# Telephone Operators Ousted by Interactive Voice Response (IVR) Systems: An Analysis of Technological Displacement and Labor Market Adaptation

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**Abstract**

This paper examines the technological displacement of telephone operators by Interactive Voice Response (IVR) systems, analyzing the impact on employment, wages, and labor market dynamics. Using Bureau of Labor Statistics data from 2002-2021, I document an 85% decline in telephone operator employment, from 46,000 to 3,870 workers. Despite this massive displacement, wages remained stagnant and declined relative to other occupations. The analysis applies skill-biased technological change theory and examines how automation affects specific demographic groups, particularly young women who historically dominated this occupation. The findings support Autor's framework that while automation eliminates routine jobs, it creates new opportunities in complementary sectors, with displaced workers transitioning to customer service and specialized emergency response roles.

**Keywords:** Technological displacement, automation, labor markets, skill-biased technological change, telephone operators

**JEL Classification:** J23, J24, O33

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# 1 Introduction

Telephone operators, also referred to as switchboard operators, were workers who handled incoming and outgoing telephone calls by manually directing calls to their designated locations. These operators established physical connections between caller and recipient lines using switchboards, listening to requests and making necessary connections by plugging cables into appropriate jacks. However, the emergence of Interactive Voice Response (IVR) technology—"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" (IBM, n.d.)—rendered manual operators largely obsolete.

This technological advancement displaced thousands of workers, though it did not completely eliminate the need for telephone operators. Modern operators work primarily in specialized settings requiring human judgment and rapid response capabilities, such as emergency services call centers. These operators handle high-stakes situations including kidnappings, shootings, and house fires, requiring critical thinking and the ability to interpret coded communications from callers in danger.

A notable example occurred in 2019 when a daughter called 911 requesting "pizza delivery" to her address. The operator immediately recognized this as a distress signal, prompting discrete police response that resulted in the arrest of a domestic abuser (Yan, 2019). Such cases demonstrate the continued necessity for skilled human operators in specialized contexts.

By examining the technological change that led to the replacement of telephone operators with IVR systems, this paper analyzes the tasks that have been replaced, new tasks created, and potential impacts on different worker categories. I apply frameworks including skill-biased technological change to understand the consequences of this technological shift and contribute to understanding the broader effects of technological improvements on labor markets.

# 2 Historical Context and Demographics

During the 20th century, telephone operators were predominantly young white women in their late teens or early twenties. Telephone companies found young women ideal for this role due to their patience and timeliness in handling manual switchboards. Men were considered less suitable as they tended to be lazy, easily distracted, and less polite in customer interactions (Daugherty, n.d.).

"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" (Daugherty, n.d.). As telephone adoption increased, so did demand for operators. Employment grew from 88,000 female operators in 1910 to 178,000 by 1920 and 235,000 by 1930.

Strategic hiring of young women also reflected wage considerations, as they could be paid lower wages compared to men. The role was viewed as an extension of women's caregiving responsibilities, with good telephone manners being essential qualifications. Women were attracted to this work because it provided social interaction, was not physically demanding, supplemented household income, and required no formal education.

The 1920 census showed that telephone operators employed 4 % of nearly 3 million young, white, American-born women in the labor force, representing "the single largest occupation-industry pair for women $\leq 20$" (Feigenbaum and Gross, 2020). This demographic concentration provides valuable insight into how automation affects specific population groups.

# 3 Empirical Evidence

## 3.1 Employment Trends

Figure 1 presents the decline in telephone operator employment over the past twenty years. In 2002, approximately 46,000 workers were employed as telephone operators. This number dropped by roughly 50% within three years, largely due to rapid IVR implementation across

industries as technology companies recovered from the dot-com bubble burst.

During the Great Recession beginning in late 2006, corporations implemented significant layoffs and cost-cutting measures. This period saw the final adoption of automated systems by companies that had previously retained human operators. By 2021, only 3,870 telephone operators remained in the United States, primarily in specialized roles requiring human intervention.

