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The Impacts of Payment Policy on Performance of Human Resource Market System: Agent-Based Modeling and Simulation of Growth-Oriented Firms

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Abstract: The impact of human resource management (HRM) on corporate growth is a crucial research topic, especially for growth-oriented firms. This paper aims to study how different payment policies (such as recruitment and dismissal strategies and payment plans) affect the human resource market system. Based on the HRM characteristics of growth-oriented firms, we develop an agent-based model to simulate the decision-making and interaction behaviors of firms and workers. The system performance is measured by six indicators: the average profit, the profit Gini coefficient, the average output of firms, the average payment, the payment Gini coefficient, and the employment rate of workers. According to the simulation results and statistical analysis, the recruitment plan is the only key factor that significantly impacts all performance indicators other than the employment rate, and companies should pay extra attention to such plans. This study also finds that the changing worker's payment gap is influenced by industry growth and their abilities, and that the payment cap policy has a positive impact on the development of growth-oriented firms in the startup stage.

Keywords: growth-oriented firms; agent-based modeling; human resource management; payment management; simulation

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1. Introduction

The rapid development of global technology has given birth to more new industries and brought rapid changes in enterprise development. These growth-oriented companies have great potential for high returns on investment in the future, with certain advantages such as industry leadership, technology monopoly, or efficient management [1]. These companies usually show a certain degree of overall growth or improvement in production capacity, assets, market share, operation, management, and the capabilities of workers. Human resource management can create obvious value [2,3], and workers are key to firm innovation and growth and have proven to be crucial to growth-oriented firms [4,5]. Therefore, human resource management is also essential to the development of growth-oriented enterprises. However, along with rapid growth, companies face difficulties in hiring and high employee attrition due to improper management and appointments [6]. In addition, companies may also compete for talent with high salaries, which leads to heavier financial burdens [7].

The classic "4Ps" of human resource management (HRM) consist of personality management, position management, performance management, and payment management. Among them, payment management (also known as compensation management, salary

administration) serves as an essential tool for growth-oriented firms to recruit and manage talent, as it highlights the employer–employee relationship. It is a complex system that can be viewed from two perspectives. (1) Externally, payment management does not only relate to competitive job posts, but is also a key factor in recruitment [8]. Higher payments help to attract talent and improve the company's human capital. (2) Internally, payment management is associated with payment adjustments after orientation and is designed to ease the financial burden resulting from a mismatch between payroll costs and outputs. Public opinion and policy guidance also have impacts on firm payment management [9]. An excessive payment discrepancy within firms is likely to result in negative social discussion, which will be a detriment to corporate growth. To this end, some industries have already introduced initiatives or policies for payment caps. However, the existing literature on the payment management of growth-oriented firms mainly focuses on the influence factors. It thus cannot explain the relations between the strategical behaviors of HRM and the corporate progress of growth-oriented firms and worker payment, which is worth further investigation.

This paper investigates the impacts of payment strategies on the performance of growth-oriented firms based on the theoretical model of 3P1M, which is composed of four parts: (1) position, the payment aligned with the position; (2) performance, the payment in line with performance; (3) person, the payment for personal ability; (4) market, the payment in line with the growing needs of firms based on surveys and analyses of their counterparts in the same region. Due to the characteristics of growth-oriented firms, an agent-based model is developed in this paper to describe the above elements in workers' job search processes and the payment management decisions of firms, so as to study and verify the effects of different HRM strategies on system performance, worker payment, and employment, and provide suggestions and recommendations for growth-oriented firms. More specifically, this paper attempts to answer the following three questions.

Q1: Do the hiring and dismissal plans of a growth-oriented firm affect its performance?

Q2: Do the hiring and dismissal plans of a growth-oriented firm affect worker payment?

Q3: Does a payment cap policy partly contribute to the development of a growth-oriented firm?

The agent-based model proposed in this paper draws on the assumptions of the latest literature [8], and also considers the payment structure, job hunting, corporate recruitment, and dismissal [10], among other elements, in order to simulate real-life scenarios of payment management in growth-oriented firms. Supported by the experimental design, the simulation results show that the hiring plans of growth-oriented firms significantly affect both firm performance and worker payment, while dismissal plans do not. In addition, salary cap policies positively impact the early survival and development of growth-oriented firms. In general, motivation factors relating to growth-oriented firms' performance, workers' payment, the percentage of hiring and dismissal, payment cap policies, the distribution of emphasis on incentive payments, the focus on the firm's value, and the ratio of firms searched by workers are analyzed in the paper.

The contributions of this study can be summarized as follows. (i) In terms of methodology, it adopts the agent-based modeling and simulation approach, which enriches the literature by modeling the dynamic influence of heterogeneity and the interactions of enterprises and employees in HRM systems. (ii) In terms of research content, we successfully model the mechanisms of recruitment and payment strategies in growth-oriented enterprises, introduce the salary cap policy, and examine how these policies affect the performance of the HRM system. (iii) In terms of results, we design experiments to identify the factors with significant effects on performance indicators, conduct a sensitivity analysis, and summarize the managerial insights for various stakeholders.

The rest of the paper is organized as follows. Section 2 reviews the related literature; Section 3 introduces the method and data; we describe the model and agent interaction in Section 4; Section 5 describes the design of the simulation experiment; Section 6 analyzes the simulation results; Section 7 concludes the paper and suggests future research directions.

2. Literature Review

Human resources are very important for enterprise development and internal organization construction [11]. Costs from the loss of workers can negatively impact a firm's internal investment structure; hence, some institutions try to assess the needs of human resources [12] and companies tend to devise mechanisms to reduce the adverse impact of the uncertainty of human resources [13]. At the same time, the uncertainty is likely to cause risks, affecting organizational security [14]. Therefore, human resource management is essential. Since this paper aims to examine the human resource management strategies of growth-oriented enterprises, we review the literature on human resources and payment, as well as growth-oriented enterprises. The research gap is then identified in the final part of this section.

2.1. Human Resources and Payment

Considering that the management of human resources and payment is closely related to firm operations, especially to cost control, the previous literature has focused more on the influence factors of payment and on the prediction and estimation of payment. Some researchers focus on verifying the relationships between payment and various factors, including appearance [15], educational background [16,17], skills [18–20], gender [21], and race [22]. Aiming to better motivate workers, some studies explore how payment and incentive mechanisms can be designed to enhance worker performance in different contexts [23,24]. Gerhart (2017) [25] provides a whole framework of key developments on incentive pay and pay for performance (PFP) in the literature. Other studies focus on estimating and predicting payment and its change rules in practice. Hung and Lim (2021) [8] build models to predict unbiased salaries and conduct empirical testing with actual data. Meng et al. (2018) [26] build the Holistic Salary Benchmarking Matrix Factorization (HSBMF) model for the prediction and supplementation of missing payment data.

HRM and the relationship between pay gaps and corporate innovation have been studied using theoretical and empirical models [4,27]. However, such studies are susceptible to factors such as data availability and reliability and are less able to show the interactions and decision-making between firms and employees. For this study, the interaction between firms and workers is considered a system, and systematic thinking is adopted to describe the interactions between heterogeneous agents and discuss the influence factors of HRM, as well as the interplay of different factors.

The conventional research on corporate payment focuses on whether a factor comes into play through the dominant lenses of empirical studies [8,16,28]. As the study of factors and complex mechanisms has been developed, that of theoretical models has expanded as well, and some scholars have begun to use the models for optimization problems and game theory. For example, Wang et al. (2019) [23] created a game model between streamers and unions in the context of a sharing economy, in order to determine the optimal pay mechanisms and influence factors for unions. In addition, new technologies have been generated and applied in studying human resources, including blockchain technology [29,30], big data [31], artificial intelligence [32,33], and machine learning [34], etc. In contrast, this paper employs a bottom-up agent-based modeling and simulation approach to show the interactions between agents [35] and to study the impacts of various strategies for hiring and dismissal based on employment and corporate performance.

2.2. Growth-Oriented Firms

Growth-oriented firms generally refer to companies in their growth stages, which entails an assessment of the development stage. They are, according to their development, usually small and medium-sized enterprises (SMEs) or enterprises in innovative industries, which have many aspects in common: for example, compared with large businesses with expensive information systems and hierarchies, growth-oriented firms tend to be more innovative, pay more attention to customer needs, and respond more quickly to consumer markets and technological changes [36,37]. These companies usually emphasize front-end

control over key technologies or emerging areas, have a flat organizational structure, and pay little attention to HRM and other non-technical departments. When skilled workers do not receive timely and reasonable payment as feedback, they tend to leave to pursue better offers. Meanwhile, the demand for talent also drives firms to continue seeking new recruits or skilled workers to quickly turn a profit for upcoming corporate operations [38]. Combined with the characteristics of growth-oriented firms, this paper focuses on the influencing mechanisms of recruitment, payment, and development, and provides insights into HRM for such firms by exploring HRM's key factors.

There has been broad yet generalized research on growth-oriented firms, which can be divided into two aspects in the context of this paper: internal management and external impacts.

