASIL. (2020a). *Evolução mensal de estoque, admissões, desligamentos e saldo por município - série com ajustes*. Ministério do Trabalho. Programa de Disseminação das Estatísticas do Trabalho. http://pdet.mte.gov.br/images/Novo_CAGED/Nov2020/3-tabelas.xlsx
- [4]. BRASIL. (2020b). *Painel Coronavírus- COVID19*. Ministério da Saúde. <https://covid.saude.gov.br>
- [5]. Delgado, M. S., & Florax, R. J. G. M. (2015). Difference-in-differences techniques for spatial data: Local autocorrelation and spatial interaction. *Economics Letters*, 137, 123–126. <https://doi.org/10.1016/j.econlet.2015.10.035>
- [6]. Demirović Bajrami, D., Terzić, A., Petrović, M. D., Radovanović, M., Tretiakova, T. N., & Hadoud, A. (2020). Will we have the same employees in hospitality after all? The impact of COVID-19 on employees' work attitudes and turnover intentions. *International Journal of Hospitality Management*, 102754. <https://doi.org/10.1016/j.ijhm.2020.102754>
- [7]. de Paulo Farias, D., & de Araújo, F. F. (2020). Will COVID-19 affect food supply in distribution centers of Brazilian regions affected by the pandemic? *Trends in Food Science & Technology*, 103, 361–366. <https://doi.org/10.1016/j.tifs.2020.05.023>
- [8]. Dwivedi, Y. K., Hughes, D. L., Coombs, C., Constantiou, I., Duan, Y., Edwards, J. S., Gupta, B., Lal, B., Misra, S., Prashant, P., Raman, R., Rana, N. P., Sharma, S. K., & Upadhyay, N. (2020). Impact of COVID-19 pandemic on information management research and practice: Transforming education, work, and life. *International Journal of Information Management*, 55, 102211. <https://doi.org/10.1016/j.ijinfomgt.2020.102211>
- [9]. Hawkins, D. (2020). Differential occupational risk for COVID-19 and other infection exposure according to race and ethnicity. *American Journal of Industrial Medicine*, 63(9), 817–820. <https://doi.org/10.1002/ajim.23145>
- [10]. Hodder, A. (2020). New Technology, Work and Employment in the era of COVID-19: reflecting on legacies of research. *New Technology, Work and Employment*, 35(3), 262–275. <https://doi.org/10.1111/ntwe.12173>
- [11]. Kickbusch, I., Leung, G. M., Bhutta, Z. A., Matsoso, M. P., Ihekweazu, C., & Abbasi, K. (2020). Covid-19: how a virus is turning the world upside down. *BMJ*, m1336. <https://doi.org/10.1136/bmj.m1336>

- [12]. Kim, A. T., Kim, C., Tuttle, S. E., & Zhang, Y. (2021). COVID-19 and the decline in Asian American employment. *Research in Social Stratification and Mobility*, 71, 100563. <https://doi.org/10.1016/j.rssm.2020.100563>
- [13]. Luciano, E. M. (2020). Information management hits and misses in the COVID19 emergency in Brazil. *International Journal of Information Management*, 55, 102194. <https://doi.org/10.1016/j.ijinfomgt.2020.102194>
- [14]. Wickham, H., & Grolemund, G. (2017). *R for Data Science: import, tidy, transform, visualize, and model data*. O'Reilly. This book was built by the bookdown R package. <https://r4ds.had.co.nz/index.html>
- [15]. Wooldridge, J. M. (2016). *Introdução à econometria: uma abordagem moderna* (P. R. d. S. Lopes & L. M. Koepl, Trads.; H. P. Bernardo, Revisão técnica). Cengage Learning.

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