

An In-depth Analysis of Economic Trends by Wage

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Abstract: Recently, countries have experienced significant progress in technology resulting in an increase in job opportunities, especially within the computing industry. However, this growth has been overshadowed by inequality between genders with more men occupying positions in the workforce and a preference of working in the urban areas. Extensive studies have highlighted the importance of achieving gender equality. Notably, there is limit research that focused on the post-pandemic economic landscape, particularly concerning the effects of gender and location. Therefore, this paper aims to investigate the economic ramifications of COVID-19 on wage structures, considering the variables of year, gender, and working location. Using census data from data.gov, this study reveals a decline in salaries for higher-income individuals in 2022. The study further establishes significant wage differences based on gender and county, proposing potential solutions such as training the recruiting team, promoting gender equality initiatives, and boosting tourism in smaller counties to attract travelers and businesses.

Keywords: wage, gender, local economics, discrimination

1. Introduction

Wage is one of the most important standards to measure life satisfaction. Wage inequality has been an evident issue since the 1980s and within various cultural backgrounds. It is most likely the result of Patriarchy, men dominated society. In early history, men were responsible for hunting and feeding the whole family. Furthermore, in the Horticultural society, people begin to plant crops, and men do have more power and strength to do more work. Therefore, the dominant hierarchies have shaped the cultures to be more favor in of men [1]. Additionally, there is a prevailing belief that men possess capabilities and earn higher incomes. It is evident that various factors, such, as gender inequality, racial disparities, educational background and local economic conditions can influence wage disparities.

Despite the abundance of COVID-19 impact articles, research declined after mask policies were relaxed, resulting in a lack of economic trend studies three years post-pandemic. Existing studies suggest steady economic improvement yearly, especially after the challenging 2020 marked by a surge in cases [2]. Countries responded with border closures, trading suspensions, and transportation halts, causing severe economic damage until mid-2021. Experts anticipate continued economic growth in the post-pandemic era. This paper examines whether 2022 exhibits better economic performance than previous years, shedding light on post-pandemic recovery.

Yearly trends aren't the sole factors affecting wages; gender also significantly impacts income levels. When dividing salaries into low and high-wage groups, women consistently constitute 3% more in the low-wage category across all races. Notably, White workers face an even larger wage gap, approximately 10% [3]. These findings emphasize the ongoing underrepresentation of women in work environments.

Research indicates that women who demonstrate a sense of collaboration in their professional endeavors are more likely to achieve higher incomes [4]. However, the issue of pay not only exists between genders but also within the female workforce. The purpose of this study is to investigate the factors that contribute to this disparity and suggest strategies for reducing it thereby fostering an more inclusive work environment, for everyone.

Lastly, the location of cities significantly influences wages. Prosperous cities typically offer higher wages due to higher living costs for laborers and increased productivity for firms. Consequently, urban and large cities tend to have higher wages, driven by companies' greater profits and workers' need for better livelihoods [5].

It's important to note that this study primarily focuses on Iowa, a state located in the middle of the United States. Being a state Iowa geographical location may lead to different trends compared to the West and East Coasts. The main objective of this paper is to examine the factors that contribute to wealth and prosperity in counties within Iowa. By exploring these factors, this paper aim to gain an understanding of what drives economic growth and wage disparities, within the state. In summary this paper will discuss how each factor impacts wage differences. The following sections outline the structure of the article; Section 2; Methodology, Section 3; Results and Data Visualization Section 4; Discussion and Analysis Section 5; Conclusion.

2. Methodology

2.1. Source of Data

This research paper will undertake a quantitative investigation utilizing the dataset retrieved from data.org entitled "The State of Iowa Salary Book." This salary book comprehensively documents the remuneration of Iowa citizens from 2007 to 2022, encompassing essential details such as their names, positions, genders, places of residence, base salaries, travel benefits, and total salaries. The dataset contains a total of 11 variables; however, to enhance focus and relevance, specific variables, namely departments, agencies, names, positions, paid dates, and travel compensations, have been excluded due to their distinctiveness. This study shall exclusively concentrate on the fiscal year, gender, county, and base salary attributes for research purposes.

2.1.1. Dependent Variable

Within this dataset, the dependent variable under scrutiny is the base salary. When evaluating both the base salary and the total salary, the former proves to be a superior metric for representing economic trends. This preference arises from the fact that the base salary reflects the original wage paid to employees, unencumbered by any compensations or deductions contingent upon variations in employee performance.

