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Telephone Operators Ousted by Interactive Voice Response (IVR) Systems.

I. Introduction

Telephone operators or also referred to as switchboard operators, are workers who handle incoming and outgoing telephone calls by directing calls to their needed locations Telephone operators manually connect calls by establishing physical connections between the caller's line and the desired recipient's line using the switchboard. They would listen to the caller's request and then make the necessary connections by plugging cables into the appropriate jacks. However, with the emergence of automation the technology called Interactive Voice Response (IVR), which is “an automated telephone system that combines pre-recorded messages or text-to-speech technology with a dual-tone multi-frequency (DTMF) interface to engage callers,” telephone operators were no longer were needed to direct requests and provide information to callers. (IBM). This advancement in technology put thousands of workers out of jobs. However, it did not completely replace the need for telephone operators. Modern day telephone operators work for businesses and organizations that need humans to always be there because of the necessity for speed in the matter. An example of places they work are in emergency services call centers where operators may handle a variety of incoming emergency calls. They have to work fast and use critical thinking in high stakes situations, such as kidnappings, shootings, or even house fires. They must be able to clearly discern the caller’s voice, understand what they are saying, and send dispatch out to the proper location. There have been so many different events where victim callers to 911 had to

speak in code to not alert their perpetrators that they are calling for help. For example, in 2019, a daughter called 911 to get help for her mother, who was caught in a violent interaction with her boyfriend. The daughter called and said that she needed a pizza delivered to her address and the telephone operator quickly understood that they were in danger and prompted the police to show up discreetly, and they later arrested the abuser (Yan, 2019). This is an example of a field that absolutely needs skilled human operators in the sense that they are critical thinkers, specialized in their field, and fast, but for a majority of the sectors in the economy any of the tasks previously performed by operators have been automated or replaced by self-service systems like interactive voice response (IVR) systems. By examining the technological change that led to the replacement of telephone operators with Interactive Voice Response (IVR) systems, this paper will analyze the tasks that have been replaced, the new tasks created, and the potential impacts on different categories of workers. Additionally, we will consider the relevance of frameworks discussed in class, such as skill-biased technological change, in understanding the consequences of this technological shift. With this analysis, this paper aims to raise understanding of the larger effects that technology improvements are having on the labor market.

II. History

During the 20th century, a significant number of telephone operators were white women, mainly in their late teens or early twenties. Telephone companies found young women to be perfect to be telephone operators because they had the necessary patience and timeliness to handle the manual switchboards to direct calls. Men tended to get lazy and not do the job in a timely fashion. They were often distracted and were not the most polite communicators. “Hoping to find operators who’d be more attentive to their duties and not cuss out the customers, local phone companies began to recruit girls and young women. As the number of telephones in the U.S. multiplied, so did the demand for operators. In 1910, there were 88,000 female telephone operators in the United States. By 1920, there were 178,000, and by 1930, 235,000” (Daugherty). Also, hiring young women as operators was strategic for telephone companies because they could be paid lower wages compared to men. Additionally, women were preferred for the job because it was seen as a continuation of their current responsibilities as caregivers, and good telephone manners were looked for in good operators. Young women were attracted to this job because it allowed them to communicate with many different people, was not labor intensive, allowed them to make some money to supplement their households, and did not require a formal education. “In 1920 census, employed 4% of the nearly 3 MM young, white, American-born women in the labor force and was the single largest occupation-industry pair for women ≤20” (Feigenbaum & Gross, 2020). Since historically, this job found its niche for the preferred demographic of workers, we can further delve into how the automation of jobs affects certain populations and what that means for certain groups.

