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Research Article

The Evolution Game of Network Platform Employment Governance

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Network platform employment management concerns the sustainable development effect of high-quality employment. However, new forms of employment in recent years have revealed many new employment problems, such as ineffective supervision of the laborer, the difficulty of defining the employment relationship between platform enterprises and laborers, and the chaotic evaluation and statistical standards of network platform employment. To achieve high-quality employment goals, an evolutionary game model between platform organization and platform enterprises, in which laborer supervision was considered, was theoretically constructed in this study. The evolutionary stability of each participant's strategy choice was analyzed, the influence of each factor on their strategy choice was explored, and the stability of the balancing point in the game system was further analyzed. The results of this study are as follows. (i) The laborer supervision has a significant impact on the "Compliance" behavior of platform enterprises and the "Strict-control" strategies of the platform organization. (ii) It is more conducive to strengthen laborer supervision and improve the platform enterprises' conduct code. (iii) The platform organization should give full play to the laborers' supervision utility in the design of the employment recommendation system. (iv) In order to achieve high-quality employment, mutual trust and a harmonious relationship between the platform organization and platform enterprises should be constructed. This study not only proposes an evolutionary game model of network platform employment governance but also advances policy and practical guidance for platform organizations and platform enterprises to accelerate the sustainable development of high-quality employment.

1. Introduction

Over the past decade, new employment modes such as maker, wit-key, two-guest, and circle guest have set off a wave of new forms of employment [1]. These new forms of employment are the product of the new economy and constitute a new employment mode spawned by the digital economy in the context of a science and technology revolution [2–4]. At present, the connotation, denotation, and implementation framework of digital innovation have been widely discussed in academic circles [5]. The new forms of employment have created a new employment space, alleviated employment pressure, and optimized employment policies, as well as promoting the characteristics of flexible relationships, fragmentation of work, and disorganization of work arrangement [3]. In 2015, the Central Committee of the Communist Party of China developed the "13th Five-Year Plan for National Economic and Social Development" and also proposed to strengthen the support for flexible employment and new employment forms to promote laborers' autonomous employment. This can be seen as a new form of flexible platform employment that serves to promote higher quality and fuller employment, thereby affording greater employment opportunities in the future.

In terms of new forms of employment governance, scholars have mainly examined its connotations from two perspectives: chance and challenge. Because the new forms of employment create challenges for traditional labor

relations, they also entail new requirements for their governance. Current employment concepts and statistical calibers have been unable to clearly define the new employment form that has emerged [6]. Under the traditional employment form, the employment rate, unemployment rate, labor market participation rate, and other indicators of the national and local Bureaus of Statistics are generally used to measure the changes in the employment market. The rise of new forms of employment has increased mobility and flexibility in the workforce, and employment and unemployment are increasingly difficult to measure as multiple part-time jobs, freelancing, and liquid self-employment have disrupted traditional definitions and measures [7, 8]. The sensitivity of the employment index system of the traditional employment market can hardly reflect the changes of the new employment forms.

In terms of the relationship between the laborer and platform enterprises, the new forms of employment and employment mode challenge the traditional labor relationship mode and operation mechanism. In the new employment mode, labor relations are reshaped [9], work and employment are separated, workers' attachments to employers become loose, and work independence is enhanced [10]. In the traditional form of employment, employers and workers establish labor relations by signing labor contracts, and the laws and systems related to workers' rights and interests are all established through labor contracts and labor relations. The new employment form arises from the virtualization of the employment relationship and separation from the workplace. Unable to use many of the labor relations determined by the legal system under the traditional labor relations [11], the legitimate rights and interests of workers, such as the rights of remuneration, rest and vacation, and labor safety, are difficult to guarantee. Under the traditional form of employment, trade union workers safeguard their legitimate rights and interests on behalf of all workers. Under the new form of employment, workers find it difficult to join or to be fully covered by trade unions, and the ability of current trade union organizations to safeguard the rights and interests of workers is weakened [12].

The employment governance of the network platform under the new form of employment involves multidimensional governance [13], which it is thus necessary to coordinate to resolve network platform employment problems. Under the new employment form, the platform organization and platform enterprises primarily have the role of employment management, and the relationship between workers and the platform enterprise is new, loose, and alienated [14]. The relationship between the platform organization and enterprises is no longer a simple service relationship, so the traditional employment management mode cannot resolve the problems or demands arising as the relationship between the platform organization and enterprise changes. Management practice has also gradually developed to address similar problems in the relations between employees and enterprises, management and governance issues [15], and the supervision of enterprise behavior in the platform ecosystem [16]. Some scholars have argued that with the new form of employment, the government should decentralize by establishing government-led enterprises, training institutions, and market and social organizations in which individuals and other social organizations participate, thereby encouraging competition among multiple employment service supply patterns and facilitating the diversification of the institutions supplying employment services and of supply mode [17]. Some have argued that the market economy should play a regulatory role in the governance of the new employment form [18], while others have pointed out the major role that training institutions and the supporting role of social organizations should play in the governance of the new employment form [19].