2.1.2. Independent Variable

Numerous factors may exert influence upon the base salary, encompassing the economic conditions prevailing in distinct fiscal years and regions, as well as potential gender disparities. To ensure a comprehensive analysis while managing the vastness of the dataset, this research selectively extracts data from the years 2019 to 2022, as they provide the most recent wage information. Furthermore,

this study exclusively concentrates on the yearly wage component, representing the most formal aspect of a contract worker's compensation. By focusing on this metric, the research seeks to highlight the stability demonstrated by employees who remain with a company for several years, resulting in fewer fluctuations in remuneration.

2.2. Data Processing

As indicated earlier, the initial step involves data extraction from the years 2019 to 2022, leading to a reduction in the sample size from 978,675 to 253,483 entries. Subsequently, this research selectively extracted only those entries with a yearly salary component, resulting in a refined sample of 8,517 records. The final stage of the process entails eliminating any instances of empty data, such as N/A values, leading to the removal of 17 observations.

This study encompasses three distinct wage models, each centered around the year, gender, and place variables. Consequently, individual data processing subgroups were established for each model. For the yearly comparison, the data was segregated into four subsets based on fiscal year, and outliers were identified and removed within each subset using distribution summaries. When examining gender differences, the dataset was divided into two groups based on each gender. These groups included data from the four-year period. As, with the model any unusual data points were removed from each group. Additionally, this study will compare the results both including and excluding outliers. Regarding the place of residency, the boxplot chart emerges as the primary visualization method, wherein outliers are not removed, as they play a crucial role in clearly depicting the maximum wage within the dataset. Table 1 displayed the variables that are being used in this study including salary, year, gender, and county.

In order to conduct accurate statistical analysis, the normality of the data is important to know. Employing the Shapiro-Wilk Test and examining histograms for each year, all four years exhibit non-normal distribution, evidenced by p-values significantly lower than 0.05. However, it is noteworthy that 2022 stands as an exception, presenting a small p-value, despite its large sample size of 6000, and displaying a histogram that appears normal. However, due to the non-normalized data, this paper will employ non-parametric tests, as they do not assume the data to be normally distributed.

Table 1: Description of Variables.

Variable	Category	Description
Base Salary	Numerical (Y)	The base salary for an individual of the fiscal year
Fiscal Year	Numerical (X)	12 months starting from the salary paid to date
Gender	Categorical (X)	M = Male, F = Female
Place of residence	Categorical (X)	County name of each individual's residency

2.3. Model & Evaluation

The objective of this study is to examine potential wage disparities between the period during COVID-19 and the post-pandemic era, as well as to investigate gender inequality and the impact of local economic factors. The study incorporates three distinct models, outlined as follows:

Model 1: Wage difference between fiscal years 2019, 2020, 2021, and 2022 (Friedman test)

Model 2: Wage difference between males and females in the years 2019 to 2022 (Wilcoxon test)

Model 3: Wage difference between counties, and find the county with the lowest wage and highest wage for further analysis (Boxplot)

In the first model, a Friedman test is conducted to compare wage differences between years. The Friedman test is a non-parametric test that is an alternative to ANOVA in parametric test, this test is suitable for analyzing non-normal data. By employing the Friedman test, the study aims to assess whether the null hypothesis, which assumes the equality of medians across years, holds true. The results will be examined through p-values and determine if the null hypothesis should be rejected. The studies will discuss the underlying reasons behind the observed outcomes.

Move on to the second model in this study. To compare the genders, the Mann Whitney U test will be used, also known as the Wilcoxon Rank Sum Test. This test is great for comparing the difference between two variables – in this case male and female wages.

In the third model, a boxplot is utilized to compare median wages across more than 100 counties in Iowa. By presenting the highest and lowest eight counties, the study examines variations in median wages based on local economic factors.