III. Empirical Evidence

In Figure 1 we can analyze the total number of employees that were employed as telephone operators in the past twenty years. In 2002, there were roughly 46,000 workers employed as telephone operators; that number dropped by roughly 50% within three years. This is due to the fact that interactive voice response systems were rapidly implemented in all industries, removing the need for expensive workers especially when tech companies were recovering from the burst of the dot com bubble. During the Great Recession starting at late 2006, corporations needed to heavily layoff unnecessary workers and focus on cutting costs at all corners. This is where the straggler companies finally replaced their telephone operators with more advanced automated systems. As of 2021, there were only 3870 telephone operators left in the entire United States, primarily in those specialized roles discussed earlier where humans are a necessity. The bureau of labor statistics "expects more than 20 percent of those jobs to disappear by 2029" further showcasing the effects of automation on once booming jobs (Daugherty). In Figure 2, we can examine the nominal annual wage (adjusted for inflation) of telephone operators throughout the past twenty years compared to the number of workers employed in the occupation. We can see that annual wages remained relatively stagnant, with a small decreasing regression slope. There was a small spike in 2015 that can be attributed to a variety of factors such as market demand, worker unions, or even just discrepancies in the data. Similarly in Figure 3, we can see the same thing but in terms of inflation adjusted hourly pay. In Figure 4, we can examine the average adjusted hourly wage of all occupations in the United States in the past twenty years in comparison to the hourly wage of telephone operators. We can see that overall wages are on a general trend upwards, while telephone operators have been declining to minimum wage levels. From

these graphs it is clear that even as the occupation transitioned due to automation from a large set of relatively unskilled workers to a smaller sect of some specialized workers such as emergency services operators, their incomes did not increase. This shows how the changing nature of the occupation did not lead to a corresponding rise in wages. Understanding the underlying causes of these wage trends requires a deeper analysis that incorporates economic factors, technological advancements, and labor market dynamics.

IV. Discussion

For class we read one of David Autor's notable works, specifically the paper called "Why Are There Still So Many Jobs? The History and Future of Workplace Automation." In this paper, Author explores the relationship between technological advancements, automation, and employment. Autor argues that despite the widespread fear that automation will lead to massive job losses, the reality has been quite different throughout history. He emphasizes that while automation does replace certain sorts of work, it also generates new job prospects in other areas. Technological advancement often results in the displacement of routine work performed by humans with machines, but it also complements and strengthens human skills in non-routine tasks. “Workers in abstract task-intensive occupations therefore benefit from information technology via a virtuous combination of strong complementarities between routine and abstract tasks, elastic demand for services provided by abstract task-intensive occupations, and inelastic labor supply to these occupations over the short and medium term. In combination, these forces mean that information technology should raise earnings in occupations that make intensive use of abstract tasks and among workers who intensively supply them” (Autor, 2015). In the case of telephone operators, routine tasks like call routing and basic customer inquiries have been automated, greatly reducing the demand for human operators. While there may still be a need for

operators in certain specialized sectors, the overall demand for telephone operators has diminished due to automation technologies such as IVR. However, the decline of telephone operators is an example of how technology can reshape the labor market by transitioning workers into new opportunities. For example, as telephone operators declined, there has been a rise in roles related to customer support such as customer service chat agents, live customer service agents over phone call, and other digital streams. Now, IVR technology directs callers to these agents when they need specialized help. As technology increases, Autor argues that new more complex jobs will arise as others are displaced. The jobs greatest at risk for automation are those that are simple and routine, such as telephone operators. Jobs that are abstract and task intensive such as customer service agents, who have to deal with a variety of complex issues are greatest at benefit with advancing technology. Also, the replacement of telephone operators with IVR technology opens up more specialized jobs for workers to install the technologies, develop them, and more complex tasks.

