

An Empirical Study on the Relationship Between Human Capital and Corporate Performance of Listed Companies

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Abstract—In today's society, knowledge as a virtually wealth has become extremely important. Knowledge is ubiquitous in life, and its covering a wide range application plays an obvious and significant role in improving the global economy and the high-quality development of many enterprises. Knowledge has gradually become the core competitiveness of an enterprise. As a manifestation of knowledge, human capital is creative, unique and flexible, which is very important for the long-term development, personality development and international development of enterprises. It is also an efficient strategy to improve enterprise performance. This paper uses the public data of 92 listed companies, based on SPSS software, through multiple linear regression model, using factor analysis, using regression analysis and other methods, this paper empirically studies the relationship between human capital and corporate performance in listed companies. The results show that the human capital of 92 listed companies has a great correlation with their corporate performance, and their employee human capital, executive human capital and technical human capital have a positive correlation with corporate performance. From here we see that human capital plays a very important and key role in promoting enterprise performance, and this study also puts forward relevant policy recommendations for the sustainable development of listed companies.

Keywords-human capital; enterprise performance; factor analysis; linear regression analysis

1. Introduction

With the development of society, people generally believe that knowledge as an intangible wealth is becoming more and more important. In the 1960s, Schultz and Becker made remarkable achievements in the study of modern human capital, providing theoretical support for our current research on business management. The carrier of human capital is people. As the only living and dynamic resource in an enterprise, its intangible assets, namely professional skills, are the main reasons for enterprise appreciation. Human capital is the capital that can truly create value for enterprises based on the research of domestic and foreign scholars. In this highly competitive society, the competition between enterprises has changed from the original product, geographical location, etc. to talent competition. The talents here can be those with technology or professional knowledge. These talents have become important resources and core competitiveness of enterprises. These resources play a particularly important role in the sustainable and high-quality development of enterprises.

At present, the research on the relationship between human capital and enterprise performance has attracted extensive scholars' attention. However, there are few empirical studies on the relationship between human capital and enterprise performance at home and abroad, and most of them are comprehensive and systematic. There is little research on a certain industry or field, and the consideration of enterprise performance is too single. Based on the research of domestic and foreign scholars on human capital and corporate performance, and based on the multiple linear regression model, this paper conducts an empirical study on the relationship between human capital and corporate performance of domestic listed companies, and puts forward feasible suggestions for the sustainable development of listed companies.

2. Relevant theoretical basis

2.1 Human Capital Theory

In 1961, American economist Schultz ^[1] put forward the human capital theory for the first time, and at the same time put this theory into the scope of economic research. He believed that people's investment in education and health formed human capital, and education promoted the social distribution of personal income. Becker believes that human capital is not only a manifestation of knowledge and skills, but also a byword for time, health and life. In his book *Human Capital*, he systematically given an account of various conditions required for the formation of human capital. Lucas and others established a new economic growth model with human capital as the research object based on the research of Schultz and Becker analyzed the formation process of human capital, and clearly pointed out that the improvement of labor quality has a positive role in promoting social and economic growth. Bozeman and Corley ^[2] and Bozeman et al (2001) showed that as time goes on, the practical experience of the formation of human capital and social capital will have an impact on the formation of human capital in the domain of science field. These opportunities intersect with each other and affect long-term productivity in a synergistic manner.

We now generally acknowledge that human capital refers to the sum of all kinds of knowledge and professional skills formed through investment in people. Adam Smith was the first economist who proposed human capital. He believed that the strength of human ability was tempered in the process of growth, and the ability improved through education and training was an inherent capital of human beings. It has both investment and income, and the products produced by this capital will increase national wealth. Later, Theodore W. Schultz^[3], an American economist, believed that human capital was embodied in workers, and was formed by the workers' of knowledge, technology, ability and physical strength through investment. Li Zhan et al. ^[4] believed that the investment in human capital can improve various production efficiency and is one of the important reasons for economic improvement. They believe that it is the real improvement of human capital that a person improves his ability and demonstrates his ability in various fields. Gao S.Y and Zhang M ^[5] believed that enterprise human capital is the sum of knowledge, skill concept and potential represented in employees. It has the resource characteristics that can bring sustainable competitive advantages and excess performance to enterprises. It is difficult to be copied and imitated by competitors and it is an important strategic resource of enterprises.