3. Results

3.1. Model 1. Wage Difference in Year

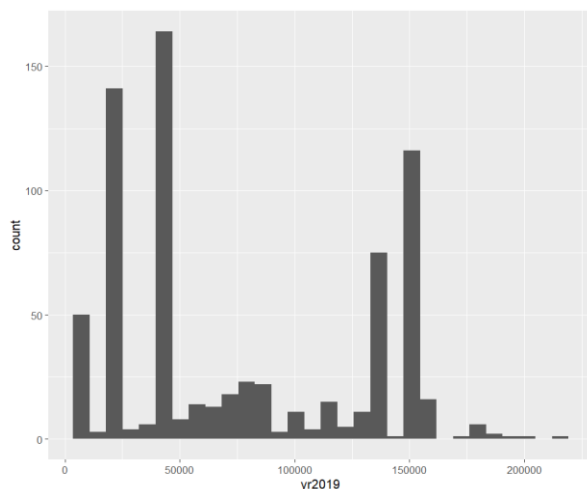


Figure 1: Histograms for the salary distribution of the year 2019.

Photo credit: Original

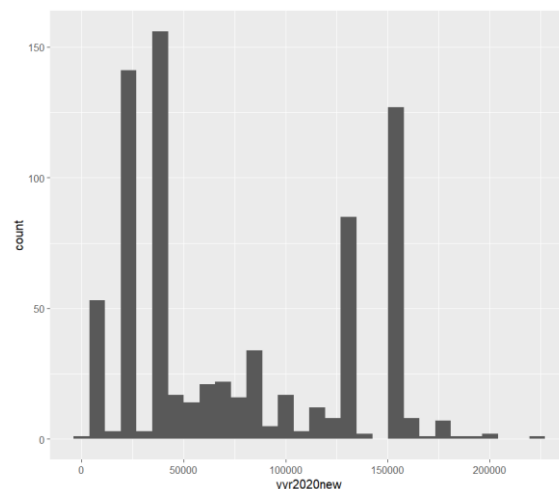


Figure 2: Histograms for the salary distribution of the year 2020.

Photo credit: Original

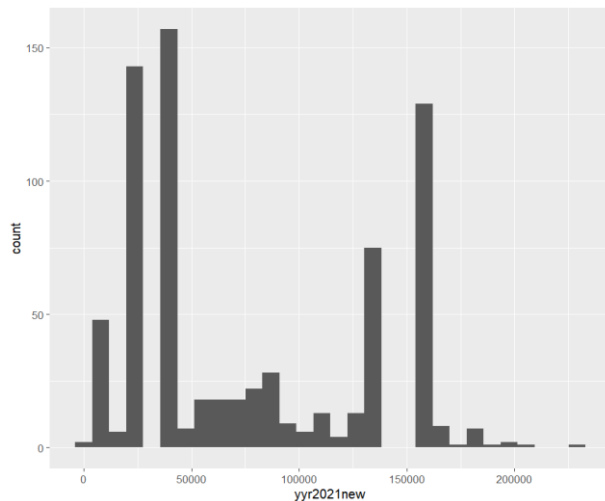


Figure 3: Histograms for the salary distribution of the year 2021.

Photo credit: Original

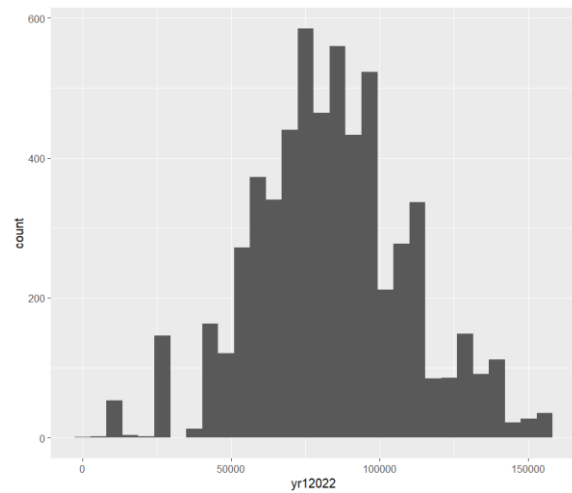


Figure 4: Histograms for the salary distribution of the year 2022.

Photo credit: Original

To assess normality, four histograms (Figure 1-4) are plotted for each year. However, upon visual examination, the histograms for 2019, 2020, and 2021 exhibit asymmetry and lack a single peak, indicating non-normal distribution. Furthermore, the study utilizes a K-S test to examine the distribution of the dataset. As the resulting p-value is lower than $2.2e-16$, which's less than the critical value of 0.05. Therefore, the null hypothesis is rejected and concludes that the salary data, excluding any outliers, does not follow a normal distribution.

