Research on the Relationship Between Intellectual Capital and Company Performance
——An Empirical Analysis Based on Panel Data

FAN Libo, YUAN Xin, WANG Su
School of Business, University of International Business and Economics, P.R.China, 100029
lbfan@263.net

Abstract: It is well known that knowledge economy is mainly based on intellectual capital. Intellectual capital plays a key role in enterprise’s value promotion. In fact, the good intellectual capital control system can bring the positive influence to the enterprise achievements. It is important to make empirical research on the relationship between intellectual capital and company performance to create value and enhance the enterprise achievements.

In the paper, we take the relation analysis between intellectual capital and enterprise performance as the main topic of our research. Based on the overseas and domestic scholars’ research, the paper selected companies listed in Shanghai and Shenzhen exchanges in intellectual capital-intensive manufacturing industry, information technology industry as well as banking and insurance industry as research samples in the period of 2007 to 2009, using Value Added Intellectual Coefficient (VAIC) as the evaluation system. The paper constructed three empirical research model based on economic performance, financial performance and stock market performance. We hope to know the status of intellectual capital development in China especially in three industries and try to find out the relationship between intellectual capital and company performance. Finally, based on the empirical study results, we try to provide constructive suggestions for intellectual capital development. And also the paper pointed out the limitations of the research and provided some help for the follow-up study.

Keywords: Intellectual Capital, Company Performance, Value Added Intellectual Coefficient (VAIC)

1 Introduction and Literature Review

In the knowledge economy, intellectual capital not only has become the driving force and an important source of value creation and sustainable development of enterprises, but also innovation and the key to profit growth. Over the past decade China's economy maintained a sustained rapid growth, how much did the intellectual capital, which is the core of value creation, contributed to the economic development of our country? Is the development of China's listed companies mainly dependent on intellectual capital or physical capital? Face of the transformation of the global economy and the domestic market economy, has the driving force of value creation China's enterprises transferred from physical capital to intellectual capital is an hot issue of business and theorists at present.

We selected three industries (manufacturing, information technology, industry and finance and insurance) to explore the relationship between Intellectual capital and company performance of our country, with the hope of providing something useful theoretically and practically for the rational allocation of economic resources and the effective development and use of intellectual capital in the period of transition economies.

Research on intellectual capital home and abroad mainly focused on three areas: the concept of intellectual capital, the composition and measurement of intellectual capital, and the relationship between intellectual capital and business development.

The concept of intellectual capital was first put forward by the Senior in 1836, but was only used as a synonym for human capital. American scholar Calbraith (1969) considered that intellectual capital is not only a static capital with the form of pure knowledge, but also a dynamic process of effective use of knowledge, and this process is related to the achievement of organizational goals. His research extended the concept of intellectual capital from individual level to organizational level. Brooking (1996)
attributed intellectual capital to "all the general term for intangible assets which can enable the enterprises to operate", he believed that "business = tangible assets + intellectual capital." Based on the theory of knowledge, Alexander (2004), Roland (2007) defined intellectual capital as the sum of knowledge resources which transformed from organizational knowledge and can enable the enterprises to realize its market value and enhance its existing assets. Many domestic scholars also made some research on the concept of intellectual capital, such as Tan Jinsong (2001) who defined intellectual capital as a form of human capital which can realize research and innovation and can make directorial allocation of corporation resources. Yuan Qinghong (2001), Wang Yong (2002), Zhang Xiaohong (2007) etc defined the concept of intellectual capital from the knowledge perspective, as well as Yan Huahai (2004) from the perspective of the characteristics of intellectual capital. The composition of intellectual capital is not only the main framework of understanding of the content of intellectual capital, but also an important basis of intellectual capital measurement tools. As a result, there are relatively large differences among domestic and foreign scholars in the field of the composition and measurement of intellectual capital. Currently there are dualism, ternary and pluralism theory. Dualists to Edvinsson and Malone (1997) are the representatives of the dualism theory, they hold the view that intellectual capital is the coupling of human capital and structural capital; Stewart (1994), Mohan (2005), Swart (2006) are the representative of ternary theory, they think that intellectual capital is composed of human capital, structural capital and customer capital and put forward the H-S-C structure; pluralists believe that intellectual capital is equivalent to intangible assets, they explain intellectual capital through the expansion and spread of the concept of intangible assets. Such as Brooking put that intellectual capital should be divided into four parts: market capital, intellectual property capital, human capital and infrastructure capital; based on the essence of the concept of Balanced Scorecard, Bassi (1999) divided intellectual capital into human capital, structural capital, innovation capital, process capital and customer capital. In essence, both the ternary theory and the pluralism theory have developed on the basis of the dualism. In the empirical researches of relationship between intellectual capital and company performance later, scholars also choose make different choices from the methods of classification of intellectual capital. In the empirical researches of intellectual capital and company development, most domestic and international researches focused on the relationship between intellectual capital and company performance. Based on the ternary theory of intellectual capital, Nick Bontis (1998, 2000) made an exploratory research on the measurement and the impact of intellectual capital on company performance. He took a questionnaire survey in companies in Canada and Malaysia and used factor analysis and least squares analysis to do his research. He got the result that the three components of intellectual capital (human capital, structural capital and customer capital) are mutually influenced, and that intellectual capital has significant positive effect on corporate performance. Ahmed Riahi-Belkaoui used 81 companies of the 100 "greatest cross-border" manufacturing and service companies of the United States as his sample and used least squares analysis to study the relationship between intellectual capital and return on total assets based on value-added method. Finally he found that intellectual capital had played a positive and significant role in the performance of multinational companies of the United States. Marvidis (2004, 2005) selected banks in Japan and Greece as the objects of his study, and found that intellectual capital and physical capital both had significantly positive effect on value adding, and that the impact of intellectual capital is greater than the impact of physical capital. Using the data of companies of South Africa, Steven Firer conducted a research on the relationship between company performance (profitability, productivity, market assessment) and the three components of VAIC (Value Added Intellectual Coefficient): VAHU (Value Added Human Capital Coefficient), STVA (Value Added Structural Capital Coefficient) and VACA (Value Added Capital Employed Coefficient), he found that human capital had a significant positive impact on production capacity, structure capital only had a modest positive impact on profitability, however, South African market still focused on the return to physical capital. Based on different intellectual capital structure theory, domestic scholars chose different industries to make empirical research. Chen Jin (2004) divide intellectual capital into human capital, structural capital, innovation capital and customer capital and put
forward a system of qualitative indicators of the measurement of intellectual capital. Besides, he did a questionnaire survey in the high-tech enterprises of Zhejiang Province, and found that both intellectual capital and its four components have significantly positive impact on company performance. More domestic scholars chose the dualism theory of the classification of intellectual capital; they selected different dependent variables and studied different industries. Such as Li Jiaming (2004) selected 30 listed companies of the computer industry, Bai Ming (2005) selected listed companies of telecommunications and computer industry, chemical industry and textile industry, Wan Xi (2006) used 41 of the best-operating listed companies in China as his sample, Yu Haizong and Deng Qian (2007) selected high-tech industry and textile industry, Liu Chao, et al(2008) selected listed companies of the information technology industry, Wang Xinli (2008) selected listed companies of information technology industry and textile industry, Tian Jing (2009) selected manufacturing and information technology industry, Lu Xin, et al (2009) selected listed companies of manufacturing industry, information technology industry and real estate industries as samples to make empirical research on the impact of physical capital, human capital and structural capital on company performance. Most scholars believed that there were a significantly positive correlation between intellectual capital and corporate performance, and that intellectual capital was a source of corporate profits, while physical capital was still the most important resource of business performance. In addition, there are scholars who do their research from different perspectives, such as Yuan Yijun (2006) focused on the value creation potential of intellectual capital. Taiwan scholars Tsai and Hua(2006) focused on the relationship between stock value and intellectual capital, Fu Chuanrui (2008) studied the relationship between intellectual capital and stock price, Zou Yan (2009) did an empirical research on the relationship between intellectual capital and innovation capacity of the company.

