

# Flexibility's Price: Are Workers in the Gig Economy Thriving or Just Surviving?

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**Abstract:** The gig economy has reshaped traditional labor markets, offering new earning opportunities—but at what cost? This study examines the financial realities and job quality of gig workers operating through digital platforms in the Metropolitan Area of Lima, Peru, focusing on drivers and couriers employed by the region's most widely used ride-hailing and food delivery apps. Drawing from survey data collected from over 400 gig workers, this research evaluates their income stability, working conditions, and access to essential digital tools. The findings reveal a double-edged sword: while gig work provides quick access to income and a degree of autonomy, it is also characterized by precarious employment conditions, including unpredictable earnings, job insecurity, and the absence of critical benefits such as health insurance, paid leave, and retirement plans. Many workers rely on multiple platforms to piece together a livable income, highlighting the instability of gig-based employment. Moreover, despite their reliance on digital tools, many workers face technological barriers such as limited training, outdated devices, and inconsistent internet access, further complicating their ability to compete in this evolving labor market. This study also highlights workers' growing dependence on the very digital platforms that mediate and control their work, raising questions about who truly benefits—those striving to earn a living or the platforms profiting from their labor. This dynamic underscores a power imbalance, where risks are shouldered by workers while rewards flow to platform operators. Additionally, the study explores the challenges faced by regulators in adapting labor protections to a rapidly evolving digital workforce. By shedding light on these pressing issues, this research contributes to the global debate on the sustainability of gig work. It urges policymakers, platform operators, and other stakeholders to develop stronger labor protections, fairer wages, and improved working conditions, fostering a more equitable and sustainable economic model for the future.

**Keywords:** Gig Economy, Platform Work, Income Stability, Job Quality, Digital Inclusion

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## 1. Introduction

Over the past decade, the rise of the gig economy has drawn increasing attention as a potential paradigm shift in how labor is structured and services are delivered. This model, rooted in peer-to-peer exchanges mediated by digital platforms, has disrupted multiple sectors by redefining how goods and services are accessed, offered, and monetized (Ebirim et al., 2024). At its core, the gig economy has introduced new labor dynamics that challenge traditional employer-employee relationships and call for both innovative frameworks to analyze its broader societal impact and modernized regulatory approaches to address its consequences.

Beyond academic interest, major international organizations have also weighed in on the gig economy's potential and risks. The International Labour Organization (ILO) recognized platform-mediated gig work as a key component in achieving the United Nations Sustainable Development Goals. It highlighted their potential to lift millions out of poverty by providing flexible income-generating opportunities. However, it also emphasized the challenges these platforms pose in ensuring fundamental rights, collective representation, fair wages, and social protections (ILO, 2020).

Across developed and developing nations alike, gig work has reshaped employment patterns. Sectors such as transportation and food delivery now rely heavily on app-mediated, on-demand labor. Evidence suggests that digital infrastructure and literacy are positively associated with GDP growth and lower unemployment rates (Sandri et al., 2022), sparking optimism that the gig economy may serve as a tool for labor inclusion, particularly in urban areas.

## 2. Literature Review

### 2.1 Defining the Gig Economy in Relation to the Sharing Economy

Although often used interchangeably in public discourse, the terms *sharing economy* and *gig economy* refer to overlapping yet distinct models of digitally mediated activity. Both rely on digital platforms and promote flexible arrangements, but they differ fundamentally in their mechanisms and participants. The sharing economy centers on peer-to-peer access to underused assets, such as homes or cars, while the gig economy is characterized by

short-term, task-based labor typically performed by independent contractors (Kaine & Josserand, 2019; Li et al., 2021).

**Table 1: Key Differences Between the Sharing and Gig Economies**

Feature	Sharing Economy	Gig Work
Core Activity	Sharing of Assets	Selling of labor / time
Participants	Asset owners and users	Workers and clients
Platform Role	Matches owners with users	Matches workers with gigs
Income Source	Renting / sharing an asset	Performing a task / service
Examples	Airbnb, Turo	Cabify, InDrive, Pedidos Ya, Rappi

While some platforms—such as Cabify or Rappi—incorporate elements of both models by requiring workers to use personal assets, the nature of the work remains fundamentally gig-based.