The Bureau of Labor Statistics projects that "more than 20 percent of those jobs [will] disappear by 2029" (Daugherty, n.d.), further demonstrating automation's continued impact on this occupation.

## 3.2 Wage Analysis

Figures 2 and 3 examine inflation-adjusted wages for telephone operators compared to employment levels. Annual wages remained relatively stagnant with a slight declining trend, showing a small spike in 2015 potentially attributable to market demand fluctuations, union activity, or data discrepancies.

Figure 4 compares telephone operator hourly wages to average wages across all occupations. While general wages trended upward over the twenty-year period, telephone operator wages declined toward minimum wage levels. This pattern persisted even as the occupation transitioned from a large pool of relatively unskilled workers to a smaller group of specialized workers in emergency services.

The failure of wages to increase despite occupational specialization suggests that changing job requirements did not correspond to wage premiums. Understanding these wage trends requires deeper analysis incorporating economic factors, technological advancements, and labor market dynamics.

# 4 Theoretical Framework and Discussion

## 4.1 Autor's Framework on Workplace Automation

Autor (2015) explores the relationship between technological advancement, automation, and employment in "Why Are There Still So Many Jobs? The History and Future of Workplace Automation." Autor argues that despite widespread fears of automation-induced job losses, historical reality shows a different pattern. While automation replaces certain types of work, it simultaneously generates new opportunities in other areas.

Technological advancement typically displaces routine work performed by humans with machines while complementing and strengthening human skills in non-routine tasks. As Autor notes:

> "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, substantially reducing demand for human operators. While specialized sectors still require operators, overall demand has diminished due to IVR and related technologies.

However, the decline of telephone operators exemplifies how technology reshapes labor markets by transitioning workers into new opportunities. As telephone operators declined, roles in customer support expanded, including customer service chat agents, live phone support agents, and other digital communication channels. IVR technology now directs callers to these agents when specialized assistance is needed.

Autor argues that technological advancement creates more complex jobs as others are displaced. Jobs most vulnerable to automation are simple and routine, like traditional telephone operation. Jobs that are abstract and task-intensive, such as customer service agents handling complex issues, benefit most from advancing technology. Additionally, replacing telephone operators with IVR creates specialized roles for technology installation, development, and maintenance.

## 4.2 Evidence from Feigenbaum and Gross

Research by Feigenbaum and Gross (2020) at Duke and Boston University examined how complete job automation impacts future worker cohorts typically filling those roles. They focused on telephone operators as representative jobs for young women, exploring how automation might displace future generation cohorts in the labor force.

Their findings revealed that the "shock did not reduce future cohorts' employment rate." Instead, "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 research documented "adverse consequences of automation [that] 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 and Gross, 2020).

Feigenbaum and Gross observed a large negative shock to local labor demand specifically for young, white, American-born women, with a nearly 80% reduction in young operators. This represented a "near-total collapse in entry-level hiring in one of the country's largest occupations for young women," where approximately "2% of jobs for this group" were "permanently replaced by machines, essentially at the flip of a switch" (Feigenbaum and Gross, 2020).

Their research confirms Autor's claims that automation and technological advancement create pathways for new jobs amid displacement of old ones. The study provides empirical support for Autor's theoretical framework while emphasizing the dramatic nature of change when automation replaces large employment sectors previously dominated by specific demographic groups.

## 4.3 Skill-Biased Technological Change

The skill-biased technological change framework provides valuable insights into automation's impact and telephone operator decline. This framework explains how technological changes affect demand for different skills in labor markets. Technological advancements typically decrease demand for routine, low-skilled jobs while increasing demand for individuals with high-level skills who can effectively utilize and adapt to new technologies.

For telephone operators, automation of routine tasks such as call routing and basic customer inquiries reduced demand for human operators. This decline affected career opportunities for operators performing simple, automatable tasks. Conversely, demand increased for workers with abstract skills including problem-solving, analysis, and decision-making—capabilities less easily automated, exemplified by emergency service workers and specialized customer service agents.