Internal capabilities in firms are analyzed from the perspective of internal management. The relationship between corporate absorptive capacity and organizational responsiveness has drawn scholars' attention in enterprise management. For example, Liao et al. (2003) [36] took growth-oriented SMEs as the research object and external knowledge acquisition and internal knowledge dissemination as indicators to measure corporate absorptive capacity. Some studies have built on the contexts of specific countries—for example, comparing the similarities and differences between growth-oriented firms in Russia and the United States in terms of the relationship between absorptive capacity and organizational responsiveness [39] and studying the relationship between absorptive capacity and organizational performance (OP) in Colombian firms [40], among others. In terms of corporate growth promotion, Hansen and Hamilton (2011) [37] adopted an inductive approach to analyze the impacts of four factors, namely the opportunistic perception of the external environment, the owner–manager's controlled ambitions, the culture of innovation and flexibility, and extensive private business networks. Theodorakopoulos and Figueira (2012) [41] illustrated how strategic leadership can support the development of knowledge-intensive, growth-oriented small firms by developing organizational learning capabilities.

The impacts of external factors on corporate development are considered as well. The external environment significantly influences firm growth and receives attention and support from the government and society. Extraordinary business opportunities and extraordinary resource endowments would explain the rapid growth of these firms [42], and such elements as economic growth [43], knowledge creation [44], knowledge spillovers [45], the entrepreneurial culture [46], talent [47], intermediate services, networks [48], and finance [49] all play critical roles in driving the prosperity of high-growth firms [5,50]. These factors also explicate why firms enjoy different development degrees in different regions. Due to major challenges such as the pandemic and the acceleration of the transition to digital technologies, the labor market landscape and human resource policy priorities have undergone significant changes. For instance, new jobs, methods, and innovative practices have appeared [51,52]. In addition, the impacts on and countermeasures of growth-oriented firms when struck by external contingencies, e.g., the COVID-19 pandemic, have also attracted attention [53].

2.3. Summary of the Literature and the Research Gap

Relevance and difference of research questions: from the above literature review, talent and knowledge are crucial to the development of growth-oriented firms, and talent is the carrier of knowledge progress, dissemination, and application, which makes recruitment essential for both short-term and long-term business operations. Therefore, HRM is vital to business management improvement, and its recruitment and payment plans are essential to talent recruitment. However, previous researchers mainly discuss the influence factors and salary prediction, and they seldom consider the influence of the interaction behaviors and strategies of various agents in HRM on enterprise development. To address this research gap, this paper explores the influencing mechanism between recruitment, payment, and

the development of growth-oriented firms, and incorporates the payment cap policy to display the features of the changing mechanism holistically.

Relevance and differences of methodologies: from the literature review, it is clear that existing research mainly adopts empirical approaches to prove the influence between different factors. However, few studies take the firm and the worker as agents to study their interaction, and there is little research related to agent heterogeneity. To address this research gap, this paper takes the firm and the worker as agents to build an agent-based model [54] and studies their interplay during optimization. Meanwhile, an experiment is designed to demonstrate the influences of significant factors, providing an analytical perspective and recommendations for corporate recruitment and payment management.

3. Method and Data

3.1. Method

Agent-based modeling is a bottom-up modeling and simulation research method for complex adaptive systems [55]. Agents are often viewed as autonomous entities interacting with other agents and the environment to achieve predefined objectives. By setting agents' attributes and behavior rules, complex systems can be simulated to test the impacts of individual behaviors and interactions on the system's performance [35,54,56,57].

This paper aims to analyze how enterprises' hiring and dismissal plans and payment policies affect the interactions between firms and workers, as well as the performance of the HRM system. Given the importance of their interactions, it is appropriate to use the agent-based modeling approach to investigate these research questions. Therefore, we build an agent-based model, in which the agents are characterized by bounded rationality and heterogeneity, and their interactions are also modeled reasonably.

3.2. Data

The companies listed on the sci-tech innovation board usually have the characteristics of a short establishment time and a small scale, but they have great development potential. Meanwhile, the sci-tech innovation board focuses on supporting startups with new information technology, high-end equipment, and other emerging technologies. Therefore, the characteristics of sci-tech innovation board enterprises are widely treated as those of growth-oriented firms [36,37]. In addition, due to the difficulty in obtaining relevant data on growth-oriented enterprises (non-listed), we collected data on the total market value of China's sci-tech innovation board (C-STAR Market as of the end of December 2022, see Figure 1) and used them to simulate the industry growth in the simulation by computing the growth rate, which is 0.0027 per month (time step in simulation).

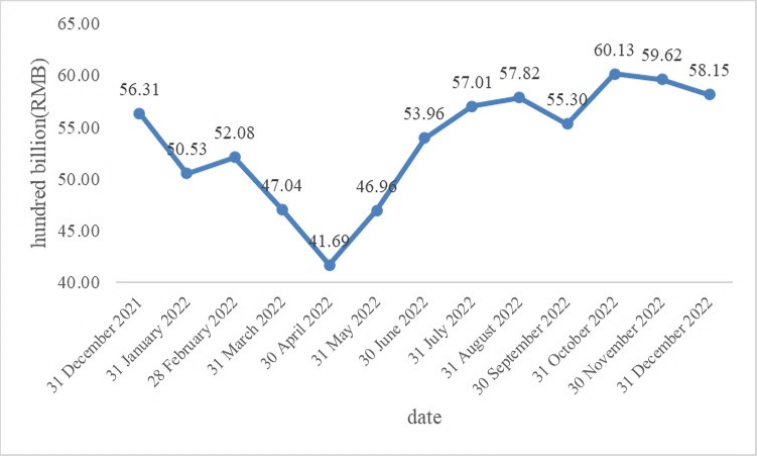

Figure 1. Total market value of China's sci-tech innovation board from December 2021 to December 2022.

We set the number of workers as 1000 and the number of firms as 100 in the simulation environment.

4. Model Description

4.1. Model Assumptions

The background of this paper draws upon the HRM characteristics of growth-oriented firms and related theories.

The following assumptions are considered according to the HRM characteristics of growth-oriented firms:

- Workers can only demonstrate their capabilities by moving from one job to another [6], i.e., changing jobs for a pay raise, due to deficient management capabilities at growth-oriented firms;
- Growth-oriented firms regularly choose one worker among candidates for their firms due to their high reliance on talent [5,50]; based on the conclusion that profit-oriented firms would be more likely to survive [7], firms dismiss workers once a loss is incurred;
- Since firms are prone to salary competition for talent [7], workers will receive base pay and incentives from the new firm that exceeds their previous salary (still within the payment cap).

Additionally, the following general assumptions on worker payment, recruitment, and dismissal plans are introduced:

- Worker payment consists of base pay and incentives [58]; working years are associated with worker output, and higher output helps workers to attain better job opportunities;
- Workers can receive a pay raise at each post adjustment, but their payment does not exceed the payment cap (in this case, 10% of company profits); because the widening payment gap among workers may undermine productivity, increase attrition, or even harm corporate performance [59], the actual policy developments are also considered;
- The salary in this paper is based on the theoretical model of 3P1M, and the enterprise output follows the Matthew effect; in this paper, the workers are divided into senior and junior groups according to a ratio of 0.2:0.8, while the weight ratio of the two groups is set at 0.8:0.2 to measure the equilibrium output;
- The dismissal mechanism is developed; Peter's principle states that when workers reach Peter's plateau, a high level where they are no longer competent, more workers are needed to finish the work. Unfortunately, this is not the correct solution, because new workers will eventually reach Peter's plateau as well, and the vicious circle will continue. Inevitably, this leads to an excessive number of workers compared with the actual working needs, thus reducing the organizational efficiency.

The recruitment and dismissal plans of firms are as follows:

Recruitment plan 1 (RP1): Firms rank candidates according to their individual output and select the top-performing candidates.

Recruitment plan 2 (RP2): Firms rank candidates according to their individual output per unit payment and choose the top-performing candidates.

Dismissal plan 1 (DP1): Firms dismiss the workers with the lowest output.

Dismissal plan 2 (DP2): Firms dismiss the workers with the lowest output per unit payment.

Firstly, we consider two recruitment strategies, as shown in RP1 and RP2. Of these two scenarios, the first one mainly considers that some enterprises may pursue greater production and expand the production capacity as much as possible. Another considers that some enterprises care more about the output level brought by the unit salary payment, i.e., they consider the proportion of the payment cost and benefit.

DP1 and DP2 are based on the same considerations. When firing workers, some firms will directly eliminate the employees with the least productive capacity as DP1. Some enterprises will combine the employee's labor cost with the production capacity as DP2.

4.2. Agents and Variables

We describe the agents and their attribute variables in detail. Variables are divided into exogenous variables and endogenous variables. Exogenous variables refer to the fact that once the agents' attributes are generated, they are unaffected by other variables or agents' behaviors. Endogenous variables may change under the influence of the agents' behaviors. Table 1 presents the parameter settings of the simulation and experiment.

Table 1. List of parameters.