## 2.2 Access and Entry Barriers

App-based gig work has created new income opportunities, often accessible to individuals excluded from traditional labor markets (Huang et al., 2020). However, it introduces its own set of barriers. These include the need for capital (e.g., owning a vehicle or smartphone), digital literacy, and platform-specific requirements (Burger & Fourie, 2019). While often marketed as accessible, such work still filters out individuals lacking these resources.

Additionally, structural drivers of unemployment—such as job market exclusion, urgency for income, and lack of alternatives—push many into platform work. For some, it is a choice; for others, a necessity born of economic precarity (MTPE, 2023; Clark & Lepinteur, 2019).

## 2.3 Digital Inclusion and Narrowing the Divide

The digital divide remains a key obstacle in many developing nations, where access to reliable devices, internet, and digital literacy is uneven (Rosário & Dias, 2023). Yet gig work can offer a bridge, connecting people to digital tools and enabling participation in the digital era.

Key elements of this inclusion include access to devices and networks (Prianto et al., 2021), training to use platform tools effectively (Waldkirch et al., 2021), and the demographic dimension: individuals from low-income or rural areas who often benefit the most from these opportunities—but are also at highest risk of exclusion (Sanchez-Prieto et al., 2020).

## 2.4 Regional Views on the Gig Economy in Latin America

Latin America has seen a rapid rise in gig work, with Colombia standing out as the origin of Rappi—one of the region’s most prominent app-based gig services—and thus one of the most studied cases (Fernández & Benavides, 2020; Salinas et al., 2022). Neighboring countries such as Chile and Ecuador have also drawn scholarly attention due to their geographic and socioeconomic proximity, showing similar gig work patterns. In Colombia, large-scale surveys of Rappi workers revealed mixed outcomes: income flexibility on one hand, but legal ambiguity and lack of protections on the other (Fernández & Benavides, 2020). In Chile, interview-based studies have emphasized similar concerns, calling for minimum labor standards and better communication between workers and platforms (Arriagada et al., 2023).

In Ecuador and Chile, workers report algorithm-driven schedules, long hours, and weak protections for health, income, and labor rights (Albornoz & Chavez, 2024; Arriagada et al., 2023). These trends reveal a regional challenge: balancing opportunity with protections. Portuguese-language studies from Brazil were excluded from this review due to language constraints, and limited data availability restricted the inclusion of Bolivian cases.

## 2.5 The Peruvian Context

In Peru, two key organizations have emerged in response to the evolving gig economy landscape: the Observatorio de Plataformas Digitales (OPD), a research-focused institution dedicated to analyzing labor transformations within platform-based gig work, and the Sindicato de Trabajadores de Plataformas Digitales

(SINTRAPLADI), a labor union representing app-based gig workers. Reports from OPD and Fairwork (2023) reveal that while gig platforms offer flexibility and income, most fail to meet fair work standards.

Fairwork scores Peruvian platforms on principles like pay, contracts, and representation, with most platforms receiving low ratings. Meanwhile, national studies from the Instituto Peruano de Economía (IPE, 2023), a prominent Peruvian economic research institute, estimate that over 130,000 individuals worked in app-based gig roles in 2022. Most have completed secondary or technical education, and their motivations range from income supplementation to flexible scheduling. The IPE notes that gig work has contributed to lowering unemployment and expanding income-generating options.

## **2.6 Diverging Perspectives**

Supporters of the gig economy argue that it fosters innovation, creates jobs, and accommodates diverse work schedules (Flores et al., 2020; Borys et al., 2021). They also emphasize company-led digital training initiatives that build worker capacity.

Conversely, critics point to precarity, lack of labor rights, and weak regulatory frameworks (de Andrés et al., 2024; García et al., 2021). Gig workers are often excluded from legal definitions of employment, which limits access to benefits and protections. Studies also highlight the influence of political and legal ambiguity in shaping labor outcomes across platform sectors.

## **2.7 Research Gap and Purpose**

Despite growing scholarship on the gig economy, there remains a notable lack of integrated research examining both its impact on employment generation and digital inclusion, particularly in the Peruvian context. Most studies focus on these aspects separately, failing to explore how participation in gig work influences both economic and technological integration for workers. This gap is especially significant in Lima, where ride-hailing and delivery platforms have become widespread sources of income, yet workers continue to face labor precarity, income instability, and barriers to digital access.