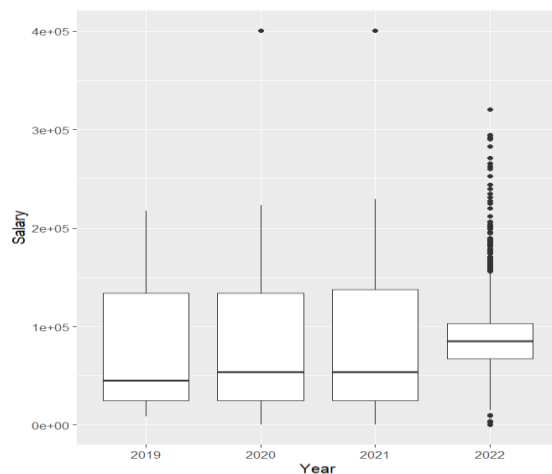


Figure 5: Years Boxplot with outliers.

Photo credit: Original

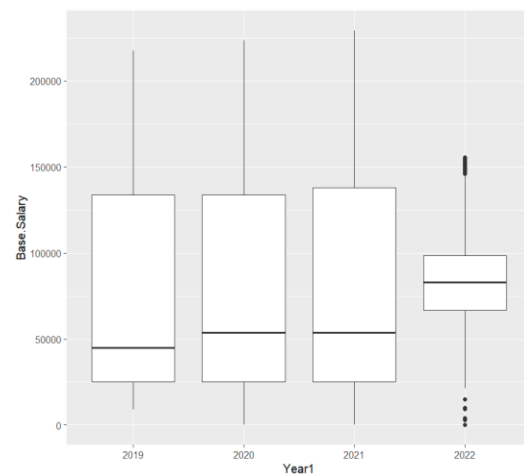


Figure 6: Years Boxplot without outliers.

Photo credit: Original

As depicted in the result of the Friedman rank sum test, the observations for each year were transformed into a matrix, as necessitated by the Friedman Test, accommodating various sample sizes. By evaluating the p-value, less than 0.05, the null hypothesis is rejected. This indicates that there is a statistically significant difference in salaries across the four years. To ascertain the direction of this difference, the study utilizes boxplots, displayed in Figures 5 and 6. These visualizations reveal that

the median salary for 2022 surpasses that of the other three years, while the 75th percentile has experienced a decline.

3.2. Model 2. Wage Difference in Gender

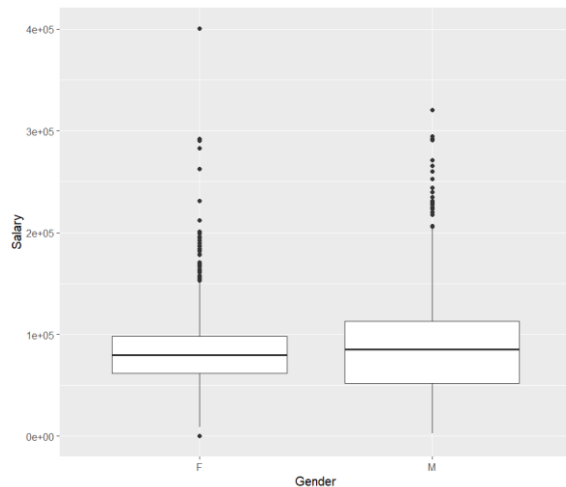


Figure 7: Gender Boxplot with outliers.

Photo credit: Original

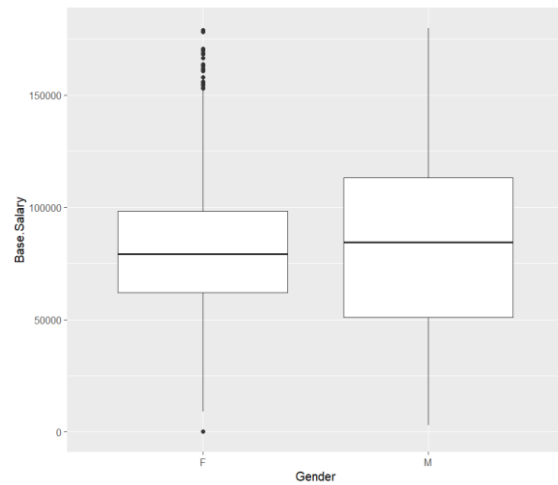


Figure 8: Gender Boxplot without outliers.