Agent	Variable	Category	Type	Description	Initial	Range/Unit
Worker	e_i	XV, Unchanged	float	Effort level	random	$(0,1)$
	m_i	XV, Unchanged	int	Initial working years	random	$(0,60)$
	α_i	XV, Unchanged	float	Significance attached to incentives by workers (reverse is the significance attached to the firm value)	0.5	$(0,1)$
	$persearch_i$	XV, Unchanged	float	Ratio of firms searched by workers each time	0.2	$(0,1)$
	$d_{i,t}$	NV	int	Working years, increasing monthly when at work		Month
	$s_{i,t}$	NV	float	payment		yuan
	$y_{i,t}$	NV	float	output		$(0,1)$
	$w_{i,j,t}$	NV, DV	bool	Whether worker i applies to firm j		$\{0,1\}$
	$f_{i,t}$	NV	bool	Hired or not		$(0,1)$
Firm	v_j	XV, Unchanged	float	Level of incentive	random	$(0,1)$
	$s_{0,j}$	XV, Unchanged	float	Initial payment for non-job-hopping workers	random	(8000, 10,000)
	$IsRH_j$	XV, Unchanged	bool	Choose RP1 or not		$\{0,1\}$
	$IsFH_j$	XV, Unchanged	bool	Choose DP1 or not		$\{0,1\}$
	$\bar{y}^h_{j,t}$	NV	float	Average output of senior workers: the top 20% workers in the firm		$(0,1)$
	$\bar{y}^n_{j,t}$	NV	float	Average output of ordinary workers: those workers whose output level is lower than the top 20%		$(0,1)$
	$r_{j,t}$	NV	float	Firm revenue		yuan
	$\pi_{j,t}$	NV	float	Firm profit		yuan
	$wealth_{j,t}$	NV	float	Equity		yuan
	$\mathcal{W}_{j,t}$	NV, DV	list of workers	Worker list at the current time step		
Environment	t		int	Time	200	
	C_t	XV, Changing	float	Industrial gross value	58,151	100,000,000 yuan
	$percent\_RH$	XV, Unchanged	float	Proportion of all firms choosing RP1	0.5	$(0,1)$
	$percent\_RH$	XV, Unchanged	float	Proportion of all firms choosing DP1	0.5	$(0,1)$

"XV, unchanged" means that the agent attribute, once determined, will not be changed by other factors. "XV, changing" means that the attribute is not affected by the agent, but will change over time steps. "NV" means that the agent attribute or state changes over time or other factors. "DV" is the decision-making of agents. Column "Type" indicates the numerical characteristics of the variables, which is consistent with the setup of variable attributes in Python. Column "Initial" indicates the initial values or value characteristics of variables or parameters.

4.2.1. Worker Agents

1. Exogenous variables
   - e_i: effort level; it is random within (0, 1) and remains constant throughout the experiment.
   - m_i: initial working years; it is a random integer within (0, 60), representing the working capability and practical experience.
   - α_i: significance attached to incentives by workers (the reverse is the significance attached to the firm value). The utility equation of the agent's decision making is shown in Equation (1) with two major influence factors: the significance attached to the incentive and to the enterprise value. The firm value displays the future growth potential of the enterprise with the initial value set at 0.5 (see Section 6.2 for the impact analysis of different values of this variable); when the two factors are equally important, the equation takes the CDU model.
   - $persearch_i$: ratio of firms searched by workers at each time. We assume that workers will search for some companies and compare them and then select one to submit a resume to at each time step, and the initial value of the search ratio is 0.2 (see Section 6.2 for the impact analysis of different values of this variable).
2. Endogenous variables
   Next, we briefly introduce the endogenous variables and their value ranges. The specific change rules are illustrated in Section 4.3.1.
   - $d_{i,t}$: working years;f the agent is at work, the working years will increase with the time step.
   - $s_{i,t}$: payment of worker i at time t; it changes according to Equation (5).
   - $y_{i,t}$: output of worker i in time t; it follows Equation (4) based on the e_i and $d_{i,t}$.
   - $w_{i,j,t}$: whether worker i applies for firm j; it is binary. When worker i chooses to apply for a job at firm j, the value of $w_{i,j,t}$ is 1; otherwise, it is 0.
   - $f_{i,t}$: hired or not; it is binary. When the worker is on the job, the value of $f_{i,t}$ is 1; otherwise, the value of $f_{i,t}$ is 0.

4.2.2. Firm Agents

1. Exogenous variables
   - v_j: the coefficient of incentives (or the incentive level) is heterogeneous. Once the agent is generated, the incentive level can be any value within (0, 1) and remains constant throughout the experiment.
   - $s_{0,j}$ the initial pay for non-job-hopping workers (i.e., workers who were initially unemployed) is within (8000, 10,000). Such values are assigned randomly to firm agents and remain unchanged throughout the experiment.
   - $IsRH$ and $IsFH$ are binary values. $IsRH$ is 1, meaning that the firm selects RP1; otherwise, it represents RP2. Similarly, $IsFH$ is 1 for DP1; otherwise, it is for DP2. During the experiment, firm agents are randomly assigned recruitment and dismissal plans, and the proportion of agents choosing different plans is adjusted by $percent\_RH$ and $percent\_FH$ (see the section on environmental subjects for their specific definitions).
2. Endogenous variables
   - $\bar{y}^h_{j,t}$ denotes the average output of senior workers, i.e., the firm's top 20% workers. $\bar{y}^n_{j,t}$ denotes the average output of ordinary workers, i.e., those workers whose output is lower than that of the top 20% in the firm. $\bar{y}_{j,t}$ denotes the output of the firm, calculated regarding Equation (6). According to the output formula in Equation (6), the above three variables' ranges are $(0, 1)$.
   - $r_{j,t}$ and $\pi_{j,t}$ denote the income level and profit level of the firm. $wealth_{j,t}$ is the sum of profits at each time step. When the firm has a negative profit in the current time step, it will dismiss workers according to the chosen dismissal plan;

when the equity in the time step becomes negative, the enterprise goes bankrupt and exits the market, and a new enterprise will enter the market.

- $\mathcal{W}_{j,t}$ is the list of workers at work in firm j in period t.

4.2.3. Environment Agent

The environment agent comprises the external attributes of corporate recruitment and dismissal, and those not dominated by agents, i.e., the time steps and the total industrial gross value of growth-oriented enterprises C_t. The proportion of all firms choosing RP1, *percent_RH*, and that of all firms choosing DP1, *percent_FH*, are mainly set up to facilitate random division during the coding simulation.

4.3. Agent Behavior

The simulation runs along with the progress of time. The model has three types of agents, and their status is updated when the conditions of the "if-then-else" rules are met. The variable marked as XV in the table of variables of agents' attributes is defined when the agents are first established and will not change during the operation. The following part is the treatment stage of the process in the interpretation and expression of the status variables, as illustrated in Figure 2.

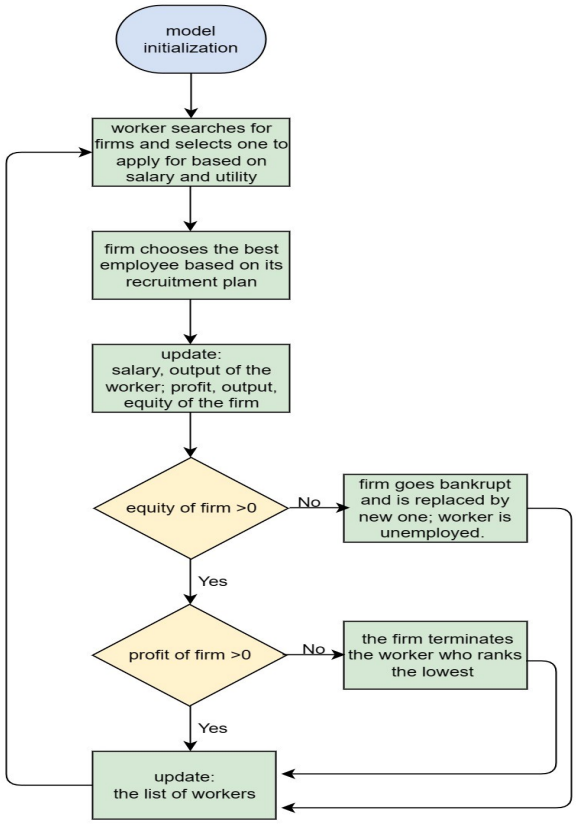

Figure 2. Flow chart of interactive procedures.

4.3.1. Worker Agents

1. Selecting firms: in the initial stage, the status of all worker agents is "unemployed". At each time step, the agent can search for firms and apply for positions in which they can maximize their utilities. The agent considers three factors to optimize the selection process of the firm.
   (i) The pay and incentive level of the target firm v_j. When the agent is employed by the firm for the first time, he or she can receive only the initial payment level $s_{0,j}$ and will attain the incentive payment of the firm only after he or she changes employment.