In research done by Feugenbaum and Gross at Duke and Boston University, they examined how the complete automation of a job impacted the future cohort of workers that tend to fill those jobs. They found that the occupation of telephone operators represented jobs for many young women and wanted to explore how automation may cause displacement of the future generation cohort in the labor force. They found that the "shock did not reduce future cohorts' employment rate." It turned out that "comparable middle-skill office jobs and some lower-skill service sector jobs absorbed future generations of young workers, and did so fairly quickly, with women of only the youngest ages on average ending up in lower-paying occupations than they would have been in otherwise. The adverse consequences of automation were concentrated in incumbent telephone operators, who were subsequently less likely to be

working, and conditional on working, more likely to be in lower-paying occupations—but even then, the magnitudes of these impacts were relatively modest" (Feigenbaum & Gross, 2020). Feigenbaum and Gross's research revealed a large negative shock to local labor demand specifically for young, white, American-born women. They observed a drastic reduction in the number of young operators, with a decline of near 80%. This represented a "near-total collapse in entry-level hiring in one of the country's largest occupations for young women". Remarkably, approximately "around 2% of jobs for this group" were "permanently replaced by machines, essentially at the flip of a switch," symbolizing an abrupt and significant shift in the industry (Feigenbaum & Gross, 2020). Their research confirms Autor's claims that automation and technological advancement paves the way for new jobs amidst the displacement of the old jobs. Their research is particularly interesting because the study not only presents empirical data to back up Autor's claims, but it also emphasizes the drastic change that took place when automation replaced a large chunk of the jobs that had previously been occupied by young, white women.

The skill-biased technological change framework provides valuable insights into the impact of automation and the decline of telephone operators. This framework explains how changes in technology affect the demand for different skills in the labor market. Technological advancements tend to decrease the demand for routine, low-skilled jobs while increasing the demand for individuals with high-level skills who can effectively utilize and adapt to new technologies. In the case of telephone operators, the automation of routine tasks such as call routing and basic customer questions reduced the need for human operators. This decline in demand affected the career opportunities of telephone operators who had simple and routine tasks that were automatable. In contrast, there was an increased demand for workers with

abstract skills, such as problem-solving, analysis, and decision-making, which are less easily automated, such as emergency service workers or specialized customer service agents. The skill-biased technological change framework also emphasizes the importance of learning new skills as a response to technological advancements and automation. Workers who can adapt their skills and acquire new ones aligned with the changing demands of the labor market are more likely to find employment in emerging roles. A lot of telephone operators were able to learn more skills and traversed the ladder up to become specialists in customer service. Feigenbaum and Gross's research supports the framework's premise by demonstrating that future generations, particularly young women, were absorbed into alternative occupations such as lower-skilled service sector jobs and middle-skill office roles. This suggests that individuals who were able to adapt and transition their skills found employment in sectors that were less vulnerable to automation. Overall, the skill-biased technological change framework provides a lens to understand how automation and technological advancements reshape the labor market. It highlights the importance of learning new skills to navigate the evolving employment landscape and capitalize on emerging job opportunities.

V. Conclusion

In conclusion the effects of automation have completely decimated the job occupation of telephone operators. Even though the landscape of the job has drastically changed since its inception in the late 1800, early 1900's, it was still a job that kept thousands of people employed. Today, there are less than 5,000 telephone operators left in the workforce in the United States. Interactive Voice Responses (IVR) and even now artificial intelligence technologies have taken dominance in routing callers and answering basic to now even sometimes sophisticated questions. These technologies have been picked up by a majority of all sectors in the economy.

In Boston there was a study done where patients received automated calls as a reminder to take their medication and how to properly take it. The study found an “increased adherence to the medication regimen and the increase in patient satisfaction, IVRT was seen as a cost-effective intervention in this population” (Kraft & Androwich). The need for human operators to manually connect people together, answer questions, and make reminder calls is pretty much depleted due to automation. The telephone operator occupation was greatest at risk for automation and employee displacement due to its simple and routine nature. Jobs with abstract and task-complex jobs complement the best with advancements in technology, unlike that of the telephone operator. The relationship between automation, technological advancements, and employment is exemplified by the skill-biased technological change framework, as supported by studies conducted by David Autor, Feigenbaum, and Gross. This framework illustrates that while automation may eliminate certain jobs, it also creates fresh opportunities in other sectors. This is exemplified by the decline of telephone operators as routine tasks were automated, subsequently giving rise to specialized customer support positions. The framework places significant emphasis on the imperative of skill enhancement and adaptability to navigate the dynamic job market. Understanding and applying this paradigm empowers individuals and policymakers to effectively respond to technological transformations such as the automation that occurred with the telephone operators, ultimately yielding inclusive employment outcomes.