Photo credit: Original

The findings depicted in Figures 7 and 8 reveal a similar salary range for males and females. However, there is a significant distinction in the interquartile range (IQR), with males displaying a wider range. Additionally, Figure 5 displays outliers for both the lowest and highest salaries within the female group. To determine the importance of the gender-based difference, a Wilcoxon rank sum test is conducted. The results indicate a p value of 0.001148, which's below the critical value of 0.05. As a result, the null hypothesis is rejected and conclude that there is a significant disparity in median salaries, between males and females. Although the salary ranges may seem similar at glance this study highlights that male and female salaries are not equal bringing attention to the problem of gender inequality.

3.3. Model 2. Wage Difference Between Counties

Given the cluttered nature of the label containing over 100 counties, the county names were converted to numbers for a more organized purpose. The Place ID utilizes an alphabetical order, starting with 0. During this conversion process, data from the same county but varying regions, as well as any misspellings, were merged. Moreover, counties with fewer than 10 observations were removed from the analysis. As a result, the initial sample size of 104 counties has been reduced to 91, ensuring a more focused and manageable dataset.

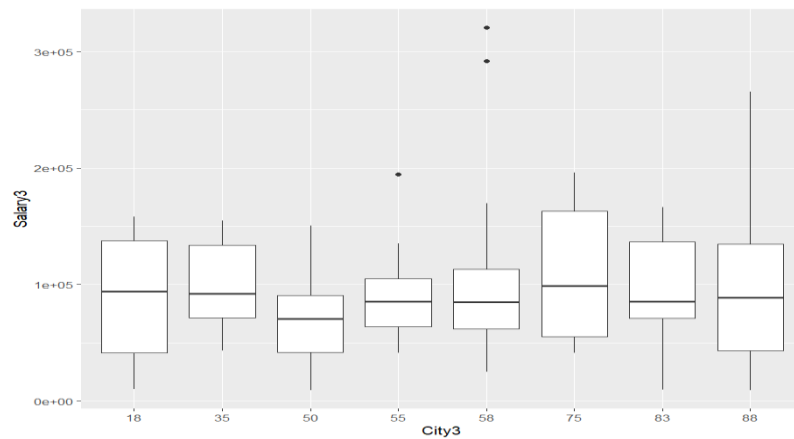


Figure 9: Eight Counties With the Highest Wage.

Photo credit: Original

In the 91 counties, Figure 9 sorts out the eight highest median wages counties, which are PlaceID numbers 18, 35, 50, 55, 58, 75, 83, and 88.

Table 2: 8 County with Highest Wage, Population data founded on Iowa demographic data [6].

PlaceID	County Name	Sample Size	Population
18	Chickasaw	21	11,716
35	Grundy	31	12,356
50	Kossuth	15	14,475
55	Madison	57	17,036
58	Marshall	142	39,879
75	Shelby	18	11,645
83	Washington	38	22,571
88	Woodbury	154	105,671

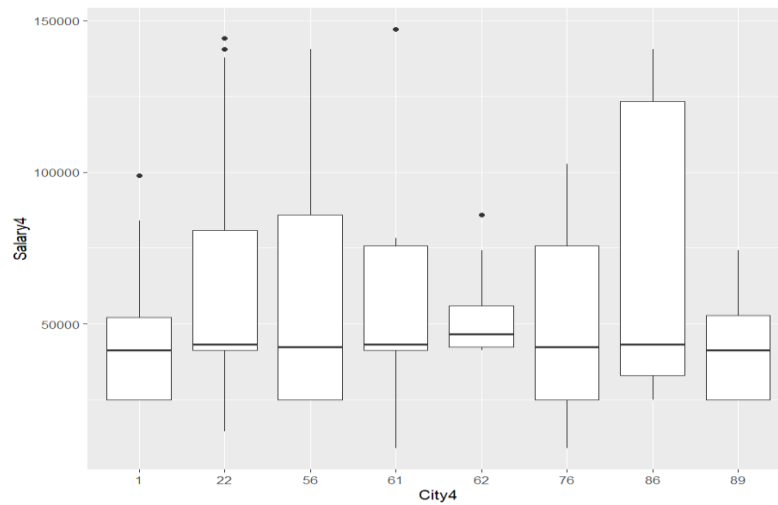


Figure 10: Eight Counties With the Lowest Wage (Photo credit: Original).

Figure 10 listed the eight lowest counties for analysis which are PlaceID 1, 22, 56, 61, 62, 76, 86, and 89.

Table 3: 8 County with Lowest Wage, Population data founded on Iowa demographic data [6].