(ii) Personal utility: the agent's utility depends on the payment incentive v_j of the target firm and the equity of the target firm $wealth_{j,t}$. We use the Cobb–Douglas utility function to assign weights (sum to one) to the two factors to express the importance that the agent attaches to them, as the distribution coefficient α_i, as illustrated in Equation (1).

$$utility_{i,j,t} = v_j^{\alpha_i} wealth_{j,t}^{1-\alpha_i}, \quad (1)$$

The target firm's assets $wealth_{j,t}$ reflect how well the firm is doing. (iii) Anticipated payment. The agent can obtain higher compensation based on their incentive level when they switch to another firm, but, at the same time, they are subject to the payment cap policy. Whether the agent i applies for a job at the firm j is expressed as follows:

$$w_{i,j,t} = SelectFirm(v_j, utility_{i,j,t}, E[s_{i,t+1}]), \quad (2)$$

2. Updating yield level: When the worker agent successfully applies for a new job, his status will update to "employed". The worker with an "employed" status updates his employment length $d_{i,t}$ one time step, as shown in the following formula:

$$d_{i,t+1} = d_{i,t} + 1 \quad (3)$$

Meanwhile, the production level is updated, as shown in the following formula:

$$y_{i,t} = logistic(e_i, d_{i,t}) = \frac{2}{1 + e^{-0.01 d_{i,t} \times e_i}} - 1 \quad (4)$$

With efforts remaining unchanged, an increasing employment length can also enhance the production level. The above description supports the idea that work experience can enhance capability. Meanwhile, considering that growth-oriented firms usually are closely related to the high-tech industry, the learning capability of the agent will slow down when reaching a certain level. Therefore, it is set as Equation (4) above shows.

3. Updating payment or salary: According to the hypothesis, the worker agent can only attain higher pay by job hopping. The main reason is that the poor internal management of growing firms renders them incapable of evaluating their employees promptly and offering a raise accordingly. At the same time, talent competition is critical for firms. More capable workers are more likely to be paid more. Therefore, this paper assumes that the pay level of the agent after successfully applying for a new job is as follows:

$$s_{i,t+1} = s_{i,t} \times (1 + v_j) \quad (5)$$

4.3.2. Firm Agents

1. Selecting worker: After the firm receives an application from a worker agent, it ranks the workers according to the recruitment plan and chooses the most suitable applicant. At the same time, the firm agent updates its status as per the following procedure.
2. Updating output and revenue: The firm categorizes its employees into seniors and juniors according to the assumption based on the Matthew effect, as mentioned previously, and calculates the output of the firm as follows:

$$\overline{y}_{j,t} = 0.8\overline{y}_{j,t}^{h} + 0.2\overline{y}_{j,t}^{n} \quad (6)$$

After the production level of different firms is calculated, the income level is confirmed according to the proportion of its indexation level to the overall indexation level, as shown in the following:

$$r_{j,t} = \frac{e^{\overline{y}_{j,t}}}{\sum e^{\overline{y}_{j,t}}} \times C_t \quad (7)$$

3. Updating profit and wealth: To better focus on the study of human resource management relevant to salary, we only consider the payment's impact on the firm's profit.

$$\pi_{j,t} = r_{j,t} - \sum s_{i,j,t} \tag{8}$$

We sum up the firm profit of each session, and this sum is the equity level:

$$wealth_{j,t} = \sum \pi_{j,t} \tag{9}$$

4. Dismissal mechanism: We discuss the mechanism that triggers the dismissal of employees. When a firm's profit $\pi_{j,t}$ becomes negative, it means that the current income of the firm can no longer sustain its payment expenditure, and the firm will start to dismiss employees according to DP1 or DP2. Considering that growing firms may expand in a disorderly manner—that is, to attract talent, they continue to offer high salaries—we set a threshold for bankruptcy. When $wealth_{j,t}$ is negative, the firm goes bankrupt and exits the market. Because the industry to which the growing firms belong is developing rapidly, the exiting firms will be replaced by new ones quickly. Therefore, the number of firms in the market remains unchanged, as there are always new firms replacing those exiting the market.
5. Hiring or firing: In general, the decision-making practices of the firms or the listed conditions of firm employees are subject to the influence of the following factors and are expressed as

$$W_{j,t} = SelectWorker(IsRH_j, IsFH_j, \pi_{j,t}, wealth_{j,t}) \tag{10}$$

4.3.3. Environment Agents

The environment agents are mainly responsible for three aspects: (i) the control of the time step; (ii) updating the industrial gross value according to the time step—considering the fast development of the growing firms, the calculation for the increase in total industry value adopts the compound interest model; (iii) determining the proportion of the firms that apply different recruitment and dismissal plans, so as to adjust the proportion of firms choosing different plans in the industry.

5. Simulation Experiment Design

5.1. Benchmark Case

The objective of this case is to show and analyze the simulation results of 6 indicators, namely the average profit of firms, the Gini coefficient of the profit of firms, the average output of firms, the average payment of workers, the Gini coefficient of the payment of workers, and the employment rate of the human resource market. The average profit of firms is the ratio of the total profits of all enterprises in the market to the total number of enterprises, and the higher profitability of firms means a greater growth capacity in the future [37]. Similarly, the average output of firms is the percentage of the output of firms to the number of firms. The output of an enterprise is related to the output of employees, and the production of employees is related to their efforts. If an enterprise wishes to gain a foothold in the market, it needs to rely on high-level employees [60]. Therefore, the employment level and output level of an enterprise can be observed through this index. HRM should benefit both workers and firms according to the mutual gains formula [61], so we consider the average payment of workers, which is the proportion of all workers' payments to the number of workers. Employee payment is the primary source of enterprise costs in our model and simulation setting. Therefore, the observation of employee compensation can not only reflect the changes in the whole human resource market salary, but also indirectly reveal the relationship between the pressure on the enterprise regarding salary payment and its future development. Then, we introduce the Gini index in order to compare the differences [62] in profits among enterprises and in salaries among workers. Finally, the employment rate of the human resource market is

used to determine how many workers obtain a job. The development of new enterprises often positively impacts the employment rate [63]. Therefore, we hope to indirectly observe the development of enterprises by observing the change in the employment rate.

We observe how the decisions of firms and workers and their interactions influence the above indexes. We use the Python package AgentPy for simulation development and set the number of workers (i) as 1000 and the number of firms (j) as 100; they are heterogeneous agents, with a total of 200 time steps to be run. After 10 samples are obtained for each experiment, the mean value is taken as the output. The specific variables and attributes are shown in Table 1 above.

5.2. Description of Experiment Design

The objective is to identify influencing factors and analyze the impact on system performance. We select 4 exogenous variables, α_i, $persearch_i$, $percent\_RH$, and $percent\_FH$, as simulation factors and set up 5 scenarios for each factor. The values of the variables can be found in Table 2. Each simulation model contains 1100 agents (100 firms and 1000 workers), and the experiment ceases after 200 time steps.

Table 2. Input indexes and scenarios.

Input XV	Default Value	Value
α	0.5	Exp1 = {0.1, 0.3, 0.5, 0.7, 0.9}
$persearch_i$	0.2	Exp2 = {0.1, 0.2, 0.3, 0.6, 0.8}
$percent\_RH$	0.5	Exp3 = {0, 0.25, 0.5, 0.75, 1}
$percent\_FH$	0.5	Exp3 = {0, 0.25, 0.5, 0.75, 1}

The simulation model of this paper is implemented in Python, and the orthogonal table $L_{25}(5^6)$ is applied in the design. The data of 6 indexes are taken as simulation outputs, which include the corporate average profit, the Gini coefficient of profit, the average output, the average payment of workers, the Gini coefficient of payment, and the employment rate. The simulation is repeated 50 times in each experiment, and the average values of the six indexes are recorded. Additionally, the experiment is repeated 25 times.

6. Results and Discussion

6.1. Simulation Results Analysis

The results of the simulation are as follows. This experiment was repeated 10 times with different random seeds.

- In Figure 3a, the average profit of the firm falls first and then increases in general, with a relatively rapid descending rate within the decline interval and a gentle ascending rate in the rising interval. With the progression of the time steps, the graph shows a clear trend of fluctuation. The figure reflects the impact of changes in the average pay of workers. The sharp increase in average pay leads to a sharp reduction in firm profit margins and even results in a negative average profit. The payment cap policy suppresses the rapid growth of workers' salaries while offering firms opportunities for stable development. With the expansion of the market volume, the growth in average profit gradually recovers. Meanwhile, we also notice subsequent fluctuations, which could possibly be due to the fact that particular firms cannot afford the payment costs and thus register a negative profit and incur an overall profit decrease.
- Figure 3b shows that the Gini coefficient of the firm's profit first rises and then decreases, followed by violent fluctuations. The simulation results reveal two points that are different from the indexes of other simulations. Firstly, although different simulations exhibit similar trends, they do not precisely converge, especially after fluctuations occur. Secondly, the trends of fluctuations in different simulations vary from each other. We believe that such results occur because some enterprises might go bankrupt in different simulation environments, but this situation does not emerge in every experiment, and its timing also differs.