There are many unique aspects of the studies of domestic and foreign scholars on intellectual capital, but in general their studies are still inadequate in two aspects: Firstly, the problem lies in the design of corporate performance indicators. Although some scholars have selected a wide range of indicators, such as Steven Firer and S. Mitchell Williams (2003) chose profitability, productivity and market value as indicators of corporate performance, Taiwan scholar Shiu (2006) chose the net rate of total assets, total assets, gross margin and market valuation ratios as three corporate performance indicators, however, most scholars have selected one single performance indicator, hence they can get a comprehensive examination of the performance of enterprises; Secondly, most scholars chose to use cross-sectional data, ignoring the rapid variability feature of Chinese market, which may lead to empirical error of the conclusion. Because of these two weaknesses, this paper chose to use diversified business performance indicators, and the panel data of listed companies of 3 different industries as study sample to do empirical research.

2 Hypotheses and Design of the Research

2.1 Hypothesis of the Research

Daniel Zeghal and Anis Maalou (2010) put that company performance includes economic performance, financial performance and stock market performance. The logic is that if companies have good economic returns, it will be shown in financial result and profitability, thus causing companies to perform well in the stock market. Therefore, there are intrinsic links among economic performance, financial performance and stock market performance. In this context, we choose economic performance, financial performance and stock market performance to measure company performance.

We approve that intellectual capital is the coupling of human capital and structural capital. Human capital includes basic and professional knowledge of the staff, their experience, problem-solving skills, and the ability to update and share their knowledge. Human capital is the core element of intellectual capital, employees who master the knowledge and skills well are an important source of competitive advantage of the company that is an ultimate deciding factor of company performance. In addition, the intellectual capital alone can not create value; it must be combined with physical capital. Based on these
facts, the assumptions are as follows:
H1: there is a positive correlation between human capital and company performance
H1a: there is a positive correlation between human capital and economic performance
H1b: there is a positive correlation between human capital and financial performance
H1c: there is a positive correlation between human capital and stock market performance
Structural capital includes organizational capital and relational capital, which includes management skills, information and networking systems, business process, corporate reputation and brand, customer relationship and so on. Value of human capital cannot be achieved without the help of structure capital. Structure Capital enables companies to run in a high-quality and orderly way, it can provide a stage for the staff to achieve their accomplishment. Based on these facts, the assumptions are as follows:
H2: there is a positive correlation between structural capital and company performance
H2a: there is a positive correlation between structural capital economic performance
H2b: there is a positive correlation between structural capital and financial performance
H2c: there is a positive correlation between structural capital and stock market performance
Physical capital is the basic resource for companies to survive and develop. However, with the development of our economy, the effect of intellectual capital is more and more obvious. Intellectual capital is more precious than physical capital, it cannot be imitated, cannot be replaced and it can enable companies to maintain competitive advantage. As a result, intellectual capital is the most important capital for companies. Based on these facts, the assumptions are as follows:
H3: there is a positive correlation between physical capital and company performance
H3a: there is a positive correlation between physical and economic performance
H3b: there is a positive correlation between physical and financial performance
H3c: there is a positive correlation between physical and stock market performance