In short, human capital is the knowledge and skills reflect in people. In the process of human capital formation, it needs to spend a lot of time and money. Chinese enterprises need more people with plentiful experience, know-how and technology to enhance their competitiveness.

2.2 Enterprise Performance

Enterprise performance generally refers to the sum of operating income and merits obtained by an enterprise within a certain operating time. In the enterprise operation, the achievements made by the operator for the enterprise are the performance of the operator; The growth, profitability, debt repayment and operation of enterprises comprehensively reflect the operating efficiency of enterprises. "Performance" describes an enterprise's input-output efficiency, which is, the ability to produce business results by inputting various enterprise resources. Enterprise performance is also known as enterprise performance or enterprise performance. The following is the definition of enterprise performance by distinct scholars from different angles: 1) Enterprise performance is a representation of outcomes. Antoncic ^[6] believes that performance is closely related to the strategic planning, market objectives and capital allocation of enterprises. Therefore, performance is equivalent to the results of enterprise activities. 2) Enterprise performance is the community of behavior and result. Liu Ye ^[7] believes that enterprise performance is the overall performance of behavior and results, which includes group performance and individual performance. Li Xiaohong ^[8] pointed out that enterprise performance is the result acquired by the joint efforts of shareholders and senior managers according to the established system criterions. 3) Enterprise performance is a kind of profitability. Sheng Chunrui ^[9] believes that refers to the enterprise's operating efficiency within a certain operating period. Its criterions are mainly represented in the profitability, asset management level, debt capacity and future development competence of the enterprise.

In a word, enterprise performance represents the waxing and waning of the moon and operating efficiency of an enterprise over effluxion of time. These benefits can be material currency or other assets that can help improve the development ability of the enterprise. It is not only a result of behavior, but also a profitability.

3. Literature review

3.1 Human Capital Related Overview

3.1.1 Classification of Human Capital

Human capital theory believes that there are different labor elements in organizations. According to the different social roles played by human capital, it can be divided into three categories: senior managers, professional technicians and common employees. The classified allocation of human capital at different levels can promote employees to improve their own quality of human capital, and thus have a positive impact on their enterprise performance and economic development. Becker (1964)^[10] distinguished common human capital and distinctive human capital in his original model research. General-purpose human capital refers to technologies that can not only serve existing employers but also other potential employers. On the contrary, specialized human capital is a technology that can only help improve the efficiency of existing

work. Table 1 shows the different classifications of human capital by Chinese and foreign scholars^{[11]-[15]}.

Table 1 Classification of human capital by different scholars

<i>Representative scholars</i>	<i>Classification Criteria</i>	<i>Specific Type</i>
Yulin Guo (2002)	Knowledge composition	Explicit human capital and Implicit Human Capital
Haisheng Liu (2006)	Nature difference	Homogeneous human capital and heterogeneous human capital
Yaping Xie (2008)	Entrepreneurial behavior	Educational, practical and inspiring
Guoqin Zhang (210)	Nature of work	Leader human capital, operational human capital and professional human capital
Zibiao Li (2020)	Characteristics of human capital	Knowledge-based human capital and experience-based human capital
Wenshu Gao (2021)	Formation pathway	Education type Human capital, training human capital and experience human capital
Schultz (1961)	social role	General type, skill type and management type
Becker (1964)	Knowledge specificity	General value human capital, specific human capital
Lucas (2015)	Labor Angle	Physical human capital and skilled human capital

3.1.2 Characteristics of Human Capital

The enthusiasm, initiative and innovation generated by human capital are the basic guarantee for enterprises to achieve their development goals, the important source of lasting competitive advantages, and the final determinant of enterprise performance. Scholars at home and abroad have described the characteristics of human capital from distinct visual angle. Liu Chuang^[16] believes that the human capital of high-tech enterprises is characterized by heterogeneity, scarcity, high mobility and high added value. Cui Tingting^[17] believes that some characteristics of human capital, such as knowledge and techniques, can affect the surrounding human capital, thereby improving the quality of human capital in the whole industry or field and accelerating innovation efficiency. Vindingal, Li Jianjun et al., Li Peinan et al., Robertst and other scholars^{[18][19][20][21]} chose the education level, average years of education and professional techniques, the proportion of employees with medium-grade professional title and college degrees reflexes the characteristics of enterprise human capital.