New employment forms under a platform arise from the fact that the service platform is paid to provide talent demand information, so essentially the platform organization and platform enterprise have an economic exchange relationship; thus, due to the limited rationality of trading on both sides through the pursuit of self-interest maximization, a process of game learning for strategy selection will arise, so its evolution can be modeled with game theory to better reflect the strategy selection of both sides. In terms of evolutionary games, there are many game-theoretic algorithms that have been applied in a wide variety of fields, such as management, information science, and computer science. The mechanism of the evolution of the relationship between platform enterprises and employees under the background of a sharing economy has been discussed, and the evolutionary game model of the employee relationship with platform enterprises was built by introducing considerations of platform user supervision [14]. The reputation incentive mechanism has been addressed from the point of the game theory, and the prisoner's dilemma in mobile crowdsensing has been discussed [20]. Similarly, another study constructed an evolutionary game model of an integrated "platform sellers-platform e-commerce-government" system to analyze the internal formation mechanism of the "regulatory dilemma" of platform e-commerce credit [21]. The most stable choices of each game party in the development path of network public opinion have been deeply explored based on game theory [22]. An evolutionary game model with third-party platform enterprises in a sharing economy was constructed to carry out competitive and complementary strategic cooperation with other enterprises [23]. A Stackelberg game was used to analyze the behavior of contributors and find their optimal strategies, and two-stage and multistage contributor game models for two scenarios were formulated, for which it was proved that a Stackelberg equilibrium exists and is unique [20]. Similarly, in another study Stackelberg game modeling was used to design the entirety of the interaction process as a kind of incentive mechanism, and the optimal strategy for both sides of the game was analyzed through reverse induction. The existence and uniqueness of Stackelberg equilibrium in the two-stage game were proved, and a genetic optimization algorithm was designed to quickly obtain the optimal strategy for both sides of the game [24].

To sum up, earlier studies have focused on qualitative analyses and the development of models of high-quality employment. There have been very few pieces of research on

the convergence of employment governance, and there is a dearth of research analyzing major stakeholders' behavior strategies. The relationships between major stakeholders and the methods for evaluating digital network governance have been systematically explained, but there is a lack of research on macropolicies and microcountermeasures from the perspective of improving the development of high-quality employment [25]. Moreover, with the rise of platform employment, the relationship between stakeholders is more complex, and their conflicts have deepened. Evolutionary game theory can thus better describe the problems in the development of platform employment.

Accordingly, an evolutionary game model of a "platform organization-platform enterprise" system in platform employment will be established in this study. The balancing solution of the model will be analyzed by introducing the laborer as a third party. From a theoretical perspective, the research perspective and method of network platform employment governance will be established in this study, and on a practical level, policy guidance and practical guidance for platform employment will be advanced with a view to accelerating the long-term evolution of platform employment under new employment forms.

This paper makes the following innovative points: (1) This study clarifies the relationship between platform organization and platform enterprises. Based on the bounded rationality of the participants, research on the relationship between platform organization and platform enterprises under the new form of employment is conducive to solving the problem of false employment information on the platform and optimizing the employment environment. (2) This study shows that the use of evolutionary game theory to analyze the evolutionary game process of platform enterprise strategy choice is beneficial for finding the balancing state of each strategy. (3) This study introduces laborer participation into the analysis of the impact of supervision on employment management, thereby improving the match of employment information on the platform and helping achieve high-quality employment.

The rest of this paper is structured as follows: The model variables and assumptions are proposed, and the evolutionary game model is constructed in Section 2. In Section 3, the evolutionary stability strategies in different situations are discussed. Section 4 presents a numerical simulation analysis and illustrates the impact of laborer supervision on these strategies. In Section 5, the conclusions of this study, suggestions for future research directions are summarized.

2. Materials and Methods

Under the background of sharing economy, the relationship between the network platform organization and platform enterprises is essentially that of strangers. The platform enterprise provides the platform with planning information on talent demand to the platform, and the platform organization transmits the demand information to the employment service system according to the requirements of the platform enterprise. The platform organization has the responsibility of supervising the platform enterprise. Due to the bounded rationality of the participants there are two employment management strategies available to the platform organization: "Strict Control" and "Non-Strict Control." The platform enterprise can employ two strategies in the network employment governance process: "Compliance" and "Noncompliance." At the same time, because of information asymmetry, the two sides find it difficult to make optimal decisions at one time. During a long period of imitation and learning, both sides will constantly adjust their strategies, finally reaching a balanced and stable state. In addition, as the third party, the laborer's real evaluation and supervision of the employment information released by the platform will affect the decision-making of the platform organization and platform enterprise.

2.1. Model Variables and Assumptions. This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, the interpretation, and the experimental conclusions that can be drawn.

Hypothesis 1 (H1): Assume that the probability of the platform organization choosing a Strict Control strategy is x and $0 \le x \le 1$, and that of choosing a nonstrict control strategy is $1 - x$. Further assume that the probability of the platform enterprise choosing the compliance strategy is y and $0 \le y \le 1$ and that of adopting the noncompliance strategy is $1 - y$.

Hypothesis 2 (H2): When the platform organization takes strict control measures and the platform enterprise chooses compliance behavior, the platform organization's primary benefit is R_p and it incurs the cost C_p. The net income is then $R_p - C_p$. The platform enterprise's benefit is R_e and it incurs the cost C_e. The platform enterprise's net income under this strategy is then $R_e - C_e$.

Hypothesis 3 (H3): When the platform organization chooses the nonstrict Control strategy and the platform enterprise chooses the Compliance behavior strategy, the platform organization obtains a revenue of R_p and the platform enterprise a revenue of $R_e - C_e$.

Hypothesis 4 (H4): When the platform organization adopts strict control measures and the platform enterprises choose the Noncompliance behavior strategy, if the behavior of platform enterprise is discovered, it will be punished by the platform organization by an amount equal to all earnings. Assuming that the platform enterprise obtains extra income M through noncompliance, in addition to R_e, the platform organization then eventually earns $R_p - C_p + R_e + M$ and the platform enterprise's earnings are $-C_e$.

Hypothesis 5 (H5): When the platform organization follows the nonstrict Control strategy and the platform enterprise chooses the noncompliance behavior strategy, the revenue of the platform organization and platform enterprise will also be affected by the laborer. If the platform enterprise chooses

Table 1: The benefit matrix of game revenue between the platform organization and platform enterprise based on laborer supervision.