2.2 Research Design
2.2.1 Independent Variable
Value-added intellectual capital coefficient (VAIC), which was put forward by Ante Pulic, is a popular method to evaluate intellectual capital. It has advantages such as it is simple; the data required is easy and credible. According to VAIC method, company performance depends on the ability to use financial capital and intellectual capital. We choose VAIC method to measure intellectual capital, which has three independent variables: VAHU (Value Added Human Capital Coefficient), STVA (Value Added Structural Capital Coefficient), VACA (Value Added Capital Employed Coefficient). Finally, VAIC (Value Added Intellectual Coefficient) is the sum of the three variables; the calculation method is as follows:
VAHU= Value added (VA) / Human Capital (HC)
STVA= Structural capital (SC-VA) / Value added (VA)
VACA= Value added (VA) / capital available (CA)
VAIC=VAHU+STVA+VACA

2.2.2 Dependent Variable
According to Daniel Zeghal and Anis Maalou (2010), corporate performance is a system including economic performance, financial performance and stock market performance. We select Operating Margin (OM), Weighted Average Return on Equity (ROE) and Price-to-Book Ratio (P/B), respectively, to measure economic performance, financial performance and stock market performance.

2.2.3 Control Variable
As the capital structure can affect the cost and value of the corporation, it may lead to great difference in company performance; Second, different size of enterprises may cause different competitive environment and market position, thus the ability to get profit is not the same; In addition, the different efficiency of different enterprises will affect competitiveness, resulting in different company performance; Finally, different companies are at different stages of life cycle, that will have great impact on company performance. Therefore, we choose Asset-Liability Ratio (Lev), Firm Size (Size), Total
Asset Turnover Ratio (TAT) and Growth Ability (GR) as our control variables. For Firm Size (Size) we take the natural logarithm of total assets, and Growth Ability (GR) is measured by revenue growth ratio. Economic meaning and computing method of all variables are shown in table 1.

2.2.4 Sample Selecting and Data Filtering

Different industries have different resource; this paper selected three industries that have distinctive characteristics to conduct research. They are manufacturing industry- a traditional industry, information & technology industry - high-tech industry and finance & insurance industries - new service industry. In this way, we can explore the difference of the driving power of intellectual capital of different industries. Manufacturing industry is traditional, its production technology is mature and market is stable, it demands for a large number of employees, its demand-income elasticity and degree of risk are low. Information & technology industry is a knowledge-intensive industry, its competition is fierce, and it demands for employees who have relatively higher quality. Financial & insurance industry is a highly knowledge-intensive industries, its technological innovation is fast, product life cycle is short, and market is volatile. Its demand-income elasticity and degree of risk are high.

<table>
<thead>
<tr>
<th>Name of Variables</th>
<th>Economic implications</th>
<th>Calculation</th>
<th>Types of Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>OM</td>
<td>Operating Margin</td>
<td>Operating Profit / Operating Income</td>
<td>dependent variable</td>
</tr>
<tr>
<td>ROE</td>
<td>Weighted Average Return on Equity</td>
<td>data from the annual reports of listed companies</td>
<td>dependent variable</td>
</tr>
<tr>
<td>P/B</td>
<td>Price-to-Book Ratio</td>
<td>yearly tradable market value / book value of net assets</td>
<td>dependent variable</td>
</tr>
<tr>
<td>VAHU</td>
<td>Value Added Human Capital Coefficient</td>
<td>value added / human capital</td>
<td>independent variable</td>
</tr>
<tr>
<td>STVA</td>
<td>Value Added Structural Capital Coefficient</td>
<td>structural capital / value added</td>
<td>independent variable</td>
</tr>
<tr>
<td>VACA</td>
<td>Value Added Capital Employed Coefficient</td>
<td>value added / book value of net assets</td>
<td>independent variable</td>
</tr>
<tr>
<td>Lev</td>
<td>asset-liability ratio</td>
<td>Liabilities / Total Assets</td>
<td>control variable</td>
</tr>
<tr>
<td>Size</td>
<td>Firm Size</td>
<td>Ln(total assets)</td>
<td>control variable</td>
</tr>
<tr>
<td>TAT</td>
<td>Total Asset Turnover</td>
<td>net operating income / average total assets*100%</td>
<td>control variable</td>
</tr>
<tr>
<td>GR</td>
<td>Revenue Growth Ratio</td>
<td>revenue growth of the year / total operating income of last year *100%</td>
<td>control variable</td>
</tr>
</tbody>
</table>

We select 1084 enterprises which are listed in Shanghai and Shenzhen stock exchange market during the period of 2007-2009 as our sample. There are 957 enterprises from manufacturing industry, 95 enterprises from information & technology industry and 32 enterprises from finance & insurance industry. Considering missing value and abnormal value may have bad affect on statistical results, we reject the companies which have missing data or have got special treatment during 2007-2009. Besides, we reject the companies whose human capital, structural capital and the book value of equity is negative. In addition, some manufacturing companies are traditional labor-intensive enterprise, whose value

\(^{\text{c}}\)The industry categorization standard is consistent with the standard of the Securities Regulatory Commission of China; the data of this paper all comes from the RESSET database and the 2007-2009 annual reports.
creating process relies less on knowledge. It makes no sense to include these companies in our research, thus we reject these labor-intensive industry: food & beverage industry, textile & fur industry, wood & furniture industry, paper & printing industry, petrochemical industry, plastics industry, metal & nonmetal industry. After screening, the final sample has a total number of 856, including 267 in manufacturing industry, 38 in information & technology industry, 20 in finance & insurance industry.