3.1.3 Measurement of Human Capital

Table 2 shows the measurement indicators and calculation methods of human capital by different scholars.

Table 2 Different scholars measure the indicators and calculation methods of human capital.

<i>Variable name</i>	<i>Variable Definition</i>	<i>Metrics</i>	<i>Computing Method</i>	<i>Author</i>
Human Capital	Ordinary employee type human capital Top management human capital Skilled human capital	Education level of employees Logarithm of the sum of executive compensation Technical human capital stock	Number of employees with college degree or above / total number of employees Ln (sum of executive compensation) Number of technicians / total number of employees	Chuang Liu (2017)
	Enterprise human capital stock Enterprise human capital investment	Average years of education method Investment of enterprises in vocational training of employees	$HC = \sum_{i=1}^n W_i H_i$ Per capita training expenses of employees = enterprise labor union funds and education funds / total number of employees (unit: 10000 yuan)	Chunrui Sheng (2014)
	Human capital appreciation	Human capital appreciation efficiency	Value added of enterprises / human capital	Ye Li (2020)
	Average age of senior executives Average tenure of senior executives Average education level of senior executives Average Title level of senior executives	Total age / number of senior managements in the current period Total tenure / number of senior managements in the current period Total value / number of senior managements in the current period Total value / number of senior managements in the current period		Shiyao Sun (2020)

3.2 Research on the Relationship Between Human Capital and Enterprise Performance

As the core competitiveness of an enterprise, enterprise human capital is the linchpin to improve enterprise performance. It ought to have professional knowledge, extensive experience, skilled skills and other capabilities. Jens M. Ungera and Andreas Rauch^[25] found that personnel human capital has a tricky relationship with the success of an enterprise. Crook, T. Russell, Todd, Samuel Y.^[26] found in their research that human capital is highly correlated with the company's operating efficiency, and leaders should make relevant plans to increase the company's specific human capital investment. Aino Kianto and Josunes Áenz^[27] shows that the knowledge-based human resource management structure affects the operation of other capital through human capital, and human capital in turn affects the improvement of enterprise innovation ability by strengthening other capital.

Li Jiaming et al.^[28] the empirical analysis shows that human capital in different industries is positively correlated with enterprise performance. In the same industry, the operating income and efficiency of enterprises with more human capital are uncertain more successful than those with less human capital. Deng Xuefen et al.^[29] found that human capital of listed high-tech enterprises is positively related to enterprise performance through empirical research of multiple linear regression model. Along with the overall development of enterprises, having a large number of human capital can no longer have an apparent effect on enterprise performance, enterprises should pay more attention to quality while paying attention to quantity, but

the flow of human capital between enterprises will have a greater impact on enterprise performance. Yu Shulian ^[30] believes that the research on the intermediary effect between human capital and enterprise performance should start from the aspects of strategy, scale and senior management. In addition, Li Jian et al. ^[31] by combing the literature of domestic and foreign scholars, the following conclusions are drawn: most scholars have confirmed that human capital investment has a significant positive correlation with enterprise performance, and the development of these results needs the support of practical experience in enterprise human resource management.

3.3 The Concrete Manifestation of Human Capital Affecting Enterprise Performance

Chinese scholars have studied human capital and enterprise performance from different perspectives. Mao Qinghua ^[32] concluded through empirical research that enterprises with a certain amount of human capital have a very positive impact on their operating income and productivity, among which employees with professional techniques have the greatest impact on enterprise performance. Liu Tian ^[33] believes that the consideration of enterprise performance should be analyzed from both financial and non-financial perspectives. Nonfinance, such as innovation performance, relationship performance, etc. Zhu Jinwei et al. ^[34] empirical research shows that the higher the average education level of senior executives is, the more their business revenue is, and the higher their efficiency of operations is. High education level can better promote communication and cooperation between senior executives and avoid many problems. Li Ye ^[22] believes that the impact of human capital on enterprise performance is mainly reflected in the knowledge education, work ability, practical experience and professional technology of employees.