- Figure 3c reveals that the firm's average outputs frequently fluctuate in the early stages, first decreasing gently and then increasing. Then, they undergo a stable increase stage and later a fluctuating increase. The overall upward trend aligns with the firm's development and setting. Frequent job changes by workers may cause temporary fluctuations in the early stage. Moreover, as the salary cap policy takes effect, the fluctuations become even less noticeable.
- As shown in Figure 3d, the average employee pay rises rapidly at first, stabilizes for a while, and then starts to rise again. This might be due to employees receiving low wages at the beginning of the simulation. With the accumulation of work experience, they gain "wage bargaining power," and the average pay increases exponentially. Because the market's growth rate can no longer keep up with the pay increase, the salary cap policy slows the ascending trend of the average pay. However, in general, continuous market growth will raise the threshold of workers' salary caps, and the average salary will rise.
- Figure 3e shows that the Gini coefficient of workers' compensation decreases first, then flattens out, and finally stabilizes at a certain value. With an increase in newly hired employees, the difference in payment gradually narrows. The Gini coefficient tends to stabilize after reaching a certain level. This is probably because the payment level depends on workers' efficiency (level of proficiency), and thus the difference typically remains unchanged.
- In Figure 3f, the employment rate of workers in the simulation shows a rapid increase. It approaches 1 and then declines slightly and registers a downward trend after a relatively stable period. In the early stages of industry development, firms' demand for workers is enormous. Only the firms with enough workers can achieve high output, and so the employment rate increases rapidly during the early stages. When it reaches a certain level, there might be a situation in which the firm's profits in a single period are negative and it may have to lay off workers. Thus, the employment rate decreases slightly in this period because former employees cannot find new jobs immediately. During a period in which average salaries and average profits are relatively stable, the employment rate also remains relatively stable. Possible reasons for this are that the payment cap policy contributes to a stable level of average profit and there are fewer firms registering negative profits and conducting layoffs in multiple periods (including layoffs over multiple periods by a single firm and layoffs in a single period by multiple firms).

From the above analysis and illustrations, we can see that the inflection points in the fluctuation periods of the above six indexes all occur around the point where t = 100, suggesting that the reasons for these inflections are the same. Based on previous assumptions and analysis, we can infer that the inflection point appears due to the payment cap policy. We can attribute this to two main aspects.

- In the early stages of market development, workers have recently entered the market, and their salaries are all at the base level. At this time, the number of employees that firms are able to attract is limited, and only firms with enough employees can engage in production activities, make a profit, and obtain a relatively high income. In such conditions, the salaries of workers generally cannot reach the salary cap threshold.
- The results of firms' efforts to recruit are evident. Workers who have already been employed will move to another firm that offers higher salaries, resulting in a rapid increase in the payment level in the graph. However, this places a burden on firms' operations. As the overall market conditions improve, the firms' average profit declines due to skyrocketing payment costs.

We can propose that when wages reach the salary cap threshold, even though the payments of workers will still rise, the overall trend will slow down. The subsequent rise in workers' salaries is attributed to the overall condition of the market, set as C_t. Namely, the development of the market increases the overall payment cap threshold and thus increases the average worker pay.

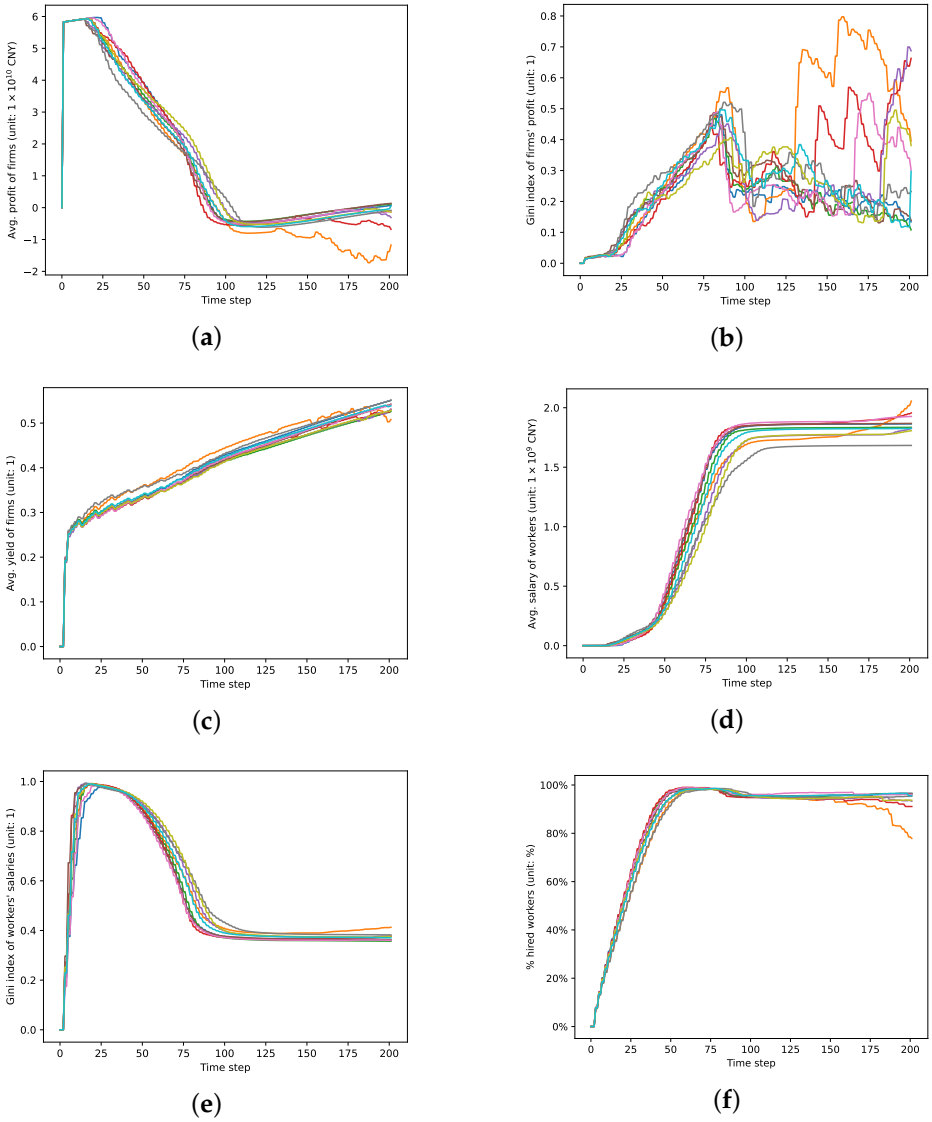

Figure 3. Simulation results. (**a**) Firm's average profit. (**b**) Gini coefficient of the firm's profit. (**c**) Firm's average output. (**d**) Average payment of the workers. (**e**) Gini coefficient of the payment of the workers. (**f**) Employment rate.

6.2. Analysis of Experimental Results

The output data of the model are shown in Table 3. Because the orthogonal table has six columns and the experiment has only four influencing factors, the table has two blank columns (also known as error columns) for the estimation of errors. The experimental results show that the only significant factor is the proportion of different recruitment policies that firms in the industry adopt—namely, the firms' selection of recruitment plans affects their own development and the salaries of their employees, as illustrated in Table 4.

Table 3. Experimental results.

	α	$persearch_i$	$percent\_RH$	$percent\_FH$	avg_profit	gini_profit	avg_yield	avg_salary	gini_salary	percent_hired
0	0.1	0.1	0	0	8.39×10^9	0.027939	0.621319	2.24×10^9	0.313706	0.9976
1	0.1	0.2	0.25	0.5	5×10^8	0.430967	0.621537	4×10^9	0.31987	0.47048
2	0.1	0.3	0.5	0.75	-1.6×10^9	0.411932	0.663965	3.44×10^9	0.353351	0.5332
3	0.1	0.6	0.75	1	2.49×10^9	0.093138	0.720269	1.46×10^9	0.452569	0.9007
4	0.1	0.8	1	0.25	2.2×10^9	0.045547	0.740577	5.1×10^8	0.482506	0.97158
5	0.3	0.1	0.25	0.25	7.13×10^8	0.410708	0.635418	3.58×10^9	0.318594	0.59938
6	0.3	0.2	0.5	1	4.38×10^9	0.114265	0.684246	2.13×10^9	0.356604	0.88972
7	0.3	0.3	1	0	3.56×10^9	0.304474	0.730233	9.74×10^8	0.540827	0.58168
8	0.3	0.6	0	0.75	7.35×10^9	0.031434	0.612464	2.23×10^9	0.324342	0.99916
9	0.3	0.8	0.75	0.5	-1.5×10^7	0.361681	0.693714	2.53×10^9	0.437841	0.55692
10	0.5	0.1	0.5	0.5	1.96×10^8	0.432355	0.657213	3.5×10^9	0.337972	0.57874
11	0.5	0.2	1	0.75	1.39×10^9	0.344672	0.723607	8.92×10^8	0.561117	0.60622
12	0.5	0.3	0.75	0.25	-3.9×10^8	0.500436	0.667578	3.27×10^9	0.403866	0.32234
13	0.5	0.6	0.25	0	-8.4×10^8	0.490868	0.623951	3.95×10^9	0.312689	0.51456
14	0.5	0.8	0	1	7.33×10^9	0.030636	0.611351	2.22×10^9	0.324083	0.99996
15	0.7	0.1	0.75	0.75	-1.4×10^9	0.271831	0.700462	2.21×10^9	0.44766	0.73492
16	0.7	0.2	0	0.25	7.7×10^9	0.0299	0.613062	2.24×10^9	0.320585	0.99734
17	0.7	0.3	0.25	1	2.16×10^9	0.21401	0.64452	2.76×10^9	0.329188	0.7904
18	0.7	0.6	1	0.5	1.6×10^9	0.404587	0.703279	1.38×10^9	0.453787	0.19522
19	0.7	0.8	0.5	0	2.75×10^9	0.638787	0.622425	4.22×10^9	0.311246	0.37052
20	0.9	0.1	1	1	1.27×10^9	0.252744	0.719015	4.89×10^8	0.564013	0.97836
21	0.9	0.2	0.75	0	-5.7×10^8	0.543475	0.643587	3.53×10^9	0.38322	0.3159
22	0.9	0.3	0	0.5	7.5×10^9	0.030237	0.614366	2.23×10^9	0.323111	0.9984
23	0.9	0.6	0.5	0.25	2.56×10^9	0.62329	0.62374	4.22×10^9	0.314919	0.3693
24	0.9	0.8	0.25	0.75	3.55×10^8	0.405524	0.628465	3.77×10^9	0.315356	0.5439

Table 4. ANOVA table.