2.2.5 Empirical Research Model

For the purpose of our research, we tend to carry out empirical research based on these three models

\[ \text{OM} = \beta_0 + \beta_1 \text{VAHU} + \beta_2 \text{STVA} + \beta_3 \text{VACA} + \beta_4 \text{Lev} + \beta_5 \text{Size} + \beta_6 \text{TAT} + \beta_7 \text{GR} + \mu \] (model 1)

\[ \text{ROE} = \beta_0 + \beta_1 \text{VAHU} + \beta_2 \text{STVA} + \beta_3 \text{VACA} + \beta_4 \text{Lev} + \beta_5 \text{Size} + \beta_6 \text{TAT} + \beta_7 \text{GR} + \mu \] (model 2)

\[ \text{P/B} = \beta_0 + \beta_1 \text{VAHU} + \beta_2 \text{STVA} + \beta_3 \text{VACA} + \beta_4 \text{Lev} + \beta_5 \text{Size} + \beta_6 \text{TAT} + \beta_7 \text{GR} + \mu \] (model 3)

3 Empirical Analyses

3.1 Descriptive statistical analysis

Based on the 2007-2009 panel data of three industries, we use STATA software to make a descriptive statistical analysis of the variables; Results are shown in Table 2

<table>
<thead>
<tr>
<th>variables</th>
<th>manufacturing industry</th>
<th>information &amp; technology industry</th>
<th>finance &amp; insurance industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAHU</td>
<td>3.092875</td>
<td>2.2524454</td>
<td>4.0719365</td>
</tr>
<tr>
<td>STVA</td>
<td>0.55692</td>
<td>0.4862719</td>
<td>0.7286728</td>
</tr>
<tr>
<td>VAIN</td>
<td>3.649795</td>
<td>2.7387173</td>
<td>4.8006093</td>
</tr>
<tr>
<td>VACA</td>
<td>0.361888</td>
<td>0.2966731</td>
<td>0.3201595</td>
</tr>
<tr>
<td>VAIC</td>
<td>4.011683</td>
<td>3.0353904</td>
<td>5.1207688</td>
</tr>
<tr>
<td>Lev</td>
<td>0.447497</td>
<td>0.3786801</td>
<td>0.7816546</td>
</tr>
<tr>
<td>Size</td>
<td>21.45758</td>
<td>21.419555</td>
<td>25.419223</td>
</tr>
<tr>
<td>TAT</td>
<td>0.823411</td>
<td>0.8916649</td>
<td>0.1210483</td>
</tr>
<tr>
<td>GR</td>
<td>16.68593</td>
<td>19.418836</td>
<td>59.894295</td>
</tr>
<tr>
<td>OM</td>
<td>0.105386</td>
<td>0.1150212</td>
<td>0.4837577</td>
</tr>
<tr>
<td>ROE</td>
<td>0.127199</td>
<td>0.1217382</td>
<td>0.2393567</td>
</tr>
<tr>
<td>P/B</td>
<td>2.156659</td>
<td>2.1099317</td>
<td>2.8511109</td>
</tr>
</tbody>
</table>

As is shown in the table, the mean value of VAIC of the manufacturing industry is 4.011683, which indicates that each Yuan we put in our manufacturing industry will produce a value of 4.011683 Yuan; and the mean value of VAIC of the information & technology industry and the finance & insurance industry are 3.0353904 and 5.1207688. Clearly, VAIC of the finance & insurance industry > VAIC of the manufacturing industry > VAIC of the information & technology industry, This result is contradict to our general sense that the efficiency of intellectual capital of the information & technology industry should be higher than its efficiency of the manufacturing industry. To some extent, it points out that our business still depends more on the finance & insurance industry and the manufacturing industry to create value. From the perspective of the structure of Value-added intellectual coefficient system, no matter it is the manufacturing industry, the information & technology industry or the finance & insurance industry, they all share one characteristic: the mean value of VAHU > the mean value of STVA > the mean value of VACA, that indicates that these three typical industries all rely more on...
human capital, followed by the structural capital, more on physical capital to create value. This shows the development level of intellectual capital is still in its infancy. In addition, of the three industry, the mean value of VAIN > the mean value of VACA, it indicates that even in traditional industries, such as the manufacturing industry, companies have begun to rely more on intellectual capital to create value, rather than relying solely on material and financial capital to create value. This conclusion is consistent to the study results of Zéghal (2000), Firer and Williams (2003).

3.2 Correlation Analysis
We use Pearson Correlation Analysis Method to test the correlation of the variables of the three industries.
Table 3 reflects that in China's manufacturing enterprises, Value Added Human Capital Coefficient (VAHU) and Operating Margin (OM) and Weighted Average Return on Equity (ROE) are significantly positive correlated, but the positive correlation between VAHU and Price-to-Book Ratio (P/B) is not significant.

<table>
<thead>
<tr>
<th>variable</th>
<th>manufacturing industry</th>
<th>information &amp; technology industry</th>
<th>finance &amp; insurance industry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OM</td>
<td>ROE</td>
<td>P/B</td>
</tr>
<tr>
<td>VAHU</td>
<td>0.26**</td>
<td>0.18**</td>
<td>0.06</td>
</tr>
<tr>
<td>STVA</td>
<td>0.57**</td>
<td>0.60**</td>
<td>0.15**</td>
</tr>
<tr>
<td>VAIN</td>
<td>0.27**</td>
<td>0.19**</td>
<td>0.06</td>
</tr>
<tr>
<td>VACA</td>
<td>-0.03</td>
<td>0.10**</td>
<td>0.04</td>
</tr>
<tr>
<td>VAIC</td>
<td>0.27**</td>
<td>0.20**</td>
<td>0.06</td>
</tr>
<tr>
<td>LEV</td>
<td>-0.39**</td>
<td>-0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>SIZE</td>
<td>-0.05</td>
<td>0.25**</td>
<td>-0.13**</td>
</tr>
<tr>
<td>TAT</td>
<td>-0.25**</td>
<td>0.19**</td>
<td>-0.06</td>
</tr>
<tr>
<td>GR</td>
<td>0.15**</td>
<td>0.39**</td>
<td>0.12**</td>
</tr>
</tbody>
</table>