The framework emphasizes the importance of acquiring new skills in response to technological advancement and automation. Workers who adapt their skills and acquire new competencies aligned with changing labor market demands are more likely to find employment in emerging roles. Many telephone operators successfully learned additional skills and advanced to become customer service specialists.

Feigenbaum and Gross's research supports this framework by demonstrating that future generations, particularly young women, were absorbed into alternative occupations including lower-skilled service sector and middle-skill office roles. This suggests that individuals able to adapt and transition their skills found employment in sectors less vulnerable to automation.

# 5 Contemporary Applications and Extensions

The principles demonstrated in telephone operator displacement extend beyond this specific case. IVR and artificial intelligence technologies now dominate caller routing and answer increasingly sophisticated questions across economic sectors. A Boston study found that patients receiving automated medication reminder calls showed "increased adherence to the medication regimen and increase in patient satisfaction," with "IVRT seen as a cost-effective intervention" (Kraft and Androwich, 2012).

The need for human operators to manually connect calls, answer questions, and make reminder calls has been largely eliminated by automation. Telephone operation was particularly vulnerable due to its simple and routine nature, while jobs with abstract and task-complex requirements complement technological advancement more effectively.

# 6 Conclusion

The effects of automation have fundamentally transformed the telephone operator occupation. Despite dramatic changes since its inception in the late 1800s and early 1900s, this role previously employed thousands of workers. Today, fewer than 5,000 telephone operators remain in the U.S. workforce.

Interactive Voice Response systems and artificial intelligence technologies have achieved dominance in caller routing and question answering across economic sectors. The telephone operator occupation was highly vulnerable to automation and employee displacement due to its simple and routine nature, while jobs with abstract and task-complex requirements better complement technological advancement.

The relationship between automation, technological advancement, and employment is exemplified by the skill-biased technological change framework, supported by studies from Autor (2015), Feigenbaum and Gross (2020). This framework demonstrates that while automation eliminates certain jobs, it creates new opportunities in other sectors, exemplified

by telephone operator decline as routine tasks were automated and specialized customer support positions emerged.

The framework emphasizes the critical importance of skill enhancement and adaptability for navigating dynamic job markets. Understanding and applying this paradigm enables individuals and policymakers to respond effectively to technological transformations, ultimately yielding more inclusive employment outcomes.

