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Impact of Employment Salary Level of Graduates from Higher Education Institutions in China

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Authors' contributions

This work was carried out in collaboration between both authors. YW designed the study, LZ performed the statistical analysis, wrote the protocol, LZ and YW wrote the first draft of the manuscript. LZ and YW managed the analyses of the study. LZ managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Based on the analysis of questionnaire survey data on college graduates, we constructed a multiple linear regression model using Matlab software to study the factors affecting the salary level of graduates, such as University rank and geographical locations, which provides a reference basis for the employment planning of college students. The results indicate that the nature of the university and the ranking of geographical regions have a significant impact on the salary level of college graduates. We utilize the proposed method to study typical two universities in China, demonstrating the effectiveness of our analysis. Finally, from the perspective of talent employment in universities, feasible and effective measures to improve the salary level of college graduates were discussed.

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Keywords: Multiple linear regression; higher education employment prospect; graduate salary level.

1. INTRODUCTION

1.1 Problem Background

For the career development of college graduates, it involves significant issues such as cultivating high-quality talents, enhancing the country's scientific research strength, and social stability. Therefore, it has received deep concern and widespread attention from political parties, the State Council, and other sectors. We must attach great importance to and actively respond to the work arrangement tasks of college graduates in the near future, as this is a very critical issue. The training outcomes of students are one of the most important criteria for measuring higher education in China. The specific requirements set by teaching plans in different fields or majors will directly affect the level of salary they receive after graduation. Salary level is one of the important indicators reflecting the learning effectiveness of graduates. At the same time, it is also one of the important factors affecting school and major selection, which is a sensitive and complex issue that has sparked heated discussions in various media in recent years [1-3].

This study quantitatively analyzes the salary levels of graduates from multiple types of universities and majors using mathematical modeling methods based on relevant data such as university rankings, geographical locations, and educational positioning, and draws clear and convincing conclusions. Exploring the salary levels of college graduates can help guide them to actively seek employment, improve employment quality, accelerate the process of employment work, and provide important reference for the employment guidance and post employment living standards of the new generation of college graduates.

1.2 The Significance of Studying the Salary Level of College Graduates

According to the analysis and research data of the National Bureau of Statistics on the current situation of education in China, since the resumption of the college entrance examination in 1977 and the reform and opening up, the number of graduates from Chinese higher education institutions has increased from 280000 to 11.58 million in 2023, an increase of forty times. In the 45 years since the reform and opening up, the enrollment scale of higher education has expanded, providing a channel for the upward mobility of over 100 million students at the social and economic level, and also providing a potential huge middle-class group for the talent structure and optimization of society. During this period, the corresponding employment situation also underwent significant changes. In other words, as the number of college admissions continues to increase, accompanied by more and more fresh graduates facing employment difficulties, whether college students can smoothly enter the middle class and demonstrate their educational achievements mainly depends on whether they have the opportunity to find a job that corresponds to their abilities and knowledge after graduation [4-6].

The match between education and work is related to the quality level of higher education in China and the effectiveness of talent cultivation. It is not only related to personal income level and social mobility, but also enables college graduates to obtain a satisfactory job that matches their ability level and educational level, which has long-term strategic significance for the country's technological upgrading and human resources development. Since the 1970s, the employment situation of college graduates has received much attention in Western countries. The optimization of labor supply in the talent market corresponds to the optimization of social demand, which enables college graduates to have an advantage in income compared to high school graduates, reflecting the important significance of higher education efficiency and value. Since the 1990s, both Western countries and China have undergone fundamental changes in the relationship between technological change, educational development, and income distribution among graduates due to the internationalization of the labor market and talent exchange. The field of computer science has created interdisciplinary and interdisciplinary employment opportunities, allowing college graduates to enjoy the benefits of higher education reform. Therefore, graduates from universities have seen a significant increase in income compared to high school graduates due to the rapid development of high-tech society. It can be seen that the value of higher education is largely reflected in the employment salary level

of college graduates, which also reflects the advantages of high-tech background and professional needs. At present, research on the salaries of college graduates mainly focuses on the job market and employment situation, and there is relatively little quantitative relationship analysis work on the basic data of college student employment and education. Therefore, it is necessary to study the educational resources invested in higher education, the professional settings, teaching plans, and talent training plans in the education process, as well as the impact of the corresponding regional market conditions of graduates on the salaries of college graduates. Establishing quantitative correspondence through quantitative analysis of employment data and related models can provide important reference for improving the effectiveness of higher education and educational reform to a large extent.

