Proceedings of ICEMGD 2025 Symposium: The 4th International Conference on Applied Economics and Policy Studies
DOI: 10.54254/2754-1169/2025.BJ24189

Theoretical Mechanism Research on the Shaping of Digital Economy in Digital Gig Work Participation

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Abstract. The digital economy, relying on the deep integration of platformization and digital technologies, has restructured the resource allocation logic of the labor market and accelerated the development of gig work participation. Technologies such as algorithms and big data significantly reduce the asymmetry of supply and demand information and transaction costs, enabling dynamic matching and efficient coordination of labor resources. This enhances flexibility in terms of time, space, and skills, providing workers with more autonomy. However, the labor market exhibits contradictory characteristics of "decentralized collaboration" and "platform-centered control." On the one hand, task decomposition and crowdsourcing models reconstruct complex jobs through modularization, activating global labor resources, lowering skill barriers, and improving human capital allocation efficiency. On the other hand, digital gig workers face multiple challenges, such as ambiguous labor relationships, income volatility, invisible algorithmic control, limited skill accumulation, and lack of social security. Platforms shift operational risks through algorithms, and workers, lacking legal protection and collective bargaining power, are forced to accept unequal terms, exacerbating the vulnerability of their rights and interests. To address these issues, this paper proposes the following optimization pathways: First, leverage artificial intelligence and blockchain technologies to achieve intelligent human-machine collaboration and transparency of labor rights; second, build a lifelong learning ecosystem to support skill upgrading and sustainable career development for gig workers; third, promote adaptive institutional design to clarify the legal status of "third-party workers" and establish a flexible social security mechanism. Through the dual drive of technological progress and institutional innovation, the digital economy is expected to improve resource allocation efficiency while promoting fairness and innovative development in the participation model of digital gig work.

Keywords: Digital Economy, Digital Occupation, Gig Work Participation

1. Introduction

The platform economy transforms the traditional labor market allocation logic through digital advancements. Algorithms and big data reduce information asymmetry and transaction costs between labor and capital in the platform economy. For example, ride-hailing platforms use real-time dispatch algorithms to dynamically match employers with workers, food delivery platforms

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utilize location-based algorithms to optimize delivery routes, and service platforms match gig jobs to users' needs precisely[1]. These technological methods not only break the limitations of time and space but also build trust through evaluation systems to accelerate resource matching. From a market structure perspective, the platform economy follows a "two-sided market" logic, meaning it attracts both supply and demand sides to create agglomeration effects. It accurately matches labor (freelancers, temporary workers, etc.) with market demand (temporary tasks, instant services, etc.). The platform's "real-time response" makes resource allocation dynamic. For instance, during peak demand times, delivery platforms can increase prices to attract more labor into the platform, quickly balancing supply and demand. This flexibility not only adapts to market fluctuations but also provides laborers with the opportunity to participate.

The platform economy presents a contradictory characteristic of "decentralization" and "recentralization." On one hand, intermediaries such as traditional labor market agencies are reduced, and workers are no longer limited by geography or institutions. They can directly connect with employers through platforms, which represents a "decentralized" labor market relationship. For example, freelance platforms allow workers from all over the world to compete, facilitating peer-to-peer task transactions, thus removing intermediaries. On the other hand, platforms gradually become new "digital centers," where the platform itself redistributes resources through algorithms, data, and other means. For example, food delivery platforms decide whether delivery drivers take orders and how much they earn based on algorithms, while ride-hailing platforms decide whether drivers accept orders and control their behavior using dispatch algorithms. This "recentralization" driven by technology is not the traditional hierarchical structure but is centered around digital technologies, using digital tools for redistribution[2].

In this process, the market elasticity of labor is reflected in three dimensions: time flexibility means individuals can freely manage their time, such as a DiDi driver being able to choose to accept orders during fragmented time; spatial flexibility breaks the limitations of space and geography, such as a designer being able to accept orders remotely through platforms; skill flexibility means breaking down complex problems into crowdsourcing tasks, lowering skill requirements, and attracting heterogeneous laborers. However, this flexibility comes at a cost, as platforms use technology to invisibly control laborers, such as selecting workers through scoring systems, lowering labor costs through dynamic pricing, increasing workers' sense of uncertainty, and reducing labor protections. Therefore, the decentralization and flexibility of the labor market are both a victory of technological empowerment and a paradox of technological ethics and institutional arrangements. This dual evolution, on the one hand, provides more choices for laborers, while on the other hand, it calls for a rebalancing of technological ethics and institutional arrangements.