**FIGURE 1**

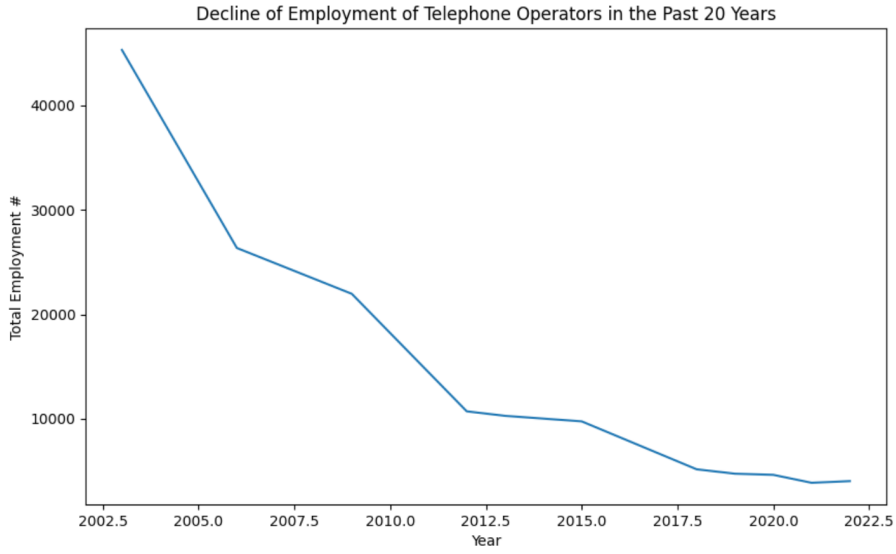


Figure 1: Decline of Employment of Telephone Operators in the Past 20 Years

**FIGURE 2**

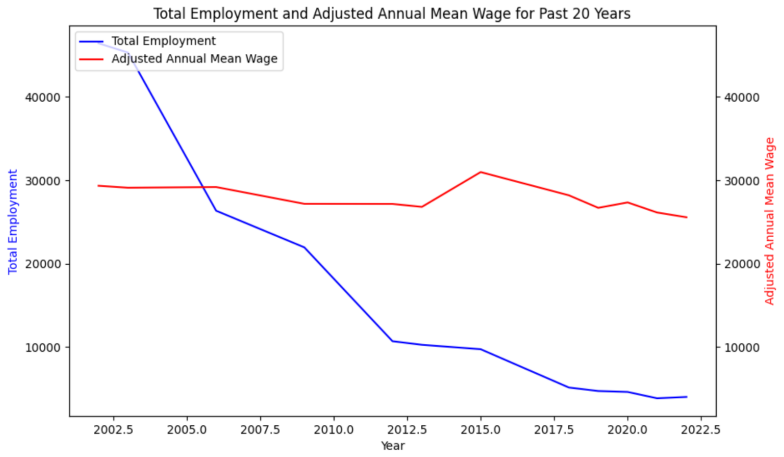


Figure 2: Total Employment and Adjusted Annual Mean Wage for Past 20 Years

**FIGURE 3**

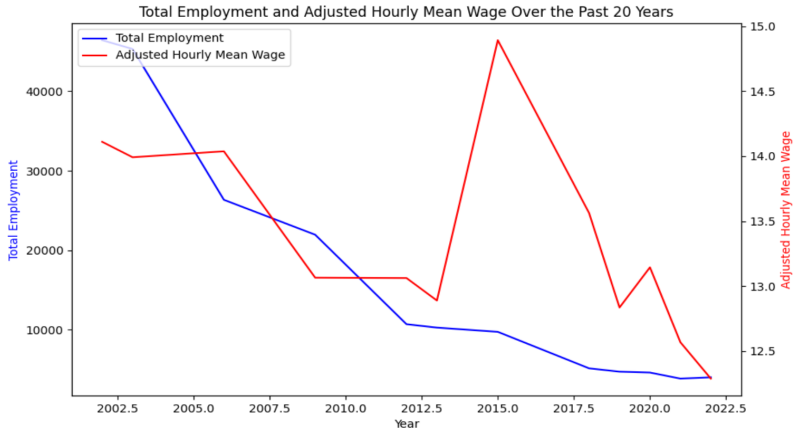


Figure 3: Total Employment and Adjusted Hourly Mean Wage Over the Past 20 Years

**FIGURE 4**

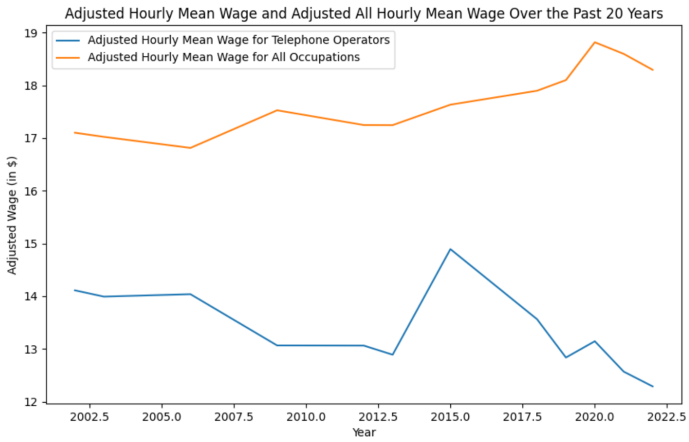


Figure 4: Adjusted Hourly Mean Wage Comparison: Telephone Operators vs. All Occupations

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