The analysis and interpretation of initial salary data for college graduates should consider the teaching quality of undergraduate students in higher education, reflecting multiple factors, among which the starting salary of graduates is only one aspect. For example, due to the different professional categories and the impact of job types, starting salary data in science and engineering and humanities generally cannot fully reflect the general correlation with the quality of school teaching. In addition, the starting salary data is also related to the growth of the country's GDP and the economic level of that year in absolute terms. Therefore, a comprehensive and reasonable interpretation of the starting salary data of graduates from different universities should take into account the corresponding links related to education and teaching effectiveness, including social environment and other factors. The corresponding starting salary data of graduates, as well as data on salary levels and job opportunities improvement five and ten years after graduation, are important factors for comprehensively measuring the quality of college student training [4].

The quality and quantity of higher education teaching are both reflected in the starting salary, which is only a single data point and does not directly reflect the types of work units for different graduates, such as state-owned enterprises, foreign-funded enterprises, and private enterprises. Although there are significant differences in salary levels, starting salary reflects a certain aspect of information in terms of social achievement and the general expectations of graduates. For example, although starting salaries are not high in state-owned enterprises and public institutions, data reflecting job satisfaction in terms of benefits and other aspects is equally important. This information is not reflected in the starting salary data of graduates. However, in the current situation of frequent or normalized talent mobility and regional exchanges, the employment and career selection scope of each university should be at the national level, so the comparison of corresponding graduation salary levels should also be compared between universities in different regions. The data on the starting salary of graduates can provide important references for graduates from different universities in career selection, employment, and personal career planning. At the same time, based on the salary data of graduates from various universities, it is necessary to establish corresponding models, analyze the data and related factors, and analyze some recent trends in the salary level of graduates from various universities. Although there are some prior works [1-2] investigating the college graduates employment salary information, here in our work we employ the effective multiple linear regression method to identify the key factors influencing the college graduate initial employment salary. From this, we can identify some important factors that affect the salary level of graduates, which provides important reference for university education and improving graduate satisfaction.

2. ANALYSIS MODEL OF SALARY DATA IN UNIVERSITIES - MULTIPLE LINEAR REGRESSION

Multiple linear regression is a statistical method that primarily studies the linear relationship between a dependent variable Y and multiple independent variables $X_1, X_2, \cdots, X_k$ .Its expression is as follows [5-9]:

$$Y = b_0 + b_1 X_1 + b_2 X_2 \cdots + b_k X_k + \varepsilon \quad (1)$$

Where $b_0, b_1, b_2, \cdots, b_k$ are the correlation linear regression coefficient obtained through analysis. ε represents random error, with an average value of 0 and a variance of $\sigma^2(\sigma > 0)$, indicating the impact of $X_1, X_2, \cdots, X_k$ on the dependent variable Y.

3. ANALYSIS OF FACTORS AFFECTING THE SALARY LEVEL OF GRADUATES FROM THREE UNIVERSITIES

3.1 Multiple Linear Regression Model for Salary Levels in Universities

Step 1: Sample extraction

Given the large amount of data on the initial salary of graduates, we have selected a portion of them as our research subjects. To ensure that our model accurately reflects the comparative relationship between key variables that affect the salary level of college students, we selected survey data from the top 100 Chinese college graduates in terms of income ranking in 2022 (see typical plotted data in Fig. 1 for details).A regression formula was constructed using this batch of data. In order to determine the main factors affecting the salary level of graduates, this study makes the following reasonable assumptions:

(1) Assuming that the employment status of graduates is only influenced by factors such as the nature of the school, geographical location, and ranking (Since the employers usually apply such factors in hiring employees).
(2) Assuming that graduates who meet the same conditions above have the same employment opportunities.
(3) Assuming that the data information in the attachment is reasonable.