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2. The theoretical mechanism of platform gig work participation in the context of the digital economy

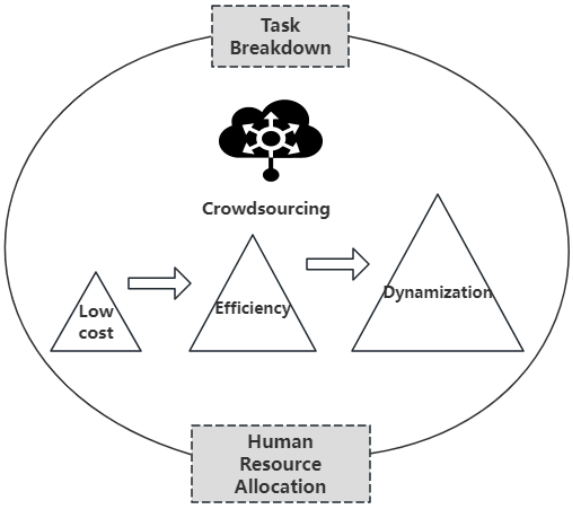


Figure 1: The relationship between task decomposition, crowdsourcing, and human capital allocation

Task decomposition, crowdsourcing, and human capital allocation optimization are the three core mechanisms that reconstruct labor division and resource allocation in the digital economy. Figure 1 illustrates the relationship between task decomposition, crowdsourcing, and human capital allocation, where the three form a progressive closed-loop: task decomposition provides executable, modular tasks for crowdsourcing, which, through distributed collaboration, completes modular work and accumulates data. Human capital allocation dynamically adapts based on task requirements and workers' skills, continuously optimizing the structure and efficiency of labor resources. This collaborative mechanism not only breaks the rigid constraints of traditional labor division, lowers skill thresholds, and enhances resource allocation flexibility, but also provides digital gig workers with flexible participation and skill upgrade pathways.

2.1. Task decomposition: modular reconstruction of complex work

The digital economy systematically decomposes complex tasks through technological means, transforming them into standardized, quantifiable independent modules. This reduces entry barriers and enhances the flexibility of resource allocation. Taking software development as an example, traditional projects rely on highly specialized teams working together over a long period. In contrast, agile development models break the project down into sub-tasks such as requirement analysis, interface design, coding, and testing/debugging. Each step can be independently assigned and completed quickly. Similarly, in film production, tasks such as special effects rendering and voice-over editing can be assigned to different teams through cloud-based collaboration platforms. This "breaking down into smaller parts" approach not only allows non-professional workers to participate in specific tasks after short-term training but also reduces a company's long-term reliance on a single labor force, enhancing market adaptability. The essence of task decomposition is to broaden the scope of labor participation by reducing complexity, while improving the flexibility and efficiency of resource allocation.

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2.2. Crowdsourcing model: efficiency revolution in distributed collaboration

Crowdsourcing, as an extension of task decomposition, relies on digital platforms to integrate decentralized labor resources and form dynamic collaboration networks. Crowdsourcing harnesses the power of the crowd to accomplish a single task. Examples include Wikipedia's open editing, Amazon's Mechanical Turk micro-task contractors, and InnoCentive's crowd-sourced problem-solving challenges [3]. Crowdsourcing offers advantages such as low cost, fast speed, and the stimulation of creativity: businesses can save labor costs through bidding or task-based payments; labor forces distributed across the globe can quickly respond, shortening task cycles. For instance, 99designs can select the best design within 24 hours. Multi-party participation and interaction stimulate creativity, resulting in breakthrough solutions, as seen in open-source communities driving technological innovation. However, crowdsourcing also presents quality assurance challenges. To balance speed and quality, algorithms (such as historical ratings), task segmentation (distinguishing simple from complex tasks), and incentive mechanisms (such as graduated rewards) must be employed to ensure the reliability and professionalism of the final output.

2.3. Optimization of human capital allocation: from fixed matching to dynamic adaptation

The combination of task decomposition and crowdsourcing drives the transformation of human capital allocation from a "fixed position - long-term service" model to an "on-demand combination - dynamic matching" approach. Digital platforms use data, algorithms, and recommendations to match labor with skills accurately, achieving precise "person - job" alignment. For example, the Upwork platform recommends suitable positions to freelancers based on their project experience, user ratings, and tag matching; the ZBJ platform automatically allocates design tasks to different-level designers according to task difficulty through its intelligent task assignment system. This dynamic matching mechanism not only enhances workers' productivity but also activates the labor resources of other groups through the long-tail effect, such as retired engineers providing technical guidance or housewives taking on data labeling tasks. On the other hand, the activation of human capital is reflected in the reconstruction of "skill combinations." Workers involved in cross-domain and cross-industry crowdsourcing tasks can develop versatile skills. For instance, programmers can acquire various skills in both software development and design tasks, enhancing their market competitiveness. This process not only increases economic income but also provides more career development opportunities for individuals. However, such development requires the supporting improvement of platform governance, including labor rights protection, skills training support, and increased algorithm transparency, to balance efficiency and fairness, thereby driving improvements in human capital through digital technology.