FIGURE 1

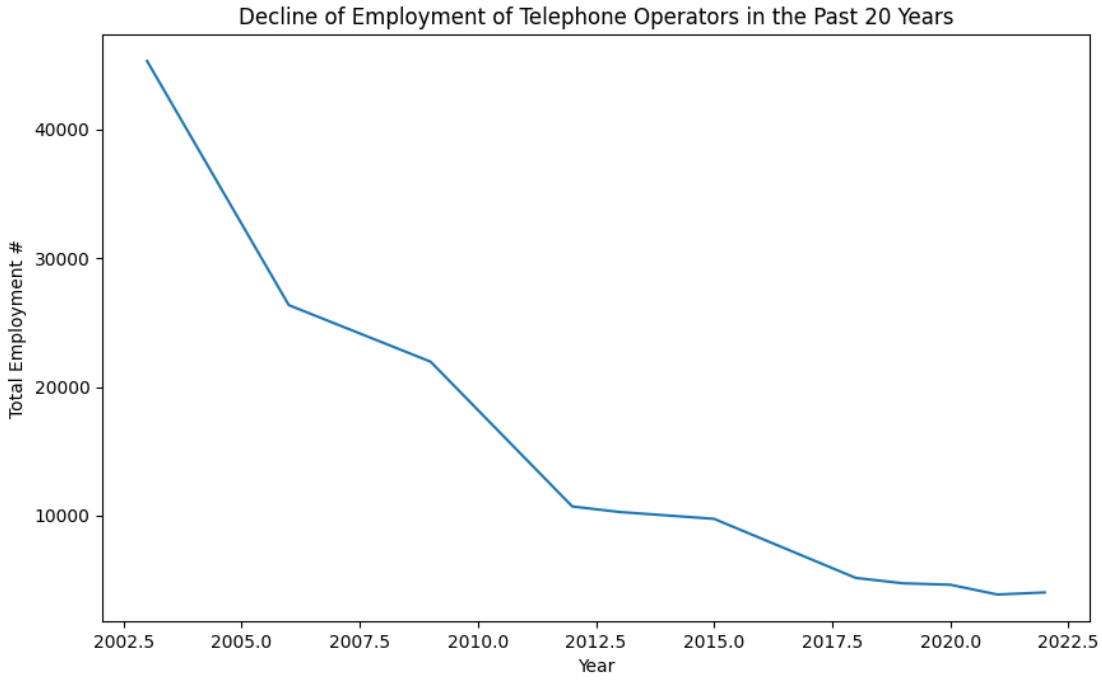


FIGURE 2