Step 2: Variable introduction

The specific assignment situation is as follows:

X_1 indicates educational level, assuming

$$X_1 = \begin{cases} 0, \text{non} 211/985 \\ 1, "211" Tier \\ 2, "985" Tier \end{cases} \quad (2)$$

X_2 represents geographical regions, assuming

$$X_2 = \begin{cases} 1, Beijing / Shanghai / Guangzhou \\ 2, OtherAreas \end{cases} \quad (3)$$

Step 3: Model establishment

We explore the mutual influence between the salary level of college graduates and various factors, in order to construct a universal model of multiple linear regression as follows

$$Y = b_0 + b_1 X_1 + b_2 X_2 + \varepsilon \quad (4)$$

Among them, X_1 and X_2 are the and independent variables representing education level and geographical region, respectively, and Y represent the salary level of college graduates.

Fig. 1. shows the linear regression chart of historical starting salary data (for the past 9 years 2014-2022) and predicted result for Tsinghua University and Harbin Institute of Technology.

3.2 Analysis of Model Results

Based on the aforementioned data, we can infer that: The main factors affecting the salary level of college graduates are ranked according to their influence, namely geographical location and educational quality.

According to geography, the salaries of college graduates in economically developed cities are higher. Among the 54 universities where graduates earn over 10000 yuan per month, more than half are located in first tier cities such as Beijing, Shanghai, and Guangzhou, while the rest are distributed in economically developed emerging cities such as Hangzhou and Nanjing.

From the data, the top 100 universities in the salary index are mainly concentrated among the top 985/211 universities. Universities with better education levels are more likely to receive higher salaries, and their employment resource advantages are more obvious compared to non985/211 education institutions.

The salary levels of Tsinghua University, Peking University, Renmin University of China, Beijing Jiaotong University, and Beihang University are among the top ten, with an average monthly income exceeding 10000 yuan. In addition, graduates from Shanghai Jiao Tong University, Fudan University, and Shanghai Foreign Studies University also earn considerable salaries. The calculated level of P values for the analyzed Tsinghua Univ. and Harbin Institute of Technology are shown in Table 1 and Table 2, demonstrating the relative good predicted values.

3.3 Analysis of Model Validity

This progressive regression model has the following advantages: It is based on simple polynomial linear regression theory and is very relevant to our research topic. However, due to

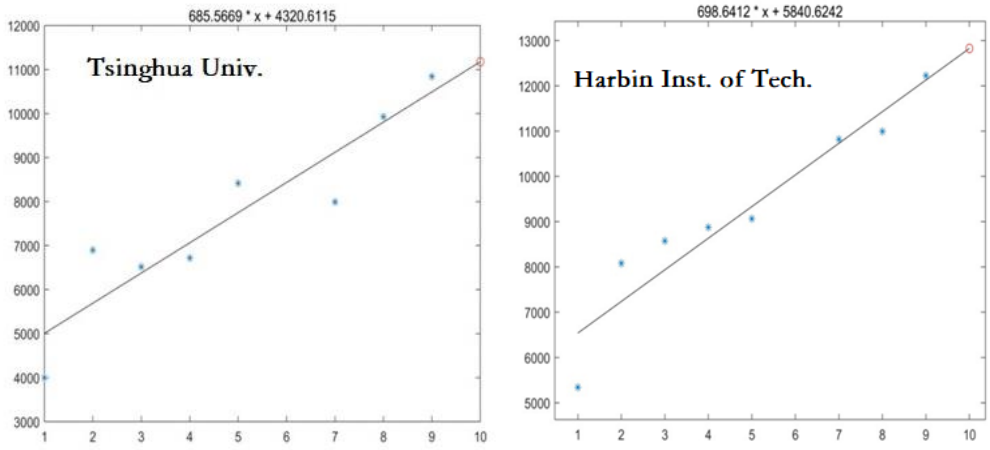

Fig. 1. Linear regression chart of historical starting salary data(for the past 9 years 2014-2022, blue marks) and predicted result (red circles and solid straight line) for Tsinghua University(left) and Harbin Institute of Technology(right)

Table 1. Model accuracy reference range

Model accuracy level	P	C
Level 1 (good)	0.95≤P	C≤0.35
Level 2 (passing)	0.80≤P＜0.95	0.35≤C<0.5
Level 3 (barely)	0.70≤P＜0.80	0.5＜C≤0.65
Level 4 (failed)	P＜0.70	0.65＜C

Table 2. Model prediction accuracy values for two Universities

University	P	C	Model Accuracy Level
Tsinghua University	Level 1	0.235	Level 1 (Good)
Harbin Institute of Technology	Level 1	0.267	Level 1 (Good)

our capabilities, this model also has certain limitations: Not all variables can be included. It is quite difficult to transform complex categorical variables, such as school type, workplace, and specific majors, into correlation analysis that can be used for modeling. In addition, due to the limitation of data volume, the accuracy of the fitted formula is not high enough, resulting in errors between the estimated results and the actual situation.