3. The Real dilemmas of digital gig work

3.1. The absence of rights and legal protection

The nature of digital gig work labor contracts is unclear, and platforms commonly avoid labor regulations by classifying workers as "independent contractors." As a result, workers are excluded from labor rights protections such as minimum wage, social security, and work injury compensation. For instance, delivery riders are unable to obtain work injury compensation in the event of an accident, as platforms avoid responsibility by classifying them as "non-employees" [4]. In addition, workers lack the right to collective bargaining, with platforms setting rules (such as commission

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rates and service conditions), resulting in an imbalance of rights. The legal system is unable to address the decentralization of platforms, leaving workers in a legal vacuum when it comes to defending their rights.

3.2. Income instability and algorithmic invisible control

Gig workers are highly dependent on market demand fluctuations and platform algorithms. Ride-hailing platforms can adjust prices during peak periods, while delivery riders are threatened with "ratings" and are subject to platform-imposed speeding policies, leading to "algorithmic chaos." Platforms distribute business risks through invisible control mechanisms, such as adjusting commission rates and order assignment logic. The real income of gig workers is highly uncertain, with a lack of long-term security, leading to significant economic insecurity.

3.3. Limited career development and skill accumulation challenges

The fragmented nature of gig work hinders systematic skill accumulation and career growth. Freelance designers on crowdsourcing platforms often take on low-value tasks for extended periods, becoming trapped in a "task-completion" cycle, with no opportunities for technical specialization or cross-disciplinary learning. The platform economy lacks clear promotion pathways, and workers struggle to earn higher income or gain social recognition through experience. The short-term nature of skill requirements further weakens workers' competitiveness, creating structural bottlenecks in career development.

3.4. Lack of social security and institutional disconnect

Traditional social security policies are insufficient to include gig workers, and workers are forced to bear the costs of retirement, medical care, and other benefits. For example, ride-hailing drivers must pay for vehicle inspections, fuel, and social insurance, which severely reduces their income. Furthermore, existing systems are poorly adapted to the platform economy, with flexible social security policies having low coverage. Platform companies lack the initiative to provide social security, creating a dual paradox between system and technology. Platforms control the labor process through algorithms, shifting the risks onto workers and exacerbating resource distribution inequalities and social injustice.

4. A new paradigm for digital gig work participation: focused on technological advancement and automation substitution

4.1. Technology-driven intelligent matching and labor collaboration

Technological development provides more efficient resource allocation methods for digital gig work participation. The widespread adoption of technologies like artificial intelligence (AI) and big data has driven the labor supply and demand transition from "coarse matching" to "fine matching." For example, intelligent algorithms can identify fluctuations in market demand, worker skill characteristics, and geographical distribution, improving matching efficiency and reducing mismatches. By integrating automation tools (e.g., RPA robotic process automation) with gig labor, repetitive, rule-based tasks (such as data entry and basic customer service) can be assigned to intelligent tools, while more complex tasks such as creative design and comprehensive analysis are

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given to gig workers. This approach not only saves and frees up human resources but also boosts labor productivity, enabling collaboration between human workers and robots.

4.2. Decentralized platforms and the reconstruction of new labor relations

Blockchain technology provides new pathways for labor relationship transparency and rights protection. Distributed platforms based on smart contracts encode labor agreements, task allocation, and payment processes as immutable on-chain records, making the rules publicly transparent. For instance, gig workers automatically receive payments via contracts, avoiding platform delays or underpayment. Furthermore, the DAO (Decentralized Autonomous Organization) model explores decentralizing traditional platform control, where gig workers participate in platform rule-making through token governance, ensuring profit-sharing and risk-sharing. This new form of labor relationship empowers workers with technology, breaking the power imbalance caused by "algorithmic hegemony."

4.3. Building a linkage mechanism for skill upgrades and lifelong learning

In the face of automation-driven displacement, the gig economy needs to shift from "single short-term tasks" to "composite long-term capabilities" [5]. Digital platforms can integrate online learning platform resources and micro-certification systems, providing workers with on-demand modular courses. For example, Coursera, a programming learning platform, collaborates with Upwork, a freelancing platform, to offer training on emerging technologies like AI and blockchain, while awarding skill certificates to enhance employment competitiveness. At the same time, governments and businesses may provide tax incentives or subsidies to encourage workers to engage in lifelong learning, creating a positive feedback loop of "skill enhancement - employment - income increase."

4.4. Adaptive systems and inclusive social security

Technological progress calls for policy framework adjustments. On one hand, labor laws should incorporate the concept of "third-party workers" and clearly define the rights of certain gig workers (e.g., minimum income guarantees, occupational injury insurance), maintaining flexibility in relevant regulations. For instance, California's AB5 bill attempts to include some gig workers under employee status, requiring platforms to provide them with benefits. On the other hand, the social security system should design flexible contribution models that allow workers to pay a proportionate amount of pension and medical insurance based on wage fluctuations, while ensuring portability of benefits through cross-platform data integration. A tripartite collaboration between the government, platforms, and workers will be key to addressing institutional disconnections.

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