Existing research has also tended to emphasize either macroeconomic outcomes or regulatory challenges, without directly engaging with workers lived experiences or evaluating how the structure of platform labor affects financial realities, access to digital tools, and autonomy in daily work. As platforms expand rapidly across Lima's urban landscape, a comprehensive understanding of how workers perceive the trade-offs between flexibility and precarity remains limited.

This study responds to that gap by collecting and analyzing worker-reported data from a broad sample of gig workers in Lima. It focuses on understanding their financial stability, job quality, and digital inclusion through a structured and multidimensional approach. By emphasizing the worker perspective, this research contributes to the growing body of international literature on the gig economy, while offering grounded insights that can inform future policy and platform accountability in Peru.

## **3. Methodological Framework**

### **3.1 Research Design and Approach**

The methodology applied in this study follows a non-experimental, cross-sectional, and correlational design, used to analyze the gig economy's impact on employment and the digital divide in Lima. This approach was selected because the variables were not manipulated, but rather observed at a single point in time, allowing for the identification of potential associations between the independent variable—participation in digitally mediated gig labor—and the dependent variables—employment access and digital inclusion.

### **3.2 Population, Sampling, and Data Collection**

The unit of analysis for this study consists of workers participating in the gig economy, specifically those employed by food delivery and ride-hailing platforms. Based on estimates from Fairwork (2023) and the Instituto Peruano de Economía (IPE, 2023), approximately 133,000 individuals are engaged in app-based gig work across Peru, with around 81% located in Lima. This proportion yields an estimated population of 107,730 platform workers in the Metropolitan Lima area.

To ensure statistical representativeness, a simple random sampling method was applied. Using a 95% confidence level and a 5% margin of error, a minimum sample size of 383 respondents was determined. Ultimately, 417 valid responses were collected through structured surveys, exceeding the required threshold and strengthening the robustness of the data.

### 3.3 Survey Instrument and Dimensions

The primary data collection technique employed in this study was a structured survey, designed to gather essential information regarding workers' experiences in the gig economy. The instrument aimed to assess not only labor conditions, but also access to digital technologies and perceptions of employability—aligning directly with the study's core research objectives.

To ensure quantitative consistency and enable statistical analysis, the survey consisted exclusively of closed-ended questions. The questionnaire was divided into two main sections:

**Sociodemographic and Work Profile:** This section captured foundational information such as gender, age, education level, district of residence, hours worked per week, platform type, duration of engagement in platform work, and monthly income bracket.

**Perceptions of Gig Work:** This section included Likert-scale items rated from 1 (Strongly Disagree) to 5 (Strongly Agree). These items were organized across five analytical dimensions:

- Financial Reality
- Job Quality
- Income Stability
- Autonomy
- Access to Digital Tools

These dimensions were conceptually developed to evaluate both economic outcomes and digital inclusion from the perspective of workers. By structuring the survey in this way, the instrument facilitates descriptive, correlational, and comparative analysis across key indicators of gig-based labor in Lima.

### 3.4 Reliability Testing (Cronbach's Alpha)

To assess the internal consistency of the survey instrument, Cronbach's Alpha was calculated for the composite dimensions derived from the Likert-scale items. The resulting coefficient was 0.68, slightly below the 0.70 benchmark. However, this value is generally considered acceptable in exploratory research within the social sciences—particularly when measuring perception-based constructs.

Although there is room for improvement in future iterations of the instrument, the obtained alpha score indicates that the items within each dimension exhibit a sufficient degree of interrelatedness and capture the intended conceptual themes. As such, the reliability level is deemed adequate to support the study's analytical framework and interpretation of results.

### 3.5 Normality Testing (Shapiro-Wilk)

To assess the distribution characteristics of the composite dimensions, the Shapiro-Wilk test was applied to each of the five key constructs: Financial Reality, Job Quality, Income Stability, Autonomy, and Access to Digital Tools. In all cases, p-values were below 0.001, indicating statistically significant deviations from a normal distribution.

The test results were further supported by skewness values: Financial Reality (0.733) and Income Stability (1.733) showed positive skewness, while Job Quality (-1.044), Access to Digital Tools (-0.615), and Autonomy (-1.045) exhibited negative skewness. These findings, in combination with the ordinal nature of the Likert-scale items, justified the use of non-parametric statistical methods in the subsequent correlational and comparative analyses.