Note: ** indicates the two-tailed significance level is 1%, * indicates the two-tailed significance level is 5%

Therefore for China's manufacturing enterprises, this finding fully supports H1a and H2a, partly rejects H3a. The correlation between Value Added Structural Capital Coefficient (STVA) and Operating Margin (OM), Weighted Average Return on Equity (ROE) and Price-to-Book Ratio (P/B) is significantly positive. Therefore, for China's manufacturing enterprises, this finding fully supports H1b, H2b, and H3b. Value Added Capital Employed Coefficient (VACA) and Weighted Average Return on Equity (ROE) are significantly positive correlated, its positive correlation with Price-to-Book Ratio (P/B) is not significant. However, its correlation with Operating Margin (OM) is negative, although not significant. Therefore, for China's manufacturing enterprises, this finding fully supports the establishment of an H2c, fully rejects H1c, and partly rejects H3c.

Table 3 reflects that in China's information & technology industry, business, Value Added Human Capital Coefficient (VAHU) is only significantly positive correlated with Operating Margin (OM), its positive correlation with Weighted Average Return on Equity (ROE) is not significant, and its correlation with Price-to-Book Ratio (P/B) is negative, although not significant. Therefore, for China's information & technology industry, this finding fully supports the establishment of H1a, partly rejects H2a, and completely rejects H3a. Value Added Structural Capital Coefficient (STVA) and Operating Margin (OM) are significantly positive correlated, its positive correlation with Weighted Average
Return on Equity (ROE) is not significant, and its correlation with Price-to-Book Ratio (P / B) is negative, although not significant. Therefore, for China's information & technology industry, this finding fully supports the establishment of H1b, partly rejects H2b, completely rejects H3b. Value Added Capital Employed Coefficient (VACA) and Weighted Average Return on Equity (ROE) is significantly positive correlated, its positive correlation with Operating Margin (OM) is not significant, and its correlation with Price-to-Book Ratio (P / B) is negative, although not significant. Therefore, for China's information & technology industry, this finding fully supports the establishment of H2c, partly rejects H3c, and completely rejects H1c.

Table 3 reflects that in China's finance & insurance companies, Value Added Human Capital Coefficient (VAHU) and Weighted Average Return on Equity (ROE) is significantly positive correlated, its correlation with Operating Margin (OM) and Price-to-Book Ratio (P / B) is negative, although not significant. Therefore, for China's finance & insurance enterprises, this finding fully supports the establishment of H2a, completely rejects H1a and H3a. Structural Capital Coefficient (STVA) and Operating Margin (OM) are significantly positive correlated, its positive correlation with Weighted Average Return on Equity (ROE) is not significant, and its correlation with Price-to-Book Ratio (P / B) is significantly negative. Therefore, for China's finance & insurance enterprises, this finding fully supports the establishment of H1b, partly rejects H2b, completely rejects H3b. Value Added Capital Employed Coefficient (VACA) and Weighted Average Return on Equity (ROE) is significantly positive correlated, its positive correlation with Price-to-Book Ratio (P / B) is not significant, and its correlation with Operating Margin (OM) is negative, although not significant. Therefore, for China's finance & insurance enterprises, this finding fully supports the establishment of H2c, partly rejects H3c, and completely rejects H1c.

3.3 Multivariable Linear Regression Model

Correlation analysis is the first step to test our nine assumptions, on this basis; we use three multivariable linear regression models to continue our test based on the panel data of the period of 2007-2009. Four control variables (asset-liability ratio, firm size, total asset turnover, the ability to grow) which may affect the company performance are also included in the models.

We use the fix-effect model of the STATA software for data processing.

3.3.1 Multivariable Linear Regression Model of Economic Performance

Table 4 reflects the results of multivariable linear regression model of economic performance of three industries. We use Operating Margin (OM) as the dependent variable.

For China's manufacturing enterprises, the value of R² is 0.2908, which indicates that 29.08% of the change in value of OM can be attributed to Value Added Human Capital Coefficient (VAHU), Structural Capital Coefficient (STVA), Value Added Capital Employed Coefficient (VACA), Asset-Liability Ratio (Lev), Firm Size (Size), Total Asset Turnover Ratio (TAT), and Growth Ability (GR). The goodness of fit of this model is satisfactory. Both the correlation between OM and STVA, and the correlation between OM and VACA are positive and reach a P <0.01 significance level, while after controlling the effects of other variables, the correlation between VAHU and OM is positive but not significant. Therefore, for China’s manufacturing industry, the model fully supports the establishment of H1b and H1c, partly rejects H1a.

For China's information & technology enterprises, the value of R² is 0.5924, which indicates that 59.24% of the change in value of OM can be attributed to Value Added Human Capital Coefficient (VAHU), Structural Capital Coefficient (STVA), Value Added Capital Employed Coefficient (VACA), Asset-Liability Ratio (Lev), Firm Size (Size), Total Asset Turnover Ratio (TAT), and Growth Ability (GR). The goodness of fit of this model is satisfactory. Both the correlation between OM and VACA, and the correlation between OM and VACA are positive and reach a P <0.01 significance level, while after controlling the effects of other variables, the correlation between VAHU and OM is positive but not significant. Therefore, for China’s information & technology industry, the model fully supports the establishment of H2c, partly rejects H3c, and completely rejects H1c.

The panel data of this paper has passed the collinearity analysis, the heteroscedasticity analysis and the auto-correlation analysis, the results show that variables generally meet the requirement; the fix-effect model has passed the LM test and the Hausman test.
and the correlation between OM and STVA are positive and reach a P <0.01 significance level, while after controlling the effects of other variables, the correlation between VACA and OM is positive but not significant. Therefore for China’s information & technology industry, the model fully supports the establishment of H1a and H1b, partly rejects H1c.