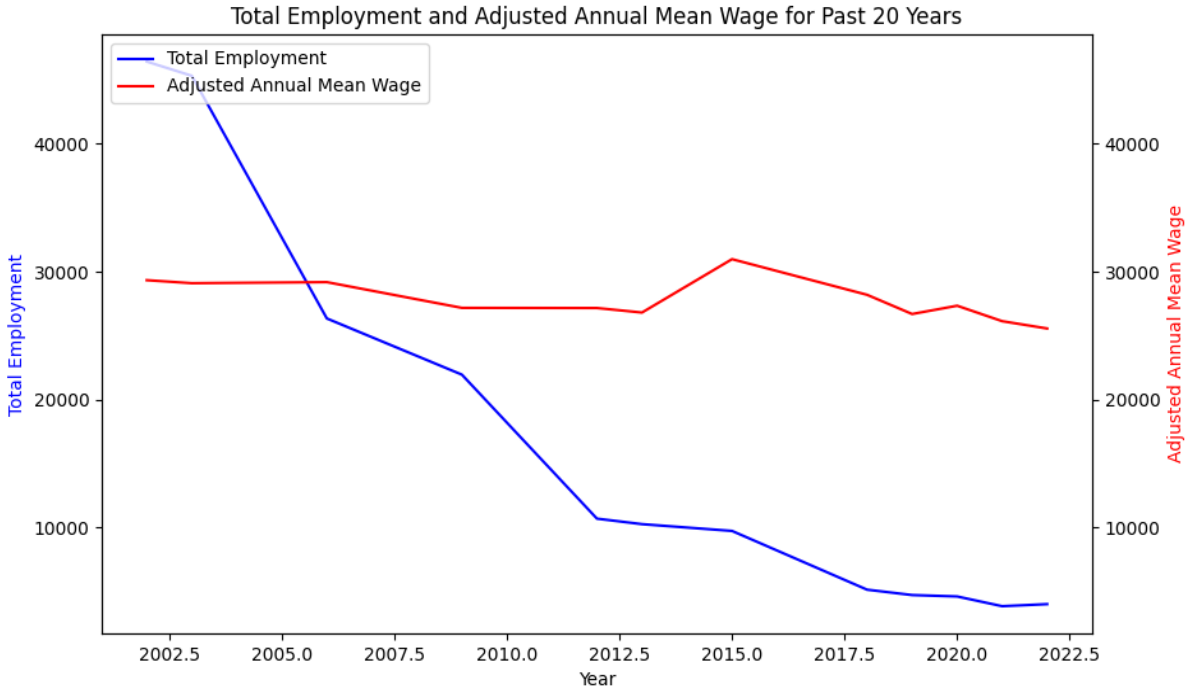


FIGURE 3