Source	**DOF**	**avg_profit**				**gini_profit**				**avg_yield**			
Source	**DOF**	**S**	**MS**	**F Ratio**	***p* Value**	**S**	**MS**	**F Ratio**	***p* Value**	**S**	**MS**	**F Ratio**	***p* Value**
α	4	7.20×10^{18}	1.80×10^{18}	1.108	0.4618	0.107	0.027	0.932	0.5266	0.003	0.001	1.149	0.4482
$persearch_i$	4	2.43×10^{18}	6.07×10^{17}	0.374	0.8182	0.007	0.002	0.059	0.9910	0	0	0.168	0.9436
$percent\_RH$	4	1.86×10^{20}	4.66×10^{19}	28.650	0.0033	0.528	0.132	4.588	0.0846	0.038	0.010	16.675	0.0092
$percent\_FH$	4	1.47×10^{19}	3.68×10^{18}	2.267	0.2237	0.185	0.046	1.609	0.3280	0.002	0.001	0.955	0.5172
per_{rf}_Inter	4	8.94×10^{18}	2.23×10^{18}	1.375	0.3825	0.017	0.004	0.147	0.9550	0	0	0.048	0.9939
e	4	6.50×10^{18}	1.63×10^{18}			0.115	0.029			0.002	0.001		
Source	**DOF**	**avg_salary**				**gini_salary**				**percent_hired**			
Source	**DOF**	**S**	**MS**	**F Ratio**	***p* Value**	**S**	**MS**	**F Ratio**	***p* Value**	**S**	**MS**	**F Ratio**	***p* Value**
α	4	1.25×10^{18}	3.14×10^{17}	0.811	0.5781	0.001	0	0.668	0.6471	0.109	0.027	0.462	0.7633
$persearch_i$	4	2.06×10^{17}	5.14×10^{16}	0.133	0.9620	0.002	0.001	1.022	0.4917	0.091	0.023	0.386	0.8106
$percent\_RH$	4	2.52×10^{19}	6.29×10^{18}	16.256	0.0097	0.154	0.039	69.109	0.0006	0.705	0.176	2.979	0.1578
$percent\_FH$	4	4.05×10^{18}	1.01×10^{18}	2.615	0.1872	0.006	0.002	2.686	0.1809	0.420	0.105	1.777	0.2957
per_{rf}_Inter	4	1.89×10^{17}	4.72×10^{16}	0.122	0.9671	0.003	0.001	1.561	0.3384	0.072	0.018	0.304	0.8621
e	4	1.55×10^{18}	3.87×10^{17}			0.002	0.001			0.237	0.059		

Next, we examine the possible reasons for the above results.

Firstly, we analyze the reasons for the significant impact of the proportion of enterprises with different recruitment policies and the reason that it has no significant impact on the employment rate. The different recruitment plans that firms select will attract different types of workers, and the salaries, profits, and production outputs of the firms will differ accordingly. The six indexes mentioned above are affected as workers and firms interact with each other during the recruitment process. Firms will select the best candidates from the list of applicants, regardless of the recruitment plan; thus, the influence on the employment rate is trivial.

Secondly, we must explain the non-significance of the influences of other input variables. The possible reasons are as follows.

- The factor α (the distribution of emphasis on incentive payment and emphasis on firm's value) does not have a significant impact.

The reason is that the number of firms is relatively small, while the market size is large in the simulation. Therefore, the development of most firms is smooth; thus, the importance of corporate value is insignificant. Additionally, it could be the case that the increase in the firm's value will not impact the actual salaries that employees receive after joining the firm. To attain a higher salary, workers still need to switch between different firms. Therefore, the corporate value of a firm will only temporarily affect those who seek a new job.

- The non-significance of $persearch_i$ might be related to the configuration of the model. Regardless of the number of firms that a worker searches in a single period, she or he can only apply for one position, which could directly cause the non-significance of $persearch_i$.
- There is a reason for the non-significance of the $percent\_FH$ index. Different recruitment plans may impact the rise in average pay. However, there are two plans that can be used to dismiss an employee: choosing the employee who produces the lowest output in relation to the unit payment or simply the one with the lowest output. Both plans may point to the same candidate. In this case, choosing a different plan does not have a significant impact on the various indexes of firms and workers. We also observe that per_{rf}_Inter, the intersection effect between $percent\_RH$ and $percent\_FH$, is not significant either.

6.3. The Payment Cap Policy and Insights of Results

The operation of companies without a payment cap policy was also simulated. It was found that these companies usually had non-performing assets. Therefore, the payment cap policy is deemed necessary for both the simulation design and actual management practice. At the same time, the Peter principle, where workers reach their level of incompetence, is rooted in management reality.

From the above analysis, the following conclusions can be reached.

- First, the experiment showed that a payment cap policy significantly affected company management. Notably, this policy had a bearing on the turning points and output indicators after a certain trend. A simulation experiment was also carried out with no such policy, and the result showed that companies without a payment cap policy obtained significantly reduced profits at large, a situation directly caused by the rapid increase in employee salary. These companies were highly likely to declare bankruptcy, which entails a loss of jobs and no income for employees. From this perspective, the importance of the payment cap policy should not be underestimated. Pan et al. (2020) showed that the pay gap between senior executives and ordinary employees negatively impacted enterprises' innovation efficiency [4]. This is of similar significance to our research conclusion. The payment cap policy is also a means to reduce the wage gap. The policy also benefits the survival and development of growth-oriented enterprises.
- Second, the experiment showed that a company's recruitment plan presented a significant influence on its average profit, profit Gini, average output, average salary, and payment Gini, but it was not so impactful on the employment rate. This is consistent with the conclusions of Aslam et al. (2023) [64], which pointed out that compensation, recruitment, and selection positively impact small and medium-sized enterprises' performance, such as labor productivity and product innovation. However, the dismissal plan had no significant influence on these indicators. This indicated that the recruitment plan was more important for the company than the dismissal plan in terms of company development and the social status of employees. In addition, the recruitment plan was critical not only to corporate management but also to the salary levels of employees.
- Third, the worker Gini coefficient decreased at the beginning, and it then became stable. It was noted that along with the development of the industry and the growth of an individual company, the salary gap between employees was dwindling and was not narrowed to zero. Instead, it could be kept at a stable level. The payment

gap, however, continued to exist as employees had different working abilities. As the industry prospers, the salary for the same position in different companies will nearly be the same [8]. In other words, when the industry grows to a certain scale, employees with the same working ability will obtain equal pay regardless of the company that they work for.

- As can be seen from the above conclusions, payment and recruitment policies are very important for the development of growth-oriented enterprises. Therefore, for policymakers, appropriate payment cap policies should be introduced to help growth-oriented enterprises to successfully overcome the difficulties of early development, caused by the pressure of payment, to ensure that more firms can survive in the market. For entrepreneurs, on the one hand, they should start with internal salary management and adjust the salary gap and excessive salary payment appropriately for the firm's long-term development. On the other hand, we should pay attention to the selection of recruitment strategies and the importance of recruitment for HRM. Finally, investors who wish to invest in growth-oriented enterprises should pay attention not only to the profits and assets but also to the HRM strategies of the enterprise, so that they can identify the inherent potential or detect crises in advance.
- Furthermore, the conclusions of this research are in line with reality, which indicates the practicability of the model. Growth-oriented companies seek talent in the initial stage, which will result in a rapid increase in employee salary and a decrease in company profit. When the company grows to a certain level, the adoption of the payment cap policy ensures the company's profit space, better operational performance, and better human resource management. The employee salary will also increase slightly. The variation in the employee salary's Gini coefficient could account for the equal pay of employees with similar working abilities.