Table 4 Multivariable Linear Regression Model of Economic Performance

| Model 1: OM = β0 + β1VAHU + β2STVA + β3VACA + β4Lev +β5Size+β6TAT+β7GR+ μ |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                  | R²      | VAHU      | STVA      | VACA      | Lev       | Size       | TAT       | GR       |
| M                | 0.291   | -0.50816  | 0.000597  | 0.3653**  | 0.0515**  | -0.158**  | 0.0223    | -0.02577  | 0.0001    |
| (-1.70)          | (1.41)  | (11.93)   | (3.67)    | (-3.32)   | (1.61)    | (-1.11)   | (1.04)    |
| I & T            | 0.5924  | -0.54986  | 0.0138**  | 0.2287**  | 0.06741   | 0.011888  | 0.025096  | -0.0423*  | -0.00009  |
| (-1.48)          | (3.21)  | (4.74)    | (0.98)    | (0.14)    | (1.44)    | (-2.36)   | (-0.88)   |
| F & I            | 0.7435  | -0.79538  | -0.0446*  | 1.3825**  | 0.107639  | -0.02354  | 0.016952  | -0.02291  | 0.00156   |
| (-0.47)          | (-2.34) | (8.68)    | (0.50)    | (-0.06)   | (0.25)    | (-0.03)   | (0.57)    |

Note: ** indicates the two-tailed significance level is 1%, * indicates the two-tailed significance level is 5%; M represents manufacturing industry, I&T represents information & technology industry, F&I represents finance & insurance industry.

For China’s finance & insurance enterprises, the value of R² is 0.7435, which indicates that 74.35% of the change in value of OM can be attributed to Value Added Human Capital Coefficient (VAHU), Structural Capital Coefficient (STVA), Value Added Capital Employed Coefficient (VACA), Asset-Liability Ratio (Lev), Firm Size (Size), Total Asset Turnover Ratio (TAT), and Growth Ability (GR). The goodness of fit of this model is satisfactory. The correlation between OM and STVA is positive and reaches a P <0.01 significance level, while after controlling the effects of other variables, the correlation between VACA and OM is positive but not significant. However, the correlation between VAHU and OM is negative, although not significant. Therefore for China’s finance & insurance industry, the model fully supports the establishment of H1b, partly rejects H1c, and completely rejects H1a.

3.3.2 Multivariable Linear Regression Model of Financial Performance

Table 5 reflects the results of multivariable linear regression model of financial performance of three industries. We use Weighted Average Return on Equity (ROE) as the dependent variable. For China’s manufacturing enterprises, the value of R² is 0.4314, which indicates that 43.14% of the change in value of ROE can be attributed to Value Added Human Capital Coefficient (VAHU), Structural Capital Coefficient (STVA), Value Added Capital Employed Coefficient (VACA), Asset-Liability Ratio (Lev), Firm Size (Size), Total Asset Turnover Ratio (TAT), and Growth Ability (GR). The goodness of fit of this model is satisfactory. Both the correlation between ROE and STVA, and the correlation between ROE and VACA are positive and reach a P <0.01 significance level, while after controlling the effects of other variables, the correlation between VAHU and ROE is positive but not significant. Therefore, for China’s manufacturing industry, the model fully supports the establishment of H2b and H2c, partly rejects H2a.
For China’s information & technology enterprises, the value of $R^2$ is 0.4709, which indicates that 47.09% of the change in value of ROE can be attributed to Value Added Human Capital Coefficient (VAHU), Structural Capital Coefficient (STVA), Value Added Capital Employed Coefficient (VACA), Asset-Liability Ratio (Lev), Firm Size (Size), Total Asset Turnover Ratio (TAT), and Growth Ability (GR). The goodness of fit of this model is satisfactory. The correlation between ROE and STVA is positive and reach a $P < 0.01$ significance level, while after controlling the effects of other variables, both the correlation between VAHU and ROE and the correlation between VACA and ROE are positive but not significant. Therefore, for China’s information & technology industry, the model fully supports the establishment of H2b, partly rejects H2a and H2c.

**Table 5 Multivariable Linear Regression Model of Financial Performance**

| Model 2 $\text{ROE} = \beta_0 + \beta_1 \text{VAHU} + \beta_2 \text{STVA} + \beta_3 \text{VACA} + \beta_4 \text{Lev} + \beta_5 \text{Size} + \beta_6 \text{TAT} + \beta_7 \text{GR} + \mu$ |
|---|---|---|---|---|---|---|---|---|
| $R^2$ | $\beta_0$ | VAHU | STVA | VACA | Lev | Size | TAT | GR |
| M | 0.4314 | -0.69089 (2.48) | 0.00039 (1.00) | 0.3949** (13.82) | 0.0577** (4.39) | -0.1192** (-2.69) | 0.0264* (2.03) | 0.070** (3.21) | 0.0003** (2.99) |
| I & T | 0.4709 | -0.50504 (0.88) | -0.009 (-1.36) | 0.3107** (4.17) | -0.00812 (-0.08) | 0.0003867 (0.00) | 0.022323 (0.83) | 0.011142 (0.40) | 0.0005** (3.46) |
| F & I | 0.6334 | -0.40186 (-0.11) | 0.1099** (2.79) | 0.068423 (0.21) | 1.4712** (3.34) | 0.2297133 (0.29) | 0.006267 (0.04) | -6.110** (-4.17) | 0.001227 (2.19) |

Note: ** indicates the two-tailed significance level is 1%, * indicates the two-tailed significance level is 5%; M represents manufacturing industry, I&T represents information & technology industry, F&I represents finance & insurance industry.