PlaceID	County Name	Sample Size	Population
1	Adams	11	3,611
22	Clinton	46	46,344
56	Mahaska	29	21,946
61	Monroe	11	7,550
62	Montgomery	19	10,205
76	Sioux	31	36,050
86	Winnebago	15	10,617
89	Worth	11	7,319

4. Discussion and Analyzation

4.1. Yearly Analysis

The advent of COVID-19 has led to a severe economic crisis, resulting in the collapse of numerous companies and financial institutions. Initially, the hypothesis is that the pandemic would have an impact on the economy between 2019 and 2021. This was mainly because of the restrictions that required people to stay at home resulting in a decrease in entertainment and leisure activities. For instance, in China, where COVID-19 is widely believed to have originated, stringent measures were implemented to mitigate the risk of infection, which included strict restrictions on mobility, hindering

tourism and visits to the city. Consequently, markets, restaurants, and all forms of entertainment faced forced closures, resulting in a rapid and pronounced economic downturn [7].

However, the analysis shows that the economics is begin the change in 2022. During this time wages decreased for higher income individuals. Increased for those in lower income brackets. As evident from Figure 4, unlike the preceding years, the wage distribution for 2022 displays a close-to-symmetrical pattern. This decline in wages for higher-income workers is a significant development. It appears that during the initial two years, companies sought to navigate the pandemic while maintaining pre-pandemic practices, relying on accumulated savings. But by 2022, these reserves started to diminish, which there is an 8.5% inflation rate in the U.S. [8]. As a consequence, the costs of goods and services surged by 8.5%, disproportionately impacting companies' housing rent expenditures. Consequently, a considerable number of companies were compelled to implement workforce reductions, resulting in layoffs.

Numerous studies have confirmed that companies frequently resort to layoffs as a way to save money. The economic crisis caused a financial situation leading more than 46% of Small and Medium Enterprises to lay off over half of their workforce [9]. This decision was driven by the belief that reducing the number of employees would lead to savings in salaries and enable the implementation of salary reductions for the remaining staff.

On the hand, the minimum wage is gradually increasing every year in response to economic inflation. Due to the rising cost of living employers are compelled to raise the minimum wage, for skilled workers ensuring they can adequately support themselves.

4.2. Gender Analysis

The analysis reveals a significant disparity between the median wages of males and females. It is evident that more males earn higher salaries compared to females. Specifically, females earn only about 60% of what their male counterparts make and generally experience slower wage growth [10]. Several factors contribute to these outcomes, including biases based on perceived abilities, differences in educational opportunities, and the similarity-attraction effect.

Biases regarding abilities may lead to gender-based divisions in certain fields. For example, the prevailing belief that men excel in STEM subjects while women are better suited to arts and communication can result in predominantly male-dominated professions such as software engineering, with women often relegated to roles involving communication and writing [11]. Additionally, traditional divisions of labor and family responsibilities often translate to women having less work experience than men [10]. Consequently, leadership positions tend to be occupied by males, making it challenging for females to be entrusted with leading teams. These ingrained perceptions and societal norms perpetuate the wage gap and hinder female representation in higher-paid and leadership roles.

Furthermore, the discrepancy in educational opportunities further contributes to the gender wage gap. In many regions, outdated beliefs persist, contending that women should not pursue education and that their primary responsibility lies in caring for children. Even if they manage to attend school, males often enjoy greater chances of continuing their studies at higher education levels, resulting in knowledge and wage disparities between genders.

Even though there are educated women aged 25 to 64 in the civilian labor force compared to men women still tend to earn less than their male counterparts. This is because of the way society socializes based on gender. As children grow up their perceptions and interests are influenced by family, society and education. They often conform to gender expectations and avoid standing out or being seen as different. This leads to stereotypes about gender roles which ultimately result in wage disparities, between men and women. These rooted societal norms and biases contribute to the continuation of the gender pay gap.

Lastly, the similarity-attraction effect significantly influences the hiring process. This effect suggests that individuals tend to socialize and associate with those who share similar characteristics, such as race, gender, education, or socioeconomic status [12]. As a consequence, black managers are more inclined to hire black candidates, while white managers are more likely to select white candidates.

In the context of gender, male managers may exhibit a preference for male workers, assuming they possess higher abilities and find it easier to communicate with them. This belief stems from the notion that effective communication enhances efficiency and yields superior outcomes. Moreover, the disproportionately higher number of male leaders compared to female leaders further perpetuates this trend, leading to the hiring of more male employees for higher-paying positions. As a result, this alignment of gender preferences in hiring practices contributes to the perpetuation of the gender wage gap.