Platform enterprise	Platform organization	
	Strict control x	Nonstrict control $1-x$
Compliance y	$(R_p - C_p, R_e - C_e)$	$(R_p, R_e - C_e)$
Noncompliance $1-y$	$(R_p - C_p + R_e + M - C_e)$	$((1-\alpha)R_p - \alpha C_{p1}(1-\alpha)(R_e + M) - C_e - \alpha C_{e1})$

Note. That the expected value of the platform organization adhering to strict control is E_{p1} and the expected value of adopting nonstrict control is E_{p2}, with an average expected value of E_p.

to violate the rules and the platform organization does not control it, then the laborer may take note and complain about the mismatch of online employment information. For example, Facebook users may divulge their employment information and give negative comments to them, which will restrain the illegal behaviors of platform enterprises to a certain extent. Therefore, α is used to indicate the intensity of the laborer supervision, where $0 < \alpha < 1$. If $\alpha = 0$, the income of the platform enterprise is $R_e + M - C_e$, and the income of the platform organization is R_p. If $0 < \alpha < 1$, the laborer plays a supervisory role, and the platform organization will be held accountable by the laborer for its lack of supervision and bear the reputation loss fee C_{p1}. Thus, its final profit will be $(1-\alpha)R_p - \alpha C_{p1}$. The platform enterprise will bear the reputation loss fee C_{e1} and service cost C_e, so its final income will be $(1-\alpha)(R_e + M) - C_e - \alpha C_{e1}$.

2.2. Construction of the Game Model. On the basis of the foregoing assumptions, the strategic combinations between platform organization and platform enterprise can be obtained as shown in Table 1.

$$\begin{aligned} E_{p1} &= y\left(R_p - C_p\right) + (1-y)\left(R_p - C_p + R_e + M\right), \\ E_{p2} &= yR_p + (1-y)\left[(1-\alpha)R_p - \alpha C_{p1}\right], \\ E_p &= xE_{p1} + (1-x)E_{p2}. \end{aligned} \tag{1}$$

Note that the expected value to the platform enterprise of the compliance behavior strategy is E_{e1}, and the expected value of the noncompliance behavior strategy is E_{e2}, with an average expected value of E_e.

$$\begin{aligned} E_e &= x\left(R_e - C_e\right) + (1-x)\left(R_e - C_e\right) = R_e - C_e, \\ E_{e2} &= x\left(-C_e\right) + (1-x)\left[(1-\alpha)\left(R_e + M\right) - C_e - \alpha C_{e1}\right], \\ E_e &= yE_{e1} + (1-y)E_{e2}. \end{aligned} \tag{2}$$

According to evolutionary game theory, the probability of the platform organization choosing the strict control strategy at the next time in the game process depends not only on the value x but also on the difference between the expected return of the strict control strategy and the average expected return. The larger the difference, the greater the probability of the platform organization choosing the strict control strategy. For platform enterprises, the probability of choosing the compliance behavior strategy is also influenced by the value of y and by the difference between their expected revenue and average expected revenue: The larger the difference, the more likely it is to choose compliance behavior. The evolutionary game between the platform organization and the platform enterprise in their strategy choices can be represented by replicating dynamic equations.

The replication dynamic equation of the platform organization is as follows:

$$\begin{aligned} F_x &= \frac{\mathrm{d}F(x)}{\mathrm{d}t} \\ &= x\left(E_{p1} - E_p\right) \\ &= x(1-x)\left(E_{p1} - E_{p2}\right) \\ &= x(1-x) \\ &\quad \cdot \left\{\alpha\left(R_p + C_{p1}\right) - C_p + R_e + M - y\left[\alpha\left(R_p + C_{p1}\right) + R_e + M\right]\right\}. \end{aligned} \tag{3}$$

If we set $F_x' = 0$, the balancing point is obtained: $x = 0$or $x = 1$ or $y_0 = 1 - C_p/\alpha(R_p + C_{p1}) + R_e + M$

The replication dynamic equation of the platform enterprise is as follows:

$$\begin{aligned} F_y &= \frac{\mathrm{d}F(y)}{\mathrm{d}t} \\ &= y\left(E_{e1} - E_e\right) \\ &= y(1-y)\left(E_{e1} - E_{e2}\right) \\ &= y(1-y) \\ &\quad \cdot \left\{\alpha\left(R_e + C_{e1} + M\right) - M + x\left[\left(R_e + M\right) - \alpha\left(R_e + C_{e1} + M\right)\right]\right\}. \end{aligned} \tag{4}$$

If we set $F_y' = 0$, the balancing point is obtained: $y = 0$or $y = 1$ or $x_0 = M - \alpha(R_e + C_{e1} + M)/R_e + M - \alpha(R_e + C_{e1} + M)$

The Jacobian matrix of the equation is as follows:

$$\begin{aligned} J &= \begin{pmatrix} a_{11} & a_{12} \\ a_{22} & a_{22} \end{pmatrix}, \\ a_{11} &= (1-2x) \\ &\quad \cdot \left\{\alpha\left(R_p + C_{p1}\right) - C_p + R_e + M - y\left[\alpha\left(R_p + C_{p1}\right) + R_e + M\right]\right\}, \\ a_{12} &= x(x-1)\left[\alpha\left(R_p + C_{p1}\right) + R_e + M\right], \\ a_{21} &= y(1-y)\left[\left(R_e + M\right) - \alpha\left(R_e + C_{e1} + M\right)\right], \\ a_{22} &= (1-2y) \\ &\quad \cdot \left\{\alpha\left(R_e + C_{e1} + M\right) - M + x\left[\left(R_e + M\right) - \alpha\left(R_e + C_{e1} + M\right)\right]\right\}. \end{aligned} \tag{5}$$