3.4 Analysis of Model Improvement

Our model is based on the analysis of the average starting salary data of various universities across the country. However, the actual analysis and data did not take into account the differences in salary and benefits for corresponding job positions among graduates from different majors in universities. For example, compared to engineering majors, there is a significant difference in salary data corresponding to the same level of ability for humanities majors, and the same salary data ability and level gap for management and technology majors cannot be well reflected. Regarding further improvement analysis, it is necessary to conduct separate statistical analysis of salary data for different types of majors, taking into account the differences in corresponding salary benefits for different majors. Of course, this requires more or more detailed statistical information data on the salaries of college graduates, including the majors they have studied and the majors corresponding to their job positions. For example, all college graduates can be divided into three categories based on their majors: For science, engineering, and cultural and historical management majors, it is necessary to refine the corresponding

graduation salary data, so that the results of analysis or conclusions calculated by models will be more comparable.

At the same time, the calculation and analysis of the model are based on salary data that does not reflect regional differences. For example, the same salary data will represent different levels of job positions in Beijing, Shanghai, and the central and western regions. At the same time, in the same region, with the same salary and benefits level, but from enterprises of different levels or prestige scales, there will also be significant differences in job position levels and satisfaction. For example, regarding the corresponding salary level also in Beijing or Shanghai, and the personal sense of achievement and job development space corresponding to this welfare and benefits in famous or state-owned enterprises and general enterprises are completely different. So, to reflect comparability, a study on the salary and benefits of graduates at a certain level can be considered based on recruitment salary data from several well-known large enterprises and universities across the country. Firstly, well-known enterprises have a relatively large recruitment scale, and universities will use the salary data of graduates recruited by some well-known enterprises, such as Huawei and China Mobile Unicom, as a criterion for evaluation, which will have a certain degree of comparability. Considering that the recruitment scope of these enterprises covers almost all provinces in the country. Therefore, there is still room for improvement in the results of our model and data analysis, but it reflects some basic rules that can qualitatively serve as key indicators for enterprise recruitment and graduate career selection through the salary level data of graduates from various universities.

4. GRADUATES STARTING SALARY ANALYSIS AND PREDICTION MODELS

The starting salary for graduation reflects the ability level of graduates, and the average starting salary of a college graduate reflects the effectiveness of college education. This is based on the positive correlation between the starting salary level of graduates and their ability level and education level, which is a qualitative law. Compared to other types of employed individuals who rely on experience and qualifications to obtain extraordinary salary levels, the employment positions of college graduates generally do not require corresponding experience or qualifications for all graduates. Therefore, the employment data measurement ability of graduates is comparable to the quality of education. Moreover, there are currently a large number of recruitment positions offered by employers aimed at students from all universities across the country. Although some 985 or prestigious universities have slightly tilted their recruitment, the salary standards are mainly determined by the objective conditions of the positions to be employed, which can basically reflect the level of education received by graduates. Overall, the starting salary data can well reflect the quality of graduates, the efforts of four-year university students, and the corresponding skill preparations for their career planning in the context of a large amount of information. Although the overall starting salary data does not subdivide the types of job positions, including the nature of employers, such as companies or corporate units, and does not carefully consider the types of universities that cultivate talents, such as engineering schools, comprehensive universities, science and engineering schools, and liberal arts schools. Nowadays, large employers are recruiting, and the types of positions cover many professional categories in universities. Therefore, especially for some large recruitment units, the starting salary level of recruitment positions can still be compared for most different universities, which can qualitatively reflect the ability level and corresponding training quality level of college graduates.