4.3. County Analysis

Based on the findings from research the study identified the top eight and bottom eight counties. However, there was a limitation when comparing the dataset with census data on family income as some counties didn't match up with the dataset's findings [13]. This difference can be attributed to factors, such as the government data in this study mainly representing salaries of public servants and not including high income individuals working in private companies or those who are paid on an hourly or daily basis and earn lower incomes.

To ensure accuracy the study will focus on analyzing the counties that align with the population data. Among these counties Grundy and Madison emerged as having income levels while Adams and Montgomery ranked lowest in terms of income. By addressing this limitation and concentrating on data that accurately reflects the population the study aims to provide a comprehensive and precise assessment of wage disparities across different counties.

The Grundy County has one of the finest farmlands in the United States [14]. The rich black loam found in Iowa allows farmers to yield bountiful agricultural products each year, contributing to Grundy's thriving economy. On the other hand, Madison County is renowned for its picturesque bridges, making it an attractive travel destination [15]. Additionally, "Madison County is the second-fastest growing non-metropolitan county in Iowa" [16]. Accessible via two highways, Madison County offers an easy commute for workers, making it an appealing place to work. The increase in employment bolstered economic development, leading to higher profits for firms, which, in turn, translates to higher salaries for workers. The symbiotic relationship between economic growth and worker benefits has contributed to the flourishing job market in these counties.

Conversely, Table 3 reveals that Adams has the smallest population in Iowa. As a result, the number of companies and organizations in Adams is significantly fewer, with only 336 non-employer organizations compared to 1,424 organizations in Madison [13]. Consequently, economic development in Adams is sluggish, resulting in lower profits being generated. Montgomery, despite having a larger population, also exhibits a relatively small number of organizations. However, the number of women-owned employer firms in Montgomery exceeds those in more affluent counties, providing further evidence of gender wage inequality. This observation underscores the challenges faced by women-led firms in achieving comparable success to their male-led counterparts.

In summary, by analyzing data from Tables 2 and 3, it becomes evident that population and economics share an interactive relationship. Smaller populations tend to correspond with slower economic development, while unfavorable economic conditions can compel people to leave the area, further impacting the local population and economy.

5. Conclusion

After all analysis, the economic trends based on the data do not align with initial expectations. Notably, it is surprising to observe a decrease in wages for high-skilled labor in 2022, attributed to inflation and an economic downturn. As a consequence, multiple companies have resorted to laying off workers to mitigate losses, with high-wage groups being particularly vulnerable to cuts. However, as the pandemic's duration extends, the economy is anticipated to regain momentum, evident by the remarkable growth of the U.S. GDP in 2021, reaching its highest point in the past 60 years. Despite a higher GDP in 2022, the percentage growth rate has diminished. These contrasting trends highlight the complexities of the economic recovery process in the post-pandemic era.

This paper corroborates the existence of gender inequality in wages, a recurring finding observed in numerous studies. Although Iowa is a rural state, the generality of gender wage disparity is not unique to this region; it is a significant issue both in rural and urban areas worldwide. It requires many aspects and methods to address this problem.

To address the issue of gender inequality it is crucial to challenge and break down the stereotypes associated with gender roles. The government has a role to play in ensuring that minorities have equal access to education thus enabling everyone to have an equal opportunity to join the workforce. Moreover, companies can contribute by providing training for their recruitment teams encouraging them to evaluate candidates based on their skills and capabilities than being influenced by personal characteristics. By implementing these measures, the progress will create a more fair and balanced society and workplace where individuals are valued and rewarded based on their merits rather, than their gender.

Economic trends in various locations significantly impact wages. Counties with larger populations tend to have a higher workforce, leading to increased manufacturing efficiency and greater profitability. Conversely, smaller counties with limited labor resources may experience slower development.

To address this disparity, governments can focus on developing tourism in these smaller counties. This approach not only attracts more travelers but also potential employers. Increased tourism creates more job opportunities, and the spending of travelers becomes a vital source of income, ultimately contributing to the flourishing of the local economy.

By strategically promoting tourism and attracting investments, smaller counties can lower the gap in economic development, and encouraging a more balanced distribution of opportunities, the overall economic landscape will be enhanced.

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