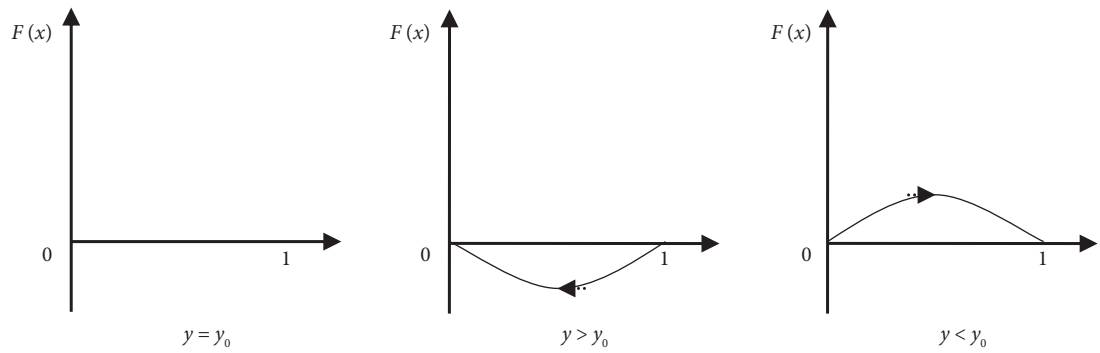

Figure 1: Replicated dynamic phase diagram of the platform organization.

3. Analysis of the Evolutionary Game

3.1. Evolutionary Game Analysis of the Platform Organization. The probability of the platform organization taking strict control measures evolves according to its replication dynamic equation. When $F_x = 0$, $x_1 = 0, x_2 = 1$, and $y_0 = 1 - C_p/\alpha(R_p + C_{p1}) + R_e + M$.

When $y = y_0$, $F_x \equiv 0$ and x is in a stable state within the range [0,1]. In other words, the probability of the platform organization taking the strict control strategy remains unchanged when the probability of the platform enterprise choosing the compliance behavior strategy is $1 - C_p/\alpha(R_p + C_{p1}) + R_e + M$.

When $y > y_0$, $\alpha(R_p + C_{p1}) - C_p + R_e + M - y[\alpha(R_p + C_{p1}) + R_e + M] < 0$, and $x^* = 0 \text{or } x^* = 1$ are the two stable states. When $x^* = 0$, $F'(x^*) < 0$, $x^* = 0$ is an evolutionarily stable strategy. The probability of the platform organization taking the strict control strategy will decrease, eventually tending to 0 when the probability of the platform enterprise choosing the compliance behavior strategy is greater than $1 - C_p/\alpha(R_p + C_{p1}) + R_e + M$ after a long-term evolution process, showing that the platform organization will choose nonstrict control strategy.

When $y < y_0$, $\alpha(R_p + C_{p1}) - C_p + R_e + M - y[\alpha(R_p + C_{p1}) + R_e + M] > 0$, and $x^* = 0 \text{or } x^* = 1$ are the two stable states. When $x^* = 1$, $F'(x^*) < 0$, $x^* = 1$ is the evolutionarily stable strategy. The probability of the platform organization taking the strict control strategy will increase, tending to 1 when the probability of the platform enterprise choosing compliance behavior is less than $1 - C_p/\alpha(R_p + C_{p1}) + R_e + M$ after a long-term evolution process. This shows that the platform organization will take the strict control strategy. The replication dynamic phase diagram of the platform organization is shown in Figure 1.

3.2. Evolutionary Game Analysis of the Platform Enterprise. The probability of the platform enterprise adopting compliance behavior evolves according to its replication dynamic equation. When $F_y = 0$, $y_1 = 0, y_2 = 1$, and $x_0 = M - \alpha(R_e + C_{e1} + M)/(R_e + M) - \alpha(R_e + C_{e1} + M)$.

When $x = x_0$, $F_y \equiv 0$, and y is in a stable state within the range [0, 1]. That is, when the probability of the platform organization choosing strict control is $M - \alpha(R_e + C_{e1} + M)/(R_e + M) - \alpha(R_e + C_{e1} + M)$, the probability of the platform enterprise taking compliance behavior remains unchanged.

When $x > x_0$, $\alpha(R_e + C_{e1} + M) - M + x[(R_e + M) - \alpha(R_e + C_{e1} + M)] > 0$, and $y^* = 0 \text{or } y^* = 1$ are the two stable states. When $y^* = 1$, $F'(y^*) < 0$. Then $y^* = 1$ is the evolutionarily stable strategy. With the long-term evolution process, the probability of the platform enterprise adopting compliance behavior increases and eventually tends to 1 when the probability of the platform organization choosing the strict control strategy is greater than $M - \alpha(R_e + C_{e1} + M)/(R_e + M) - \alpha(R_e + C_{e1} + M)$. This shows that platform enterprise will choose compliance behavior.

When $x < x_0$, $\alpha(R_e + C_{e1} + M) - M + x[(R_e + M) - \alpha(R_e + C_{e1} + M)] < 0$, and $y^* = 0 \text{or } y^* = 1$ are the two stable states. When $y^* = 0$, $F'(y^*) < 0$. Then $y^* = 0$ is the evolutionarily stable strategy. The probability of the platform enterprise taking compliance behavior will decrease and eventually tend to 0 when the probability of the platform organization choosing the strict control strategy is less than $M - \alpha(R_e + C_{e1} + M)/(R_e + M) - \alpha(R_e + C_{e1} + M)$ after a long-term evolution process. This shows that platform enterprise will choose Noncompliance behavior. The replication dynamic phase diagram of the platform enterprise is shown in Figure 2.