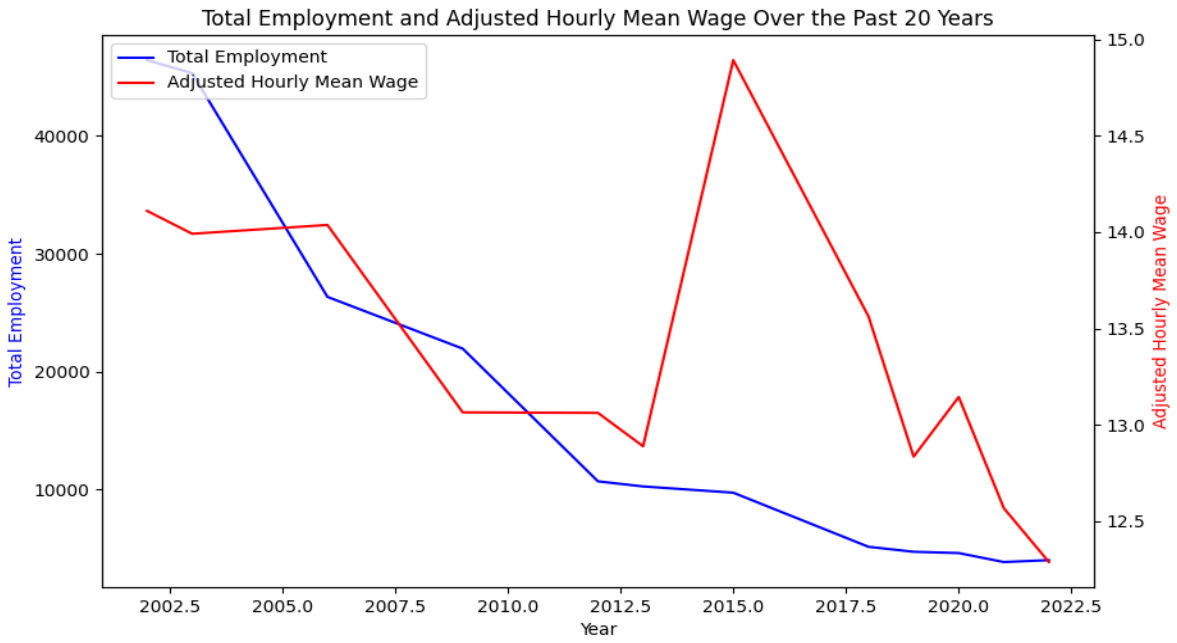
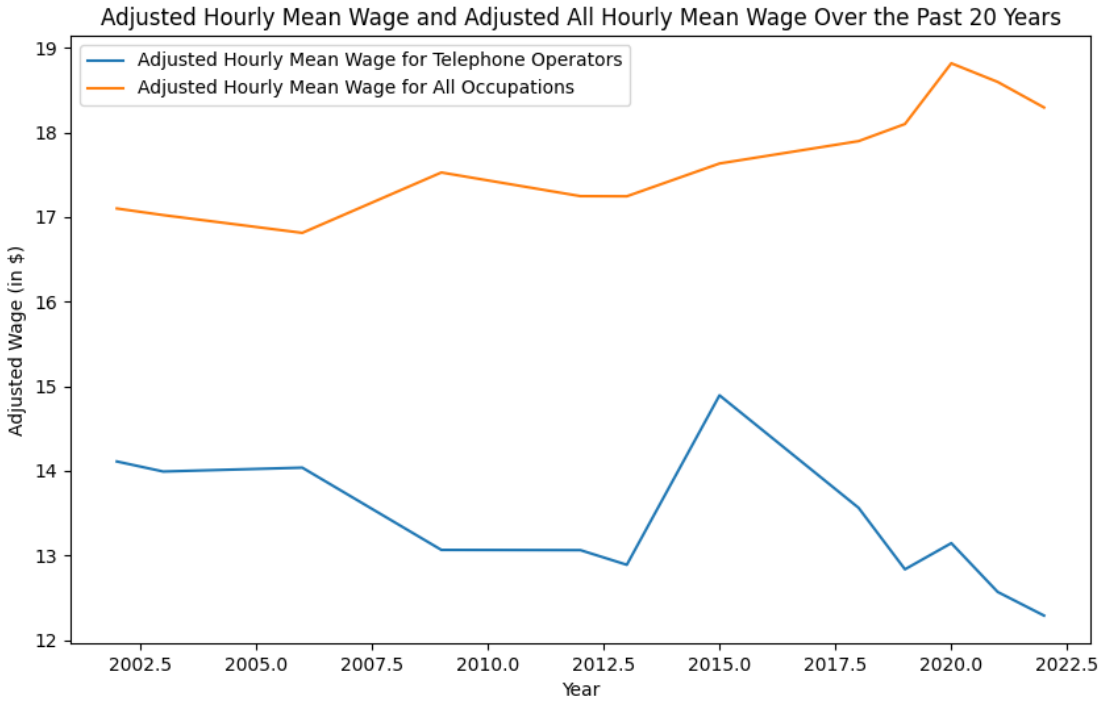