In a word, human capital can help employees better understand and get familiar with the enterprise's production mechanism, management system and enterprise culture, and quickly integrate into and adapt to the enterprise's production and operation; It directly determines whether employees can understand the knowledge and skills required for work in a certain period of time and be competent for work in a multilateral environment, and effectively improve enterprise performance; the more experienced employees are, the more proficient they are. They can complete a task quickly, improve work efficiency and reduce unit production cost; employees with high technical level can create more value for the enterprise.

4. An Empirical Study on the Relationship between Enterprise Human Capital and Enterprise Performance

4.1 Research Design

4.1.1 Data Collection

This paper selects the data of 92 listed companies in the period of national qualification certification from 2020 to 2021, mainly from Shenzhen Stock Exchange, CSMAR database, RESSET Financial Database, www.cninfo.com.cn, corporate annual report and other websites. Finally, excel software is used to summarize and sort out the data, and SPSS is used for analysis.

When collecting data, in order to ensure the validity and feasibility of statistical analysis, some listed companies that have special circumstances and are not suitable for this study are excluded.

ed. It mainly includes the following points: exclude ST and * ST listed companies, and eliminate the adverse impact of extreme values on the research results; This study does not include A-share listed enterprises that issue B shares and H shares at the same time; Exclude listed companies that do not fully disclose the data required for this study. Through sample screening, a total of 92 listed companies were finally determined as empirical research samples.

4.1.2 Variable design

Table 3 Names and definitions of variables

<i>Variable Type</i>	<i>Variable Name</i>	<i>Variable Symbol</i>	<i>Variable Definitions</i>
Explained variable	Business Performance	EP	Main business income/total number of employees
Explanatory variables	Employee Human Capital	HC	Number of employees with college degree or above / total number of employees
	Executive Human Capital	HMHC	The logarithm of the sum of corporate executive compensation
	Technical Human Capital	THC	The number of technical personnel in the enterprise / the total number of employees in the enterprise
control variable	Enterprise Size	S	total enterprise assets
	Capital Structure	LEV	Total corporate liabilities/total assets

In this study, the explanatory variables are enterprise human capital, namely employee human capital, executive human capital and technical human capital. which is measured by referring to the classification of corporate human capital by Liu Chuang [16], Xu Pei [35], the indicator of employee human capital is the ratio of the number of employees with college degree or above to the total number of employees in the company; The measurement index of senior executives' human capital is the logarithmic ratio of the total executive compensation; The technical human capital is measured by the ratio of the number of technicians to the total number of employees. The explained variable is enterprise performance. This paper uses labor productivity to measure enterprise performance, and the ratio of the total income of main business to the total number of employees to express labor productivity. This paper selects the enterprise scale and capital structure as the control variables. The enterprise scale is represented by the enterprise's total assets, the capital structure is represented by the asset liability ratio, and the ratio of the enterprise's total liabilities to total assets represents the asset liability ratio. Variable names and definitions are shown in Table 3.

4.1.3 Research Hypothesis

In the light of the outcomes of the selection of the explained variable and the explanatory variable, this study proposes the following three assumptions:

Hypothesis 1: Employee human capital is positively correlated with firm performance;

Hypothesis 2: Technological human capital is positively correlated with firm performance;

Hypothesis 3: Executive human capital is positively correlated with firm performance.

4.1.4 Analysis Model

Based on the above selection results of explained variables and explanatory variables and relevant research hypotheses, this paper constructs a multiple linear regression equation to explain the correlation between the above variables. Namely:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon \quad (1)$$