3.3. Stability Analysis of the System Balancing Point Based on the Laborer. According to evolutionary game theory, it can be concluded that the balancing points of the evolutionary game of the platform organization and platform enterprise need to satisfy $F(x) = 0, F(y) = 0$ at the same time. Five special balancing points of the evolutionary game are then obtained: $E_1(0,0), E_2(0,1), E_3(1,0), E_4(1,1), E_5(x_0, y_0)$. The values of the five balancing points yield the corresponding Jacobian matrices shown in Table 2.

If the balancing point satisfies the two conditions of $trJ < 0 \det J > 0$, the balancing point is the local asymptotically stable fixed point of the evolutionary dynamic process, corresponding to evolutionary stability. As shown in Table 2, the trace at the local balancing point $E_5(x_0, y_0)$ is equal to 0, which does not satisfy $trJ < 0$. Therefore, the balancing point $E_5(x_0, y_0)$ is not an evolutionarily stable point. Based on the above analysis, the evolutionary game model has four saddle points and one center point.

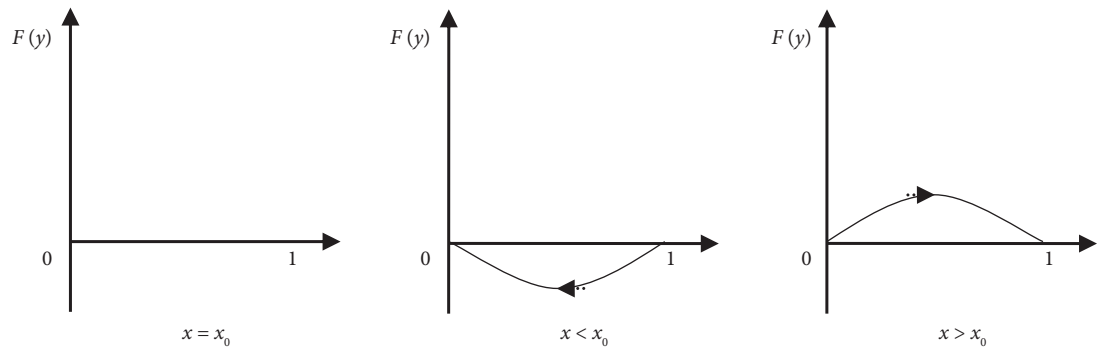

Figure 2: Replicated dynamic phase diagram of the platform enterprise.

Proposition 1. *When the laborer supervision intensity is in the interval* $0 < \alpha < \min(C_p - R_e - M/R_p + C_{p1}, M/R_e + C_{e1} + M)$*, the point* $E_1(0,0)$ *is ESS. The evolutionarily stable strategy is (nonstrict control, compliance).*

The evolution results show that the system evolves from an unstable point to the stable state (0, 0) through the saddle points (0, 1) and (1, 1). In other words, when laborer supervision is insufficient, platform enterprises will eventually choose to violate the regulations, while platform organizations will eventually adopt the nonstrict control strategy driven by self-interest maximization. Obviously, the stability strategy at this time does not meet the expectations of society. Therefore, it is necessary to introduce the laborer as the third party to supervise platform organizations and platform enterprises so as to reduce the moral hazard of platform employment under the new form of employment.

Proposition 2. *When the laborer supervision intensity is in the interval* $(M/R_e + C_{e1} + M, C_p - R_e - M/R_p + C_{p1})$*,*

(a) If α satisfies $M/R_e + C_{e1} + M < \alpha < \min(M + R_e/R_e + C_{e1} + M, C_p - R_e - M/R_p + C_{p1})$, the balancing point $E_2(0,1)$ meets the two conditions $trJ < 0 \det J > 0$, and then the point $E_2(0,1)$ is ESS. The evolutionarily stable strategy is (nonstrict control, compliance).

(b) If α satisfies $M + R_e/R_e + C_{e1} + M < \alpha < C_p - R_e - M/R_p + C_{p1}$, the balancing point $E_2(0,1)$ meets the two conditions $trJ < 0 \det J > 0$, and then the point $E_2(0,1)$ is ESS. The evolutionarily stable strategy is (nonstrict control, compliance).

The evolution results show that the system evolves from unstable point (1, 0) to stable state (0, 1) through the saddle points (0, 0) and (1, 1). In other words, when the laborer undertakes supervision, platform enterprises will regulate their own behaviors to reduce the reputation loss caused by laborer supervision. Meanwhile, the maximum benefits can be achieved when they choose compliance behavior. However, when platform enterprises choose noncompliance behaviors, platform organizations will benefit more when choosing the nonstrict control strategy, so laborer supervision is not sufficient to make platform organizations change their existing strict control strategy, although if the laborer increases supervision, this can restrain the behaviors of platform enterprises.

Proposition 3. *When the laborer supervision intensity is in the interval* $(C_p - R_e - M/R_p + C_{p1}, M/R_e + C_{e1} + M)$*, we find that there is no stable point in the evolutionary game under this condition according to the local stability condition of the Jacobian matrix.*

The evolution results show that the strategy choices of the platform organization and platform enterprise cannot reach a stable point. The game results for both sides have a certain randomness. The platform organization attaches great importance to the noncompliance behavior of the platform enterprise due to the loss of reputation through offences uncovered by the growing laborer supervision. The platform organization will the choose strict control strategy. However, the platform enterprise's offset is larger when choosing Noncompliance behavior, so the laborer supervision intensity is insufficient to shift platform enterprise's choice from noncompliance to compliance.

Proposition 4. *When the laborer supervision intensity is in the interval* $\max(C_p - R_e - M/R_p + C_{p1}, M/R_e + C_{e1} + M) < \alpha < 1$*,*

(a) If α satisfies $\max(C_p - R_e - M/R_p + C_{p1}, M/R_e + C_{e1} + M) < \alpha < M + R_e/R_e + C_{e1} + M$, the balancing point $E_2(0,1)$ satisfies the conditions $trJ < 0 \det J > 0$. The point $E_2(0,1)$ is then ESS; that is to say, the evolutionarily stable strategy is (nonstrict control, compliance).