**Table 2: Normality Test Results and Skewness of Composite Dimensions**

Dimension	Shapiro-Wilk	p-value	Skewness
Financial Reality	0.888	< 0.001	0.733
Job Quality	0.846	< 0.001	-1.044

Dimension	Shapiro-Wilk	p-value	Skewness
Access to digital tools	0.903	< 0.001	-0.615
Income stability	0.894	< 0.001	1.733
Autonomy	0.815	< 0.001	-1.045

### 3.6 Correlational Tests (Spearman) and Comparative Analysis (ANOVA)

To examine the relationships between key variables and test the proposed hypotheses, a combination of correlational and comparative statistical techniques was employed.

Spearman’s rank correlation coefficient was applied to evaluate the strength and direction of associations among the main constructs—Financial Reality, Job Quality, Access to Digital Tools, Income Stability, and Autonomy. This method was chosen due to both the ordinal nature of the Likert-scale data and the non-normal distribution confirmed by previous normality testing. Results revealed statistically significant correlations, particularly between Financial Reality and Job Quality, and between Financial Reality and Access to Digital Tools, supporting the notion of interrelated dimensions in the experience of platform workers.

To complement the correlational analysis, Chi-square tests of independence were used to assess the association between categorical variables. Notably, the relationship between Financial Reality and Job Quality yielded a p-value < 0.001 and a Cramer’s V of 0.455, indicating a moderate to strong association. Significant associations were also found between Income Stability and Job Quality, as well as between Financial Reality and Access to Digital Tools.

**Table 3: Chi-Square Associations Between Key Dimensions**

Test	Financial Reality & Job Quality	Financial Reality & Access to digital tools	Income Stability & Job Quality
Chi-square	172.87	-	-
Cramer’s V	0.455	> 0.455	> 0.455
p-value	< 0.001	< 0.001	-0.615

For group comparisons, One-way ANOVA was conducted to determine whether the degree of participation in the gig economy had a significant effect on each of the five main dimensions. While the data were not normally distributed, the large sample size allowed the use of ANOVA under the assumptions of the Central Limit Theorem. The results were compelling—statistically significant differences were observed across all dimensions, with F-statistics ranging from 64.218 to 79.219 and p-values < 0.001, suggesting that participation in app-based gig work considerably influences workers’ perceptions and experiences.

**Table 4: ANOVA Results for Dimensions**

Variable	F-statistic	p-value	Interpretation
Financial Reality	64.218	< 0.001	Significant effect of gig economy
Job Quality	79.219	< 0.001	Significant effect of gig economy
Access to digital tools	66.734	< 0.001	Significant effect of gig economy
Income stability	71.512	< 0.001	Significant effect of gig economy
Autonomy	68.947	< 0.001	Significant effect of gig economy

These analyses underscored the pivotal role of Financial Reality as the most influential construct, while also confirming the broader impact of gig-based work on job quality, digital inclusion, income stability, and perceived autonomy in Lima’s urban labor market.

### 3.7 Tools and Software Used (Excel, JASP)

Two main tools were used for data processing and statistical analysis:

- Microsoft Excel supported the initial stages of the workflow, including data cleaning, organization, and the calculation of descriptive statistics such as frequencies, means, and standard deviations.

- JASP, an open-source and user-friendly statistical software, was used to conduct all inferential analyses. This included the Shapiro-Wilk test, Cronbach’s Alpha, Spearman correlations and ANOVA tests, as well as the generation of correlation matrices and heatmap visualizations.

## 4. Results

### 4.1 Descriptive Profile of Gig Workers in Lima

The majority of respondents identified as male (91.8%), with the largest age group being 25 to 34 years old (39.2%). Educational attainment was relatively low, with 57.9% having completed only secondary education. In terms of residential location, 33.2% lived in Zone 2 districts such as Independencia, Los Olivos, and San Martín de Porres—areas commonly associated with lower-middle socioeconomic status.

Most participants were engaged in food delivery services (76.2%), with only a minority working in ride-hailing. Nearly half of the respondents (49.8%) reported working between 41 and 50 hours per week, aligning closely with Peru’s national average of 48 hours. Additionally, 38.7% had been working on platforms for 1 to 2 years, suggesting an emerging trend toward medium-term platform engagement.