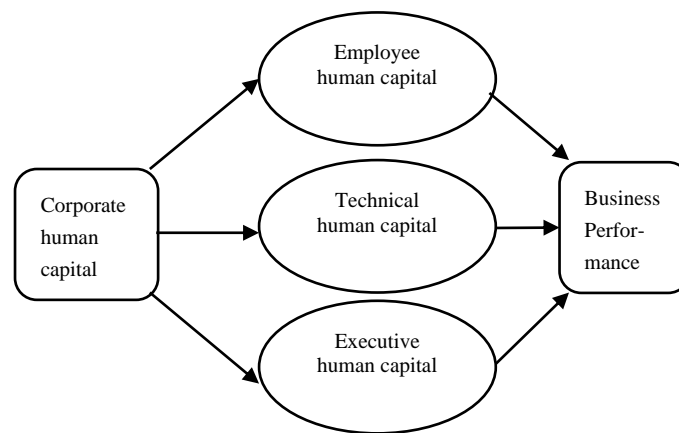


Figure 1. Model frame diagram

Where, X_1 is employee human capital, X_2 is executive human capital, X_3 is technical human capital, X_4 is enterprise scale, X_5 is capital structure, Y_i is enterprise performance, and ε is residual. Figure 1 is the model frame diagram.

4.2 Empirical Analysis

4.2.1 Descriptive Analysis

It can be seen from Table 4 that the largest variable of the average value is the enterprise size of 9.63, and the smallest variable is the technical human capital of 0.29; The largest SD is enterprise performance of 0.63, and the smallest is capital structure of 0.21; The largest variance is the enterprise performance of 0.39, and the smallest is the capital structure of 0.05; The mid-value and minimum values of each variable are 4.02, 0.05, 2.01, 8.27 and 0.01 respectively, and the maximum values are 7.58, 13.89, 0.92, 10.85 and 0.97 respectively.

Table 4 Descriptive Analysis

	<i>EP</i>	<i>HC</i>	<i>HMHC</i>	<i>THC</i>	<i>S</i>	<i>LEV</i>
Average value	5.91	0.60	2.86	0.29	9.63	0.38
Standard deviation	0.63	0.28	0.29	0.26	0.47	0.21
Variance	0.39	0.08	0.09	0.07	0.22	0.05
Minimum	4.02	0.05	2	0.01	8.27	0.01
Maximum value	7.58	1	3.89	0.92	10.85	0.97
Total	184	184	184	184	184	184

4.2.2 Data Preprocessing

Since different variables have different target attributes and cannot be compared, the original data needs to be standardized to clear up ill effects. The standardized formula (2) is as follows:

$$Z_i = \frac{X_i - X_{min}}{X_{max} - X_{min}} \quad (2)$$

In the formula, X_i is the original data and Z_i is the normalized data.

4.2.3 Adaptive Analysis

The Bartlett sphericity test was performed on the variables to judge the sig and kmo values before factor analysis. The results are shown in Table 5.

Table 5 KMO and Bartlett sphericity test

<i>Kaiser-Meyer-Olkin Metric for Sampling Adequacy</i>		0.618
<i>Bartlett's sphericity test</i>	<i>approximate chi-square</i>	235.851
	<i>df</i>	15
	<i>Sig.</i>	0.000

It can be seen from Table 5 that the KMO value is 0.618, which is greater than the critical value of 0.6, so it is suitable for factor analysis; From the Bartlett spherical test results, the P value is 0.000, less than 0.05, illustrating that the selected indicators are suitable for factor analysis.

4.2.4 Common factor Extraction

Using SPSS, the eigenvalues and variance contribution rates of each factor were obtained (see Table 6).

Table 6 Total variance explained

<i>Element</i>	<i>Initial Eigenvalues</i>			<i>Extract the Load Sum of Squares</i>		
	<i>Total</i>	<i>Variance (%)</i>	<i>Cumulative (%)</i>	<i>Total</i>	<i>Variance (%)</i>	<i>Cumulative (%)</i>
1	1.794	29.907	29.907	1.794	29.907	29.907
2	1.529	25.481	55.388	1.529	25.481	55.388

3	1.139	18.983	74.370			
4	0.927	15.449	89.820			
5	0.311	5.177	94.997			
6	0.300	5.003	100.000			

It can be seen from Table 6 that the first two common factors are 29.907% and 25.481% respectively, after explaining 55.388% of their total variance, we can know that their cumulative contribution rate has reached 55.388%. In order to explain and provide the outcomes that can be expressed by the original data, two common factors Y1 and Y2 are extracted.