(b) If α satisfies $\max(C_p - R_e - M/R_p + C_{p1}, M + R_e/R_e + C_{e1} + M) < \alpha < 1$, the balancing point $E_2(0,1)$ satisfies the conditions $trJ < 0 \det J > 0$, and the point $E_2(0,1)$ is then ESS; the evolutionarily stable strategy is (nonstrict control, compliance).

The evolution results show that the system evolves from the unstable point (0, 0) to the stable state (0, 1) through the saddle points (1, 0) and (1, 1). Platform enterprises are more inclined to adopt compliance behaviors while platform organizations will pay more attention to the noncompliances of platform enterprises and change the existing strict control strategy with the laborer supervision increasing. Therefore, platform organizations should ensure a larger space for laborer supervision

Table 2: Traces and determinants of the Jacobian matrices at the balancing points.

Balancing point	trJ	det$J$
$E_1(0,0)$	$[\alpha(R_p + C_{p1}) - C_p + R_e + M] + [\alpha(R_e + C_{e1} + M) - M]$	$[\alpha(R_p + C_{p1}) - C_p + R_e + M] \bullet [\alpha(R_e + C_{e1} + M) - M]$
$E_2(0,1)$	$-C_p + [M - \alpha(R_e + C_{e1} + M)]$	$-C_p \bullet [M - \alpha(R_e + C_{e1} + M)]$
$E_3(1,0)$	$-[\alpha(R_p + C_{p1}) - C_p + R_e + M] + R_e$	$-[\alpha(R_p + C_{p1}) - C_p + R_e + M] \bullet R_e$
$E_4(1,1)$	$C_p - R_c$	$-C_p \cdot R_e$
$E_5(x_0, y_0)$	0	$-R_e \bullet C_p \bullet [\alpha(R_p + C_{p1}) - C_p + R_e + M] \bullet [\alpha(R_e + C_{e1} + M) - M] / [R_e + M - \alpha(R_e + C_{e1} + M)] \bullet [\alpha(R_p + C_{p1}) + R_e + M]$

and regulate the behavior of platform enterprises by releasing employment information to optimize employment environment and improve employment quality.

Under this condition, the laborer evaluates employment information through various employment APP platforms and supervises platform enterprises. This has an increasingly strong influence that exerts great pressure on platform organizations and platform enterprises.

4. Simulation Analysis

In the evolution game, the changes of various parameters will have varying effects on the game's strategic choices, which will in turn influence the dynamic changes of the evolutionary process. Through simulation analysis, the validity of the game system stability will be confirmed and the evolution trend and speed of the game system in various scenarios will be analyzed. This study analyzes the static and dynamic reward and punishment measures in the game system by assigning parameter values and utilizing MATLAB tools to simulate the behavior of the evolution of platform organization and platform enterprise strategies. In order to reflect the current state of employment governance, we set parameters to assign values to various variables. Let us assume that the initial values of x, y are (0.1, 0.9) and (0.7, 0.3).

(1) As illustrated in Figure 3, the shape describes the evolution trend under the conditions of Proposition 1. Here let $R_p = 5, C_p = 2, R_e = 1, C_e = 0.2, M = 0.8, C_{p1} = 0.3, C_{e1} = 0.15, \alpha = 0.03$, where α satisfies $0 < \alpha < \min(C_p - R_e - M/R_p + C_{p1}, M/R_e + C_{e1} + M)$.

The evolution results show that regardless of the probability of the platform organization and platform enterprise choosing either of their respective strategies, the system tends to the balancing point $E_1(0,1)$ eventually. That is to say, the platform organization will adopt the nonstrict control strategy and the platform enterprise will choose the noncompliance strategy.

(2) The impact on the two participants' strategy selection is illustrated in Figure 4, describing the evolution trend under the conditions of Proposition 2 (a). Let $R_p = 4, C_p = 3, R_e = 0.8, C_e = 0.2, M = 0.4, C_{p1} = 0.13, C_{e1} = 0.15, \alpha = 0.3$, so that α satisfies $M/R_e + C_{e1} + M < \mu < C_p - R_e - M/R_p + C_{p1}$.

The evolution results show that when $\alpha = 0.3$, regardless of the probability of the platform organization and platform enterprise choosing either of their respective strategies, the system eventually tends to the balancing point $E_2(0,1)$. That is to say, the platform organization will adopt the nonstrict control strategy and the platform enterprise will choose the compliance strategy.

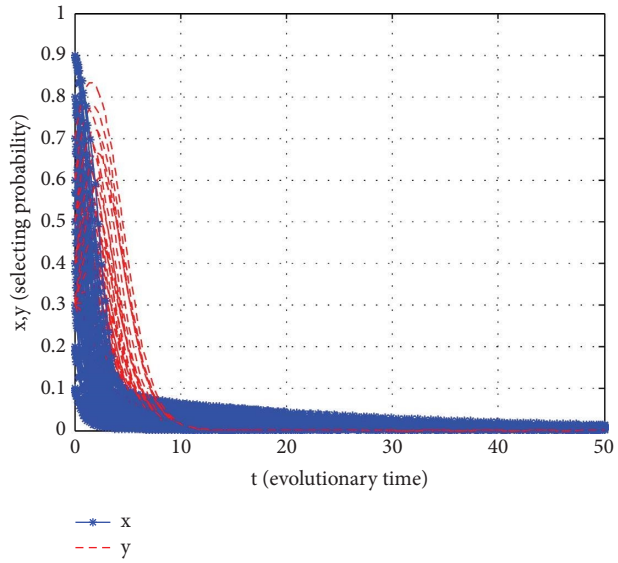

Figure 3: The evolutionary consequences of Proposition 1.