7. Conclusions and Future Research

In this paper, we study whether and how the human resource management of growth-oriented enterprises impacts corporate performance and employee payment by selecting salary policies, recruitment plans, and dismissal plans via agent-based modeling and simulation. Additionally, we analyze whether the payment cap policy has a positive impact on the development of growth-oriented enterprises.

The simulation results show that all indicators reached the turning point at almost the same stage, proving that the payment cap policy did have an influence on the indicators mentioned above. We found that when a company adopted a payment cap policy, its average output and the employees' average payment increased on the whole, but the growth rate varied from stage to stage. Affected by such policies, the average employee payment was no longer able to grow rapidly when it reached a certain level. The company's profit decreased first and increased later, while the Gini profits of firms and the employment rate showed the opposite trend. The Gini coefficient of the payment of workers gradually declined and then leveled off. In addition, a company's recruitment policy will also affect its growth and its employees' salaries, but it will not affect the employment rate. The dismissal policy did not generate a significant influence in this regard.

Based on the above-mentioned conclusions and results, this paper presents the following suggestions for practitioners. (i) A company's recruitment plan is more important to its performance and growth compared with its dismissal plan. Therefore, it is necessary for companies to prioritize recruitment efforts and planning. When the company is faced with more than one candidate, it should be aware that different recruitment plans may result in varied preferences for candidates. The recruitment plan will therefore affect the company's output, profit level, and profit gap with other companies. As a result, the recruitment plan is especially important to growing companies. (ii) The gap in employee salary depends on individual ability and the development stage of the industry. According to the change in the employee Gini, as the industry develops further and a larger labor force joins the market, the salary gap will dwindle until it reaches a stable level, and such a gap is mainly due to

different individual capabilities. To further narrow the salary gap, it is necessary to increase employees' working ability and advance the entire industry. (iii) By adopting a reasonable salary limit policy, growing companies are more likely to survive the early stages. In reality, talent is more important to growing companies at the initial stage, where the recruitment of talent becomes a requirement. Although a high salary can attract able people, it places a financial burden on the company. A sound payment cap policy (either issued by the company or the government) will help growing companies by alleviating such pressure. Nevertheless, it is worth noting that the policy must be used properly, or the company may face a loss of talent. Under the conditions of the salary limit policies of growth-oriented companies, it is necessary to develop and apply a policy of additional intangible incentives (for example, periodic home working for employees), as well as to focus the efforts of the company's HR managers on drawing up a unique motivation and incentive plan based on individual preferences for the working conditions of talented employees.

This study has some limitations, and we propose several future research directions. First, we have yet to discuss the possible influences of other factors, such as the ownership structures and original sizes of enterprises, on the hiring and dismissal planning decisions of growth-oriented enterprises. This requires in-depth studies based on empirical evidence. Second, we did not compare the recruitment and dismissal decisions of other types of firms with different characteristics. Readers from other industries may consider extending our model by modeling industry-dependent characteristics. Third, with increasingly available data, more HRM interactions, policies, and details can be modeled to study other interesting research questions.

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Abbreviations

The following abbreviations are used in this manuscript:

HRM	Human Resource Management
RP	Recruitment Plan
DP	Dismissal Plan

References

1. Cornely, P.B.; Anderson, O.W. Health Services in the United States: A Growth Enterprise Since 1875. *J. Public Health Policy* **1986**, *7*, 556. [CrossRef]
2. Gerhart, B.; Feng, J. The Resource-Based View of the Firm, Human Resources, and Human Capital: Progress and Prospects. *J. Manag.* **2021**, *47*, 1796–1819. [CrossRef]

3. Li, R.; Du, Y.F.; Tang, H.J.; Boadu, F.; Xue, M. MNEs' Subsidiary HRM Practices and Firm Innovative Performance: A Tacit Knowledge Approach. *Sustainability* **2019**, *11*, 1388. [CrossRef]
4. Pan, X.; Wan, X.; Wang, H.; Li, Y. The Correlation Analysis between Salary Gap and Enterprise Innovation Efficiency Based on the Entrepreneur Psychology. *Front. Psychol.* **2020**, *11*, 1749. [CrossRef] [PubMed]
5. Fotopoulos, G. Knowledge Spillovers, Entrepreneurial Ecosystems and the Geography of High Growth Firms. *Entrep. Theory Pract.* **2022**, 104225872211117. [CrossRef]
6. Flovik, S.; Moudnib, R.A.; Vassilakopoulou, P. Determinants of Blockchain Technology Introduction in Organizations: An Empirical Study among Experienced Practitioners. *Procedia Comput. Sci.* **2021**, *181*, 664–670. [CrossRef]
7. Zhou, N.; Park, S.H. Growth or profit? Strategic orientations and long-term performance in China. *Strategic Manag. J.* **2020**, *41*, 2050–2071. [CrossRef]
8. Hung, C.C.; Lim, E.P. On Aggregating Salaries of Occupations From Job Post and Review Data. *IEEE Access* **2021**, *9*, 43422–43433. [CrossRef]
9. Pulka, B.M.; Ramli, A.; Mohamad, A. Entrepreneurial competencies, entrepreneurial orientation, entrepreneurial network, government business support and SMEs performance. The moderating role of the external environment. *J. Small Bus. Enterp. Dev.* **2021**, *28*, 586–618. [CrossRef]
10. Soltis, S.M.; Brass, D.J.; Lepak, D.P. Social Resource Management: Integrating Social Network Theory and Human Resource Management. *Acad. Manag. Ann.* **2018**, *12*, 537–573. [CrossRef]
11. Delery, J.E.; Roumpi, D. Strategic human resource management, human capital and competitive advantage: Is the field going in circles? *Hum. Resour. Manag. J.* **2017**, *27*, 1–21. [CrossRef]
12. Otmakhova, Y.S.; Devyatkin, D.A.; Tikhomirov, I.A. Methods for Evaluation of the Region's Needs for Human Resources based on Statistics and Patent Landscapes. *Econ. Reg.* **2022**, *18*, 569–580. [CrossRef]
13. Pirrolas, O.A.C.; Correia, P.M.A.R. Human Resources Churning. *Encyclopedia* **2023**, *3*, 582–589. [CrossRef]
14. Babkin, I.; Pulyaeva, V.; Ivanova, I.; Veys, Y.; Makhmudova, G. Developing a System for Monitoring Human Resource Risks in a Digital Economy. *Risks* **2023**, *11*, 82. [CrossRef]
15. Dossinger, K.; Wanberg, C.R.; Choi, Y.; Leslie, L.M. The beauty premium: The role of organizational sponsorship in the relationship between physical attractiveness and early career salaries. *J. Vocat. Behav.* **2019**, *112*, 109–121. [CrossRef]
16. Balogh, G.; Sipos, N. Is it worth for bachelor graduates to diversify study programme for master level? *Int. J. Educ. Manag.* **2020**, *34*, 1387–1401. [CrossRef]
17. Salas-Velasco, M. The Reform of Curricula in the Spanish University System: How Well Matched Are New Bachelor's Degrees to Jobs. *Systems* **2023**, *11*, 200. [CrossRef]
18. Xu, T.; Zhu, H.; Zhu, C.; Li, P.; Xiong, H. Measuring the Popularity of Job Skills in Recruitment Market: A Multi-Criteria Approach. *Proc. AAAI Conf. Artif. Intell.* **2018**, *32*. [CrossRef]
19. Kehoe, R.R.; Collins, C.J. Human resource management and unit performance in knowledge-intensive work. *J. Appl. Psychol.* **2017**, *102*, 1222–1236. [CrossRef]
20. Sharma, M.; Luthra, S.; Joshi, S.; Kumar, A. Analysing the impact of sustainable human resource management practices and industry 4.0 technologies adoption on employability skills. *Int. J. Manpower* **2022**, *43*, 463–485. [CrossRef]
21. Säve-Söderbergh, J. Gender gaps in salary negotiations: Salary requests and starting salaries in the field. *J. Econ. Behav. Organ.* **2019**, *161*, 35–51. [CrossRef]
22. Hernandez, M.; Avery, D.R.; Volpone, S.D.; Kaiser, C.R. Bargaining while Black: The role of race in salary negotiations. *J. Appl. Psychol.* **2019**, *104*, 581–592. [CrossRef] [PubMed]
23. Wang, X.; Tao, Z.; Liang, L.; Gou, Q. An analysis of salary mechanisms in the sharing economy: The interaction between streamers and unions. *Int. J. Prod. Econ.* **2019**, *214*, 106–124. [CrossRef]
24. Gerhart, B.; Fang, M. Pay for (individual) performance: Issues, claims, evidence and the role of sorting effects. *Hum. Resour. Manag. Rev.* **2014**, *24*, 41–52. [CrossRef]
25. Gerhart, B. Incentives and Pay for Performance in the Workplace. *Adv. Motiv. Sci.* **2017**, *4*, 91–140. [CrossRef]
26. Meng, Q.; Zhu, H.; Xiao, K.; Xiong, H. Intelligent Salary Benchmarking for Talent Recruitment: A Holistic Matrix Factorization Approach. In Proceedings of the 2018 IEEE International Conference on Data Mining (ICDM), Singapore, 17–20 November 2018. [CrossRef]
27. Zaid, A.A.; Jaaron, A.A.; Bon, A.T. The impact of green human resource management and green supply chain management practices on sustainable performance: An empirical study. *J. Clean. Prod.* **2018**, *204*, 965–979. [CrossRef]
28. Dong, G. The empirical analysis on the demand of salary factors for knowledge staffs of SMES. *J. Comput. Methods Sci. Eng.* **2022**, *22*, 1591–1596. [CrossRef]
29. Yang, R.; Niu, P. Framework Design of Science and Technology Venture Capital Salary Management System Driven by Blockchain Technology. *Mob. Inf. Syst.* **2022**, *2022*, 6784385. [CrossRef]
30. Mishra, H.; Venkatesan, M. Blockchain in human resource management of organizations: An empirical assessment to gauge HR and non-HR perspective. *J. Organ. Chang. Manag.* **2021**, *34*, 525–542. [CrossRef]
31. Zhang, Y.; Xu, S.; Zhang, L.; Yang, M. Big data and human resource management research: An integrative review and new directions for future research. *J. Bus. Res.* **2021**, *133*, 34–50. [CrossRef]