Due to the relatively large overall scale of graduates from various universities in our country, although some graduates have significant differences in their employment positions and salary data, or in other words, there are certain obvious deviations. However, based on big data analysis and corresponding employment data from most universities with a complete range of disciplines, the starting salary can reflect the overall level of graduates and the level of education provided. Of course, the differences in this salary data include the types of employment positions held by employers, as well as geographical locations, such as the differences between the central and western regions and the eastern coastal areas. But a large amount of data can have zero average corresponding data bias, reflecting a comparable overall employment situation and salary and benefits information that graduates are concerned about.

The model for analyzing and predicting the initial salary of graduates constructed can qualitatively

reflect some differences in the average level of graduates for different levels of universities. For universities in the same level, such as 985 universities in the same comprehensive ranking, there may be some small deviations in the corresponding data. The randomness caused by the close average sample data may lead to some fluctuations in the analysis and prediction results. However, the differences between universities in different levels, such as 985 and non-211 universities, can be well analyzed using this model to obtain gap prediction values that can be used for comparison.

The ranking of the initial salary level for college graduates largely reflects the ranking of universities and their corresponding popularity among college entrance examination candidates. This reason is very obvious, because almost all college students choose schools based on their ability level, which corresponds to the ranking of the last selected school. Of course, the main purpose of receiving higher education is to find a satisfactory job, including satisfaction with key salary levels. So although the ranking of salary levels may fluctuate within a small ranking range, it should reflect the overall level of education, reputation, or comprehensive strength of the university.

5. CONCLUSION AND RECOMMENDATIONS SATISFACTION

Factors such as geographical region and educational level have a significant impact on the salary level of college graduates, with the geographical region having the greatest impact. This also fully demonstrates that most graduates attach enough importance to geographical regions, and the salary level of students in universities in Beijing, Shanghai, and Guangzhou is slightly higher. Next is the level of education. Students from 985 and 211 universities often have higher salary levels than those from non-985/211 universities. Employment is crucial for the country, especially for college graduates. Although the current employment situation in our country is generally stable, college graduates still face various employment pressures due to the existence of many uncertain factors in the external environment. To improve the salary level of college graduates, it is recommended to:

Provide practical employment process training to help college students broaden their career horizons, understand industry development and job requirements, improve vocational skills and employment competitiveness. By implementing elective courses such as "Employment Guidance" and "Career Planning" in universities on campus, we can provide students with education and training on the job search process, which covers four main parts: Analysis of job market conditions, industry dynamics, life path guidance, and career growth strategies. We start with the meaning and goals of life, allowing students to understand the importance of personal career planning and prompting them to actively think about their own career life, thereby assisting them in invisibly improving their career management skills and job search abilities. Improve the quality of employment, strengthen guidance and services for employment of college graduates. Propose that universities establish detailed courses on student career development and job search guides to accurately understand and predict employment trends among college students. For the phenomenon of significant wage differences among fresh graduates, schools should provide corresponding employment counseling courses to educate them to understand that there is no direct relationship between their initiative and actual income. By enhancing students' self-awareness, it can greatly help them better grasp the employment situation in the current social environment, accurately determine personal goals, and significantly improve their chances of success in employment. Expand the range of career choices and enhancing students' practical skills is one of the important tasks of universities. Schools should establish specialized positions for students to experience and exercise, in order to enhance their understanding and comprehension of future career life, thereby strengthening their ability to transform professional theory into practical technology, and making them more aware of what professional skills are required in the recruitment standards of society. By arranging students to conduct on-site inspections of the company's operations, they can increase their familiarity with potential employers. Only by allowing students to personally participate in the actual work of enterprises can they better grasp the specific responsibilities they need in the job search process. This has important guiding significance for predicting their salary expectations, selecting career directions, and smoothly entering the workforce. Promote campus recruitment and employment for enterprises. Universities should actively organize and carry out recruitment activities for enterprises to enter the campus, actively invite excellent employers to come to the campus for

recruitment, and help graduates find companies with development prospects and higher salaries as soon as possible. School leaders need to play a demonstrative and leading role, combining "going out" with "inviting in", and expanding employment opportunities through on-site visits to employers. There is a sufficient supply of employment positions related to various majors, which not only ensures that graduates have a choice, but also provides them with the opportunity to "choose well" and showcase their talents in positions that suit them.

CCS CONCEPTS

Computing methodologies ~ Modeling and simulation ~ Model development and analysis

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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