FIGURE 4



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CODE

```
import pandas as pd
```

```
import matplotlib.pyplot as plt

# Load Excel file

df = pd.read_excel('Master Sheet.xlsx')

## HERE IS THE CODE FOR JUST THE EMPLOYMERT NUMBER TREND ##

plt.figure(figsize=(10,6))

plt.plot(df['YEAR'], df['TOT_EMP'])

plt.title('Decline of Employment of Telephone Operators in the Past 20 Years')

plt.xlabel('Year')

plt.ylabel('Total Employment #')

plt.show()

## END OF THE CODE FOR JUST THE EMPLOYMERT NUMBER TREND  ##



## HERE IS THE CODE FOR TOT_EMP x  ADJUSTED A_MEAN ##

base_year_cpi = df.loc[df['YEAR'] == df['YEAR'].min(), 'CPI'].values[0]

df['A_MEAN_ADJUSTED'] = df['A_MEAN'] * (base_year_cpi / df['CPI'])



fig, ax1 = plt.subplots(figsize=(10, 6))

ax1.plot(df['YEAR'], df['TOT_EMP'], label='Total Employment', color='b')

ax1.set_ylabel('Total Employment', color='b')

ax2 = ax1.twinx()
```

```
ax2.plot(df['YEAR'], df['A_MEAN_ADJUSTED'], label='Adjusted Annual Mean Wage',
color='r')

ax2.set_ylabel('Adjusted Annual Mean Wage', color='r')

ax2.set_ylim(ax1.get_ylim())

ax2.yaxis.set_label_position("right")

ax2.yaxis.tick_right()

lines_1, labels_1 = ax1.get_legend_handles_labels()

lines_2, labels_2 = ax2.get_legend_handles_labels()

ax1.legend(lines_1 + lines_2, labels_1 + labels_2, loc='upper left')

plt.title('Total Employment and Adjusted Annual Mean Wage for Past 20 Years')

ax1.set_xlabel('Year')

plt.show()

## END OF THE CODE FOR TOT_EMP x  ADJUSTED A_MEAN ##









## HERE IS THE CODE FOR TOT_EMP x  ADJUSTED H_MEAN ##



base_year_cpi = df.loc[df['YEAR'] == df['YEAR'].min(), 'CPI'].values[0]

df['H_MEAN_ADJUSTED'] = df['H_MEAN'] * (base_year_cpi / df['CPI'])
```

```
fig, ax1 = plt.subplots(figsize=(10, 6))

ax1.plot(df['YEAR'], df['TOT_EMP'], label='Total Employment', color='b')

ax1.set_ylabel('Total Employment', color='b')

ax2 = ax1.twinx()

ax2.plot(df['YEAR'], df['H_MEAN_ADJUSTED'], label='Adjusted Hourly Mean Wage',
color='r')

ax2.set_ylabel('Adjusted Hourly Mean Wage', color='r')

ax2.set_ylim(ax2.get_ylim())

ax2.yaxis.set_label_position("right")

ax2.yaxis.tick_right()

lines_1, labels_1 = ax1.get_legend_handles_labels()

lines_2, labels_2 = ax2.get_legend_handles_labels()

ax1.legend(lines_1 + lines_2, labels_1 + labels_2, loc='upper left')

plt.title('Total Employment and Adjusted Hourly Mean Wage Over the Past 20 Years')

ax1.set_xlabel('Year'

plt.show()

## END OF THE CODE FOR TOT_EMP x  ADJUSTED H_MEAN ##
```

```
## HERE IS THE CODE FOR H_MEAN vs ALL_H_MEAN of all occupations ##

df = df.sort_values('YEAR')
```

```
base_year_cpi = df.loc[df['YEAR'] == df['YEAR'].min(), 'CPI'].values[0]

df['H_MEAN_ADJUSTED'] = df['H_MEAN'] * (base_year_cpi / df['CPI'])

df['ALL_H_MEAN_ADJUSTED'] = df['ALL_H_MEAN'] * (base_year_cpi / df['CPI'])

plt.figure(figsize=(10,6))

plt.plot(df['YEAR'], df['H_MEAN_ADJUSTED'], label='Adjusted Hourly Mean Wage for
Telephone Operators')

plt.plot(df['YEAR'], df['ALL_H_MEAN_ADJUSTED'], label='Adjusted Hourly Mean Wage for
All Occupations')

plt.title('Adjusted Hourly Mean Wage and Adjusted All Hourly Mean Wage Over the Past
20 Years')

plt.xlabel('Year')

plt.ylabel('Adjusted Wage (in $)')

plt.legend()

plt.show()

## END OF CODE FOR H_MEAN vs ALL_H_MEAN of all occupations ##

##HERE IS MY EXCEL PARSER CODE



import pandas as pd

OCC_TITLE = "Telephone Operators"

occ_num = 43-2021

df = pd.read_excel('2018.xlsx')

df_filtered = df[df['OCC_TITLE'] == OCC_TITLE]
```

```
df_filtered.to_excel('2018Filtered.xlsx', index=False)
```