For China’s finance & insurance enterprises, the value of $R^2$ is 0.6334, which indicates that 63.34% of the change in value of ROE can be attributed to Value Added Human Capital Coefficient (VAHU), Structural Capital Coefficient (STVA), Value Added Capital Employed Coefficient (VACA), Asset-Liability Ratio (Lev), Firm Size (Size), Total Asset Turnover Ratio (TAT), and Growth Ability (GR). The goodness of fit of this model is satisfactory. Both the correlation between ROE and VAHU, and the correlation between ROE and VACA are positive and reach a $P < 0.01$ significance level, while after controlling the effects of other variables, the correlation between STVA and ROE is positive but not significant. Therefore, for China’s finance & insurance industry, the model fully supports the establishment of H2a and H2c.

3.3.3 Multivariable Linear Regression Model of Stock Market Performance

Table 6 reflects the results of multivariable linear regression model of stock market performance of three industries. We use Price-to-Book Ratio (P / B) as the dependent variable.

For China’s manufacturing enterprises, the value of $R^2$ is 0.0321, which indicates that 3.21% of the change in value of P/B can be attributed to Value Added Human Capital Coefficient (VAHU), Structural Capital Coefficient (STVA), Value Added Capital Employed Coefficient (VACA), Asset-Liability Ratio (Lev), Firm Size (Size), Total Asset Turnover Ratio (TAT), and Growth Ability (GR). The goodness of fit of this model is not satisfactory. The correlation between P/B and STVA is positive and reach a $P$
<0.01 significance level, while after controlling the effects of other variables, the correlation between VACA and P/B is positive but not significant. However, the correlation between VAHU and P/B is negative, although not significant. Therefore, for China’s manufacturing industry, the model fully supports the establishment of H3b, partly rejects H2c, and completely rejects H3a.

Table 6 Multivariable Linear Regression Model of Stock Market Performance

<table>
<thead>
<tr>
<th>Model 3</th>
<th>P/B = β0 + β1VAHU + β2STVA + β3VACA + β4Lev + β5Size + β6TAT + β7GR + μ</th>
<th>R²</th>
<th>β0</th>
<th>VAHU</th>
<th>STVA</th>
<th>VACA</th>
<th>Lev</th>
<th>Size</th>
<th>TAT</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>0.0321</td>
<td>5.755</td>
<td>-0.00419* (1.52)</td>
<td>0.996411* (2.57)</td>
<td>0.2197711 (1.24)</td>
<td>1.6682** (2.77)</td>
<td>-0.2241 (-1.27)</td>
<td>-0.17999 (-0.61)</td>
<td>-0.0003 (-0.22)</td>
<td></td>
</tr>
<tr>
<td>I &amp; T</td>
<td>0.2528</td>
<td>-24.33* (-2.56)</td>
<td>0.050351 (0.46)</td>
<td>-0.877336 (-0.71)</td>
<td>1.675131 (0.95)</td>
<td>3.908856 (1.85)</td>
<td>1.1640* (2.61)</td>
<td>0.027794 (0.06)</td>
<td>-0.010** (-3.97)</td>
<td></td>
</tr>
<tr>
<td>F &amp; I</td>
<td>0.1308</td>
<td>6.75665 (0.24)</td>
<td>0.161410 (0.51)</td>
<td>-0.565199 (-0.21)</td>
<td>-3.969179 (-1.12)</td>
<td>14.005 0* (2.17)</td>
<td>-0.56114 (-0.49)</td>
<td>4.587241 (0.39)</td>
<td>-0.0023 (-0.44)</td>
<td></td>
</tr>
</tbody>
</table>

Note: ** indicates the two-tailed significance level is 1%, * indicates the two-tailed significance level is 5%; M represents manufacturing industry, I&T represents information & technology industry, F&I represents finance & insurance industry.

For China’s information & technology enterprises, the value of $R^2$ is 0.2528, which indicates that 25.28% of the change in value of P/B can be attributed to Value Added Human Capital Coefficient (VAHU), Structural Capital Coefficient (STVA), Value Added Capital Employed Coefficient (VACA), Asset-Liability Ratio (Lev), Firm Size (Size), Total Asset Turnover Ratio (TAT), and Growth Ability (GR). The goodness of fit of this model is satisfactory. Both the correlation between P/B and VAHU and the correlation between P/B and VACA are positive but not significant, while the correlation between P/B and STVA is negative, although not significant. Therefore, for China’s information & technology industry, the model partly rejects the establishment of H3a and H3c, completely rejects H3b.

For China's finance & insurance enterprises, the value of $R^2$ is 0.1308 which indicates that 13.08% of the change in value of P/B can be attributed to Value Added Human Capital Coefficient (VAHU), Structural Capital Coefficient (STVA), Value Added Capital Employed Coefficient (VACA), Asset-Liability Ratio (Lev), Firm Size (Size), Total Asset Turnover Ratio (TAT), and Growth Ability (GR). The goodness of fit of this model is not satisfactory. The correlation between P/B and VAHU is positive but not significant, while both the correlation between P/B and VACA and the correlation between P/B and STVA are negative, although not significant. Therefore, for China’s finance & insurance industry, the model partly rejects the establishment of H3a, completely rejects H3b and H3c.
4 Final Results of Empirical Analysis

Considering the results of Pearson Correlation Analysis and Multivariable Linear Regression Models, if the results of the two methods are both significantly positive, then we conclude that the establishment of our assumption is supported; if the results of the two methods are both significantly negative, then we conclude that the establishment of our assumption is rejected; if one result is significantly positive, while the other is positive but not significant, then we conclude that the establishment of our assumption is still supported; if one result is significantly negative, while the other is negative but not significant, then we conclude that the establishment of our assumption is still rejected; if one result is positive while the other is negative, or both the two results are positive/negative but not significant, then we can not determine the final conclusion of our assumption. Based on the above criteria, we summarize our final results in Table 7.