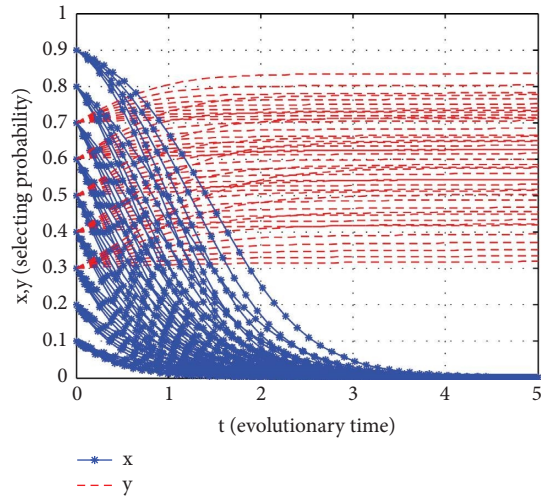

Figure 4: The evolutionary consequences of Proposition 2 (a).

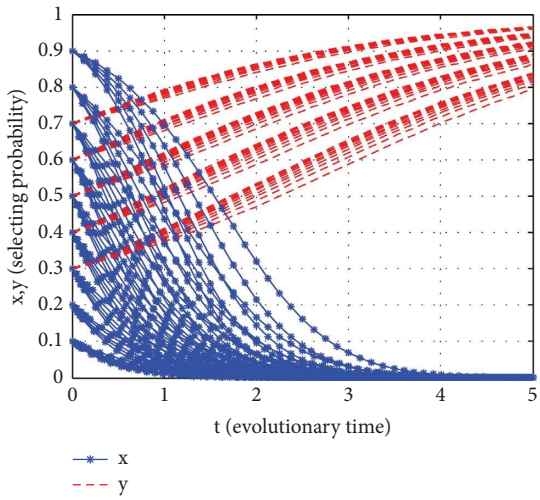

Figure 5: The evolutionary consequences of Proposition 2 (b).

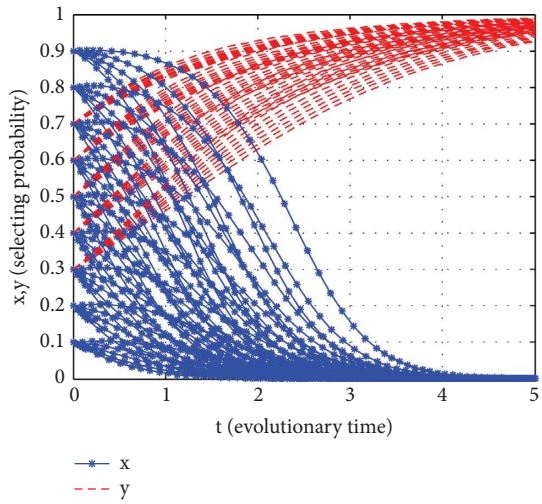

Figure 7: The evolutionary consequences of Proposition 4 (a).

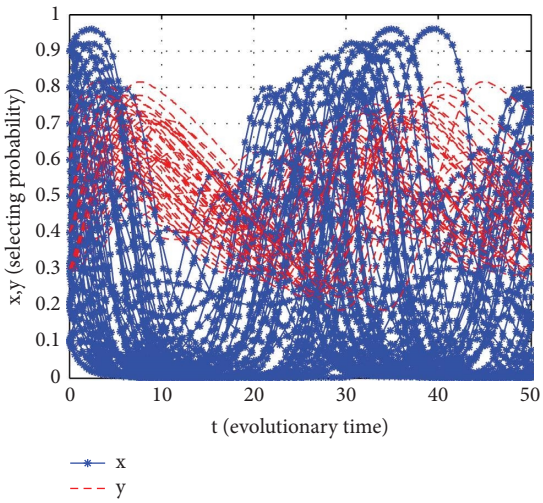

Figure 6: The evolutionary consequences of Proposition 3.

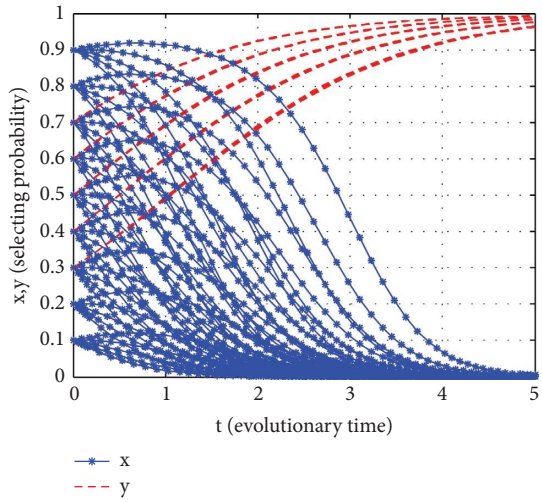

Figure 8: The evolutionary consequences of Proposition 4 (b).

(3) The impact on the two participants' strategy selection is illustrated in Figure 5, describing the evolution trend under the conditions of Proposition 2 (b). Let $R_p = 4, C_p = 3, R_e = 0.3, C_e = 0.2, M = 0.5, C_{p1} = 0.13, C_{e1} = 1.7, \alpha = 0.4$, where α satisfies $M + R_e/R_e + C_{e1} + M < \alpha < C_p - R_e - M/R_p + C_{p1}$. The evolution results show that when $\alpha = 0.4$, regardless of the probability that the platform organization and platform enterprise with choose either of their respective strategies, the system eventually tends to the balancing point $E_2(0, 1)$. That is to say, the platform organization will adopt the nonstrict control strategy and the platform enterprise will choose the compliance strategy.