In terms of income, the most commonly reported monthly range was between S/. 1026 and S/. 1500 (44.5%), which—at the time of the study—was roughly equivalent to \$277 to \$405 USD, based on an exchange rate of 3.7 nuevos soles per dollar. This bracket hovers around the minimum wage at the time (S/. 1025 ≈ \$277 USD), indicating that while platform work provides income opportunities, earnings remain precariously close to subsistence levels for many.

**Table 5: Summary of Worker Demographics and Platform Use**

Variable	Most Common Category	Percentage
Gender	Male	91.8%
Age Range	25 - 34 years old	39.2%
Education	Secondary education	57.9%
Residence (Zone)	Zone 2 (e.g., Independencia, Los Olivos, SMP)	33.2%
Platform Type	Food Delivery	76.2%
Weekly Hours Worked	41-50 hours	49.8%
Time on Platform	1-2 years	38.7%
Monthly Income	S/. 1026 – S/. 1500	44.5%

This descriptive profile highlights a labor force that is predominantly young, male, and operating within socioeconomically constrained environments.

### 4.2 Index-Based Analysis of Gig Work Realities

To evaluate the perceived impact of the gig economy, five composite indices were constructed: Financial Reality, Job Quality, Access to Digital Tools, Income Stability, and Autonomy. Each index was calculated by averaging multiple Likert-scale items (ranging from 1 = Strongly Disagree to 5 = Strongly Agree), based on responses from 417 participants.

**Table 6: Composite Index Ratings by Dimension**

Dimension	Mean Score	Interpretation
Financial Reality	2.89	Moderate financial strain, inconsistent earnings reports
Job Quality	2.56	Low job satisfaction; lack of benefits and labor protections
Access to Digital Tools	3.12	Basic access present; limitations in training and device quality persist
Income Stability	2.44	High income variability; multiple platforms to meet financial needs
Autonomy	3.41	Perceived flexibility in schedule and platform selection

The results reveal a clear contrast: Autonomy scored highest, reflecting a sense of flexibility that workers value in gig-based jobs. However, dimensions such as Income Stability (2.44) and Job Quality (2.56) received the lowest average scores, highlighting worker concerns about volatile earnings, lack of protections, and general precarity.

Interestingly, while Access to Digital Tools (3.12) scored slightly above the midpoint, it still reveals gaps in digital inclusion—particularly around device quality and training. Financial Reality, with a mean of 2.89, further illustrates that although gig work provides some income, it does not necessarily translate into financial security or economic well-being.

Altogether, these findings reinforce the notion that app-based gig work offers flexibility at the expense of stability, with financial precarity emerging as the most pressing issue among workers.

### 4.3 Correlational Analysis and Heatmap

To explore how the five key dimensions interact, a Spearman’s rank correlation analysis was conducted. This method was selected due to the ordinal scale of the data and the previously established non-normal distribution of the composite indices.

The results revealed several strong and statistically significant associations, particularly between Financial Reality and Job Quality ( $\rho = 0.61$ ), and Financial Reality and Access to Digital Tools ( $\rho = 0.55$ ). These correlations suggest that respondents experiencing greater financial strain were also more likely to report poor working conditions and limited access to digital resources.

Income Stability showed moderate positive correlations with both Job Quality and Access to Digital Tools, indicating that workers with more consistent earnings tend to have better experiences across multiple dimensions of platform work. In contrast, Autonomy exhibited weaker correlations with the other variables, suggesting that perceptions of flexibility may function independently from economic or technological constraints.

These relationships are visually represented in Figure 1, a correlation heatmap that highlights the interconnectivity—and occasional divergence—between workers’ experiences across the platform labor spectrum.

Dimension	Financial Reality	Job Quality	Access to Digital Tools	Income Stability	Autonomy
Financial Reality	1.00	0.61	0.55	0.47	0.30
Job Quality	0.61	1.00	0.50	0.59	0.33
Access to Digital Tools	0.55	0.50	1.00	0.44	0.29
Income Stability	0.47	0.59	0.44	1.00	0.35
Autonomy	0.30	0.33	0.29	0.35	1.00

Figure 1: Spearman Correlation Heatmap of Gig Work Dimension

## 5. Discussion

### 5.1 Interpretation of Key Findings

The findings of this study paint a nuanced picture of gig-based labor in Lima, revealing a clear trade-off between flexibility and economic security. While Autonomy emerged as the most positively rated dimension, reflecting workers’ appreciation for self-managed schedules and platform choice, other indicators revealed significant structural challenges. Notably, Income Stability and Job Quality were consistently rated the lowest, suggesting that flexibility often comes at the expense of predictability and protection.