32. Kovshova, T.; Trifonov, P.; Ramirez-Asis, E. Improving the Efficiency of Intellectualisation Processes in Enterprise Management Systems. *Systems* **2023**, *11*, 266. [CrossRef]
33. Li, C.; Zhang, Y.; Niu, X.; Chen, F.; Zhou, H. Does Artificial Intelligence Promote or Inhibit On-the-Job Learning? Human Reactions to AI at Work. *Systems* **2023**, *11*, 114. [CrossRef]
34. Wang, P.; Liao, W.; Zhao, Z.; Miu, F. Prediction of Factors Influencing the Starting Salary of College Graduates Based on Machine Learning. *Wirel. Commun. Mob. Com.* **2022**, *2022*, 7845545. [CrossRef]
35. Koponen, I.T. Agent-Based Modeling of Consensus Group Formation with Complex Webs of Beliefs. *Systems* **2022**, *10*, 212. [CrossRef]
36. Liao, J.; Welsch, H.; Stoica, M. Organizational Absorptive Capacity and Responsiveness: An Empirical Investigation of Growth–Oriented SMEs. *Entrep. Theory Pract.* **2003**, *28*, 63–86. [CrossRef]
37. Hansen, B.; Hamilton, R.T. Factors distinguishing small firm growers and non-growers. *Int. Small Bus. J. Res. Entrep.* **2011**, *29*, 278–294. [CrossRef]
38. Gherghina, Ș.C.; Botezatu, M.A.; Hosszu, A.; Simionescu, L.N. Small and Medium-Sized Enterprises (SMEs): The Engine of Economic Growth through Investments and Innovation. *Sustainability* **2020**, *12*, 347. [CrossRef]
39. Fuller, R.L.; Russ-Eft, D.F. Organizational responsiveness of Russian and American growth-oriented small and medium enterprises (SMEs). *Hum. Resour. Dev. Int.* **2010**, *13*, 317–339. [CrossRef]
40. ZuÑiga-Collazos, A.; Lozada, N.; Perdomo-Charry, G. Effect of absorption capacity acquired on organisational performance. *Int. J. Innov. Manag.* **2019**, *24*, 2050048. [CrossRef]
41. Theodorakopoulos, N.; Figueira, C. What Can Situated Learning Theory Tell Us About Leading to Develop Organizational Learning Capabilities for Entrepreneurial Performance? Lessons from a Knowledge-Intensive Small Firm. *Thunderbird Int. Bus. Rev.* **2012**, *54*, 859–873. [CrossRef]
42. Cassia, L.; Minola, T. Hyper-growth of SMEs. *Int. J. Entrep. Behav. Res.* **2012**, *18*, 179–197. [CrossRef]
43. Batrancea, L.M. Determinants of Economic Growth across the European Union: A Panel Data Analysis on Small and Medium Enterprises. *Sustainability* **2022**, *14*, 4797. [CrossRef]
44. Liu, J.; Zhou, H.; Chen, F.; Yu, J. The coevolution of innovation ecosystems and the strategic growth paths of knowledge-intensive enterprises: The case of China's integrated circuit design industry. *J. Bus. Res.* **2022**, *144*, 428–439. [CrossRef]
45. Audretsch, D.B.; Belitski, M. Knowledge complexity and firm performance: Evidence from the European SMEs. *J. Knowl. Manag.* **2021**, *25*, 693–713. [CrossRef]
46. Vos, J.F.; Boonstra, A. The influence of cultural values on Enterprise System adoption, towards a culture–Enterprise System alignment theory. *Int. J. Inf. Manag.* **2022**, *63*, 102453. [CrossRef]
47. Pirzada, Z.; Mahar, S.A.; Diou, N.; Memon, T.; Shah, W. Talent Management: Association in Problems of it. *Int. J. Manag.* **2021**, *12*, 1210–1218. [CrossRef]
48. Clegg, B.; Little, P.; Govette, S.; Logue, J. Transformation of a small-to-medium-sized enterprise to a multi-organisation product-service solution provider. *Int. J. Prod. Econ.* **2017**, *192*, 81–91. [CrossRef]
49. Xiang, D.; Zhang, Y.; Worthington, A.C. Determinants of the Use of Fintech Finance Among Chinese Small and Medium-Sized Enterprises. *IEEE Trans. Eng. Manag.* **2021**, *68*, 1590–1604. [CrossRef]
50. Macpherson, A.; Holt, R. Knowledge, learning and small firm growth: A systematic review of the evidence. *Res. Pol.* **2007**, *36*, 172–192. [CrossRef]
51. Otmakhova, Y.; Devyatkin, D. Priorities of Human Resources Policy in the Context of Digitalization and the COVID-19 Pandemic. In *Digital Transformation in Industry* ; Springer: Berlin/Heidelberg, Germany, 2022; pp. 481–492. [CrossRef]
52. de la Paz, J.V.B.; Rodríguez-Picón, L.A.; Morales-Rocha, V.; Torres-Argüelles, S.V. A Systematic Review of Risk Management Methodologies for Complex Organizations in Industry 4.0 and 5.0. *Systems* **2023**, *11*, 218. [CrossRef]
53. Schepers, J.; Vandekerkhof, P.; Dillen, Y. The Impact of the COVID-19 Crisis on Growth-Oriented SMEs: Building Entrepreneurial Resilience. *Sustainability* **2021**, *13*, 9296. [CrossRef]
54. Abdelshafie, A.; Rupnik, B.; Kramberger, T. Simulated Global Empty Containers Repositioning Using Agent-Based Modelling. *Systems* **2023**, *11*, 130. [CrossRef]
55. Tian, C.; Xiao, T.; Shang, J. Channel differentiation strategy in a dual-channel supply chain considering free riding behavior. *Eur. J. Oper. Res.* **2022**, *301*, 473–485. [CrossRef]
56. Railsback, S.F.; Grimm, V. Agent-Based and Individual-Based Modeling. A Practical Introduction. In *OEconomia*; Princeton University Press: Princeton, NJ, USA , 2019; pp. 407–413. [CrossRef]
57. Trivedi, A.; Sreenivas, N.K.; Rao, S. Modeling the Spread and Control of COVID-19. *Systems* **2021**, *9*, 53. [CrossRef]
58. Chen, F. Salesforce Incentives, Market Information, and Production/Inventory Planning. *Manag. Sci.* **2005**, *51*, 60–75. [CrossRef]
59. Chen, T.; Huang, G.; Olanipekun, A. Simulating the Evolution Mechanism of Inner Innovation in Large-Scale Construction Enterprise with an Improved NK Model. *Sustainability* **2018**, *10*, 4221. [CrossRef]
60. Hitka, M.; Kucharčíková, A.; Štarchoň, P.; Balážová, Ž.; Lukáč, M.; Stacho, Z. Knowledge and Human Capital as Sustainable Competitive Advantage in Human Resource Management. *Sustainability* **2019**, *11*, 4985. [CrossRef]
61. Guest, D.E. Human resource management and employee well-being: Towards a new analytic framework. *Hum. Resour. Manag. J.* **2017**, *27*, 22–38. [CrossRef]

62. Xing, X.; Ye, A. Spatial-Temporal Differentiation and Spatial Interaction Effect Analysis of Residents' Consumption Capacity and Consumption Upgrading in China. *Systems* **2023**, *11*, 219. [CrossRef]
63. Gherghina, Ș.C.; Botezatu, M.A.; Simionescu, L.N. Exploring the Impact of Electronic Commerce on Employment Rate: Panel Data Evidence from European Union Countries. *J. Theor. Appl. Electron. Commer. Res.* **2021**, *16*, 3157–3183. [CrossRef]
64. Aslam, M.; Shafi, I.; Ahmed, J.; de Marin, M.S.G.; Flores, E.S.; Gutiérrez, M.A.R.; Ashraf, I. Impact of Innovation-Oriented Human Resource on Small and Medium Enterprises' Performance. *Sustainability* **2023**, *15*, 6273. [CrossRef]