(4) Figure 6 describes the evolution trend under the conditions of Proposition 3. Here, $C_p - R_e - M/R_p + C_{p1} < \alpha < M/R_e + C_{e1} + M$. Let $R_p = 3, C_p = 2, R_e = 0.4, C_e = 0.2, M = 1.5, C_{p1} = 0.5, C_{e1} = 0.4, \alpha = 0.6$. The evolution results show that when $\mu = 0.2$, regardless of the probability of the platform organization and the platform enterprise choosing either strategy, the evolutionary system is always in a state of fluctuation without a stable point. That is to say, the platform organization and platform enterprise will respectively depend on each other's choice when choosing their strategy.

(5) Figure 7 describes the evolution trend under the conditions of Proposition 4 (a). Here α satisfies $\max(C_p - R_e - M/R_p + C_{p1}, M/R_e + C_{e1} + M) < \alpha < M + R_e/R_e + C_{e1} + M$.

Let $R_p = 4, C_p = 3, R_e = 0.8, C_e = 0.2, M = 0.5, C_{p1} = 0.1, C_{e1} = 0.15, \alpha = 0.8$. The evolution results show that when $\alpha = 0.8$, regardless of the probability of platform organization and platform enterprise choosing either of their respective strategies, the system eventually tends to the balancing point $E_2(0, 1)$. That is to say, the platform organization will

adopt the nonstrict control strategy and the platform enterprise will choose the compliance strategy.

(6) Figure 8 describes the evolution trend under the conditions of Proposition 4 (b). Here α satisfies $\max(C_p - R_e - M/R_p + C_{p1}, M + R_e/R_e + C_{e1} + M) < \alpha < 1$.

Let $R_p = 4, C_p = 3, R_e = 0.2, C_e = 0.2, M = 0.5, C_{p1} = 0.13, C_{e1} = 0.1, \alpha = 0.95$. The evolution results show that when $\alpha = 0.8$, regardless of the probability of the platform organization and platform enterprise choosing either of their respective strategies, the system eventually tends to the balancing point $E_2(0, 1)$. That is to say, the platform organization will adopt the nonstrict control strategy and the platform enterprise will choose the compliance strategy.

5. Conclusions and Suggestions

Based on evolutionary game theory, this paper analyzes the control and employment governance of platform organizations over platform enterprises under the new forms of employment. According to the process of the evolutionary game and the numerical simulation results, the following conclusions are drawn: Laborer supervision can influence the strategy choices of platform organizations and platform enterprises. When the laborer supervision is insufficient, neither platform organizations nor platform enterprises can be adequately supervised; that is, they will not change their strategic choices. When laborer supervision is strengthened, the control measures of the platform organization and the operation behaviors of platform enterprises can be unilaterally supervised, and when laborer supervision is sufficiently strengthened, the platform organizations and platform enterprises will change their strategies to strict control and compliance if they suffer great reputational losses. Based on the above analysis, the following suggestions are made:

First, it is necessary to strengthen the platform enterprises so as to standardize the platform employment behavior, increase the compliance management incentives, and encourage the assumption of social responsibility. In terms of compliance operation incentives, compliant platform enterprises can be supported with preferential loan interest rates, exemptions, and tax relief. In terms of social responsibility, a platform-enterprise self-discipline alliance should be established to formulate standards of labor remuneration, safety inputs, and platform algorithm rules to improve the working environment and employment quality of workers.

Second, the platform organization should be strengthened to strictly control the dominant position among platform employment workers. The platform organization should guide and standardize the online employment industry and platform employment. In terms of industry norms, internal management is paralleled by external reputation construction. The platform organization should strengthen the supervision and guidance of platform operations, especially the qualification examination, employment management, salary settlement, and similar matters; strengthen the supervision of the laborer opinion; establish a new model of online and offline trade union work; and smooth the channels for expressing workers' interest demands. In terms of employment norms on the platform, the "employee sharing" mode should be adopted. It is suggested that local governments promote the implementation of nonlabor-relations personnel to participate in industrial injury insurance and other policies and ease the restrictions on nondomicile employees participating in the endowment insurance and medical insurance for urban employees in places of employment as flexible employment personnel. The guidance of the "shared employee sharing" mode constitutes not only an orderly regulation of business behavior but also a direct response to the rights and interests of workers under the omissions of the business model.

Third, the supervision of workers should be strengthened, and workers' awareness of rights protection should be improved. Workers should actively study labor laws and regulations, clarify the rights and obligations of individuals, and take measures to avoid damage to their legitimate rights and interests caused by platform enterprises avoiding employer responsibilities; meanwhile, when the legitimate rights and interests are violated, they should advocate for their legitimate rights actively and rationally.

This paper establishes an evolutionary game model of the relationship between the platform organization and the platform enterprise under the new form of employment, which aids in more deeply understanding the evolutionary logic of the new labor relationship and holds important theoretical significance and practical value. Accordingly, platform organizations should give full consideration to the evaluation of laborer utility and design reasonable entry rules and an effective platform service evaluation system when setting the barriers to entry on the platform for enterprises. This will enhance its convenience for effective laborer participation and encourage the platform organization's supervisory duties, which will also constrain noncompliance by platform enterprises regarding measures to build a good employment environment with real platform employment information. The relationship between the platform organization and platform enterprises will then be more harmonious. In the future, the government can be introduced in the role of collaborative supervision to analyze the evolutionary game process of government-platform organization-platform enterprise strategy choice.

Data Availability

The data used to support the fndings of this study are included within the article.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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Supplementary Materials

The manuscript data with Matlab code and the simulated figures in the system. (*Supplementary Materials*)

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