The strong correlation between Financial Reality and both Job Quality and Access to Digital Tools indicates that economic strain is not experienced in isolation. Instead, it is intertwined with broader barriers, including precarious working conditions, insufficient digital infrastructure, and limited support systems. These interdependencies align with previous research suggesting that gig economy platforms tend to externalize risks while absorbing the rewards (de Andrés et al., 2024; ILO, 2020).

Interestingly, while Access to Digital Tools scored moderately, the data suggest that even basic levels of access do not necessarily translate into competitive digital inclusion. Gaps in training, outdated devices, and limited internet access continue to affect how workers engage with platform algorithms and optimize their income

streams—echoing the growing concern that digital infrastructure alone is not enough without active upskilling and support (Waldkirch et al., 2021).

The overall picture reflects what many have described as a "double-edged sword" dynamic in the gig economy: it creates rapid access to income-generating activities, but under conditions that often reproduce or even amplify existing socioeconomic vulnerabilities. For many respondents, gig work is not a stepping stone to upward mobility, but a survival strategy in the absence of better options.

## **5.2 How Gig Work Shapes Economic Realities**

The data clearly show that gig work offers income opportunities, but rarely delivers economic security. Most respondents reported earnings near or just above the minimum wage, and Income Stability received the lowest average rating among all dimensions. This aligns with broader critiques of gig economy models, where earnings fluctuate daily, and workers bear the brunt of market demand, app algorithm changes, and platform fees.

Moreover, the high rate of multiplatform use and long working hours—often beyond the legal average—suggests that workers are patching together income rather than building sustainable livelihoods. Financial stress is compounded by the lack of social protections, such as health insurance, paid leave, or retirement plans—reinforcing a model where workers remain economically vulnerable despite being constantly active.

Ultimately, the gig economy in Lima appears to offer access to work, but not necessarily access to economic mobility. It reshapes labor around flexibility, but does so while offloading risk onto workers, many of whom operate within already fragile socioeconomic conditions.

## **5.3 The Tension Between Flexibility and Precarity**

The data reflects a core paradox of gig work: while workers value the flexibility and autonomy it offers, these benefits coexist with economic precarity. The high score in Autonomy contrasts sharply with low ratings in Job Quality and Income Stability, underscoring that freedom in scheduling does not equate to security or dignity. This tension suggests that flexibility, while real, may act more as a coping mechanism than a real choice.

## **5.4 Policy Implications and the Role of Regulation**

Findings point to an urgent need for regulatory frameworks that recognize and protect platform workers. Current conditions fall short of fair labor standards, with low formalization, weak protections, and limited avenues for worker voice. Entities like SINTRAPLADI and global tools like Fairwork ratings offer early steps toward accountability, but systemic change will require state intervention, clearer classification of labor relationships, and enforcement of minimum protections, regardless of employment status.

# **6. Conclusion**

## **6.1 Summary of Core Insights**

This study offers a multidimensional view of gig work in Lima, revealing a labor force that values autonomy but faces significant financial and structural challenges. While digital platforms and apps provide access to income and flexible schedules, they fall short in delivering job stability, protections, and financial well-being. Key dimensions such as Income Stability and Job Quality were consistently rated low, reinforcing concerns about the precarious nature of platform-based employment.

## **6.2 Contributions to Ongoing Global Debate**

These findings contribute to a growing global dialogue on the real costs of gig work, particularly in developing urban economies. By centering worker experiences and using a grounded, data-driven approach, this research strengthens calls for a more balanced and equitable gig economy—one that doesn't trade protection for flexibility.

## **6.3 Recommendations for Policymakers and Future Research**

Policymakers should regulate gig-based labor by setting minimum standards for pay, conditions, and digital access. Partnerships with groups like SINTRAPLADI and global frameworks such as Fairwork can guide this. Future

research should explore gender, formality, algorithmic control, and AI's impact on labor through longitudinal and comparative analysis.

## Ethics Declaration

Ethical clearance was not required for the research.

## AI Use Statement

No AI tools were used in the writing of this paper.

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