4.2.5 Factor Loading

The maximum variance method is used for factor rotation analysis, and the outcomes are shown in Table 7.

Table 7 Rotation component matrix

	<i>Factor</i>	
	<i>1</i>	<i>2</i>
<i>HC</i>	0.882	
<i>HMHC</i>	0.464	-0.567
<i>THC</i>	0.878	0.180
<i>EP</i>		0.650
<i>S</i>		
<i>LEV</i>	0.112	0.653

It can be seen from Table 7 that common factor 1 has a large load in employee human capital, technical human capital and executive human capital, which can be classified into one category and delimited as human capital factor; common factor 2 has a large load in corporate performance and capital structure. Larger loads, which can be grouped together and defined as performance factors.

4.2.6 Factor Score

Calculate the component score coefficient matrix. See Table 8 for the outcomes.

Table 8 Component score coefficient matrix

	<i>Factor</i>	
	<i>1</i>	<i>2</i>
<i>EP</i>	0.017	0.344
<i>HC</i>	0.493	0.053
<i>HMHC</i>	0.231	0.357
<i>THC</i>	0.505	-0.176

<i>S</i>	-0.066	0.638
<i>LEV</i>	0.086	-0.031

$$Y_1 = 0.017X_1 + 0.493X_2 + 0.231X_3 + 0.505X_4 - 0.066X_5 + 0.086X_6 \quad (3)$$

$$Y_2 = 0.344X_1 + 0.053X_2 + 0.357X_3 - 0.176X_4 + 0.638X_5 - 0.031X_6 \quad (4)$$

Finally, the standardized raw data is substituted into the expression of the common factor, and Y_1 and Y_2 are obtained; In order to accurately analyze the performance of 92 listed companies, it is necessary to conduct a weighted calculation on the data to obtain a comprehensive scoring model, namely:

$$Y = \frac{0.29907}{0.55388} Y_1 + \frac{0.25481}{0.55388} Y_2 \quad (5)$$

4.2.7 Linear Regression Analysis

According to the factor score model, the comprehensive scores of the corporate performance of 92 listed companies from 2020 to 2021 are obtained. Making use of the multiple linear regression model, the two common factors and explanatory variables are uniformly regressed. By using the spss software, the outcomes are shown in Table 9.

Table 9 Results of regression analysis

<i>Model</i>	<i>Unstandardized Coefficients</i>		<i>Standardized Coefficient</i>	<i>Salience</i>
	β	<i>Standard Error</i>	<i>t</i>	
<i>(constant)</i>	0.000	0.000	0.945	0.346
<i>Human Capital Factor</i>	0.540	0.000	2028.269	0.000
<i>Performance Factor</i>	0.460	0.000	1743.239	0.000
<i>Explained variable: firm performance</i>				

In Table 9, it can be seen that all variables have entered the model, and only the performance factor of the two variables has passed the test. The p value is $0.000 < 0.01$, and the correlation coefficient with the explained variable β 0.460, representing a significant positive correlation. To sum up, we can see from the regression results that the p values are all 0.000, far less than 0.01, indicating that human capital factors have a great impact on enterprise performance.

5. Research Conclusions and Prospects

This paper conducts an empirical study and analysis on the relationship between human capital and corporate performance of 92 listed companies. Through the data analysis of 92 listed companies from 2020 to 2021 by SPSS, we can see that human capital affects corporate performance through its enthusiasm, initiative and innovation. From the research outcomes, there is a remarkable correlation between enterprise human capital and enterprise performance, and

it is positive correlation. Listed companies have a greater demand for talent, human capital can promote enterprise performance.

The results of this study show that there is a significant positive correlation between corporate human capital and corporate performance. Thus, the rational collocation of human capital is an important strategy for enterprises to improve performance. Enterprises can formulate various incentive measures to encourage employees to work efficiently; It can also improve the comprehensive quality of employees through various trainings, such as their knowledge and skills, so as to meet the development needs of enterprises and improve their competitiveness, and focus on enterprise department management and technical personnel as training objects; appropriate training should be adopted. In order to avoid brain drain, enterprises should promote the effective introduction of human capital and make greater contributions to corporate performance.

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