<table>
<thead>
<tr>
<th>Assumption</th>
<th>M</th>
<th>I&amp;T</th>
<th>F&amp;I</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a</td>
<td>supported</td>
<td>supported</td>
<td>rejected</td>
</tr>
<tr>
<td>H2a</td>
<td>supported</td>
<td>undetermined</td>
<td>supported</td>
</tr>
<tr>
<td>H3a</td>
<td>undetermined</td>
<td>undetermined</td>
<td>undetermined</td>
</tr>
<tr>
<td>H1b</td>
<td>supported</td>
<td>supported</td>
<td>supported</td>
</tr>
<tr>
<td>H2b</td>
<td>supported</td>
<td>supported</td>
<td>undetermined</td>
</tr>
<tr>
<td>H3b</td>
<td>supported</td>
<td>undetermined</td>
<td>rejected</td>
</tr>
<tr>
<td>H1c</td>
<td>undetermined</td>
<td>undetermined</td>
<td>undetermined</td>
</tr>
<tr>
<td>H2c</td>
<td>supported</td>
<td>undetermined</td>
<td>supported</td>
</tr>
<tr>
<td>H3c</td>
<td>undetermined</td>
<td>undetermined</td>
<td>undetermined</td>
</tr>
</tbody>
</table>

Note: M represents manufacturing industry, I&T represents information & technology industry, F&I represents finance & insurance industry.

For the intellectual capital-intensive manufacturing enterprises of our country, the final results of empirical analysis show that Value Added Human Capital Coefficient (VAHU) has positive impact on Operating Margin (OM) and Weighted Average Return on Equity (ROE), however, its impact on Price-to-Book Ratio (P / B) is not obvious; Structural Capital Coefficient (STVA) has positive impact on Operating Margin (OM), Weighted Average Return on Equity (ROE), and Price-to-Book Ratio (P / B); Value Added Capital Employed Coefficient (VACA) has positive on Weighted Average Return on Equity (ROE), however, its impact on Operating Margin (OM) and Price-to-Book Ratio (P / B) is not obvious. This indicates that although currently the organizational structure and relational capital of China's intellectual capital-intensive manufacturing enterprises is relatively stable, they still have not reached the best state. The investment companies put in structural aspect such as production process design & control and organizational management, as well as the investment companies put in relational aspect such as market and customer management all have great contribution on company performance. The investment companies put in human capital contribute significantly to the economic and financial performance of the company; however, it can not be reflected in the stock market. The reason may lies...
in that stock market investors believe human capital does not have obvious impact on the market value and development potential of the companies because of the relatively stable organizational structure and management system, as well as relatively high turnover rate of high-quality employees and low turnover rate of low-quality employees. The investment companies put in physical capital can be reflected in the financial performance, while it has little contribution to the economic and stock market performance. The possible reason may be that China’s manufacturing industry has already entered the mature stage, thus the investment companies put solely on physical capital has already entered the diminishing stage of margin utility and its impact on the upgrading of company performance is limited.

For information & technology enterprises of our country, the final results of empirical analysis show that Value Added Human Capital Coefficient (VAHU) has positive impact on Operating Margin (OM), however, its impact on Weighted Average Return on Equity (ROE) and Price-to-Book Ratio (P/B) is not obvious; Structural Capital Coefficient (STVA) has positive impact on Operating Margin (OM) and Weighted Average Return on Equity (ROE), however, its impact on Price-to-Book Ratio (P/B) is not obvious; Value Added Capital Employed Coefficient (VACA) has little impact on Operating Margin (OM), Weighted Average Return on Equity (ROE) or Price-to-Book Ratio (P/B) is not obvious. Clearly, the results of information & technology industry are not as ideal as we originally anticipated. On one hand this may be due the growth and development time of China's information & technology industry is still limited, the organizational structure and management system is still not perfect; on the other hand, the stage of China's information & technology industry and its innovation ability are in urgent need to be improved. The potential contribution human capital can have on company performance has not been prominent; the overall efficiency of intellectual capital still has large room for improvement. The reason why the investment companies put in physical capital has little impact on company performance may lies in that information & technology industry is a knowledge-intensive industry, companies should pay more attention to the creativity of employees and the quality of information, and to ensure full and timely supply of information and services is extremely critical. Comparatively speaking, investment on materials is not that important. 

For finance & insurance enterprises of our country, the final results of empirical analysis show that Value Added Human Capital Coefficient (VAHU) has positive impact on Weighted Average Return on Equity (ROE), however, its impact on Price-to-Book Ratio (P/B) is not obvious, and the final results reject he assumption that VAHU has positive impact on Operating Margin (OM); Structural Capital Coefficient (STVA) has positive impact on Operating Margin (OM), however, its impact on Operating Margin (OM) is not obvious, and the final results reject he assumption that STVA has positive impact on Price-to-Book Ratio (P/B); Value Added Capital Employed Coefficient (VACA) has positive impact on Weighted Average Return on Equity (ROE), however, its impact on Operating Margin (OM) and Price-to-Book Ratio (P/B) is not obvious. Clearly, the results of finance & insurance industry are not as ideal as we originally anticipated. The efficiency of human capital of finance & insurance companies of China can be reflected through financial performance, but can not be reflected through economic or stock market performance; the efficiency of structural capital can be reflected through economic performance, but can not be reflected through financial or stock market performance. This may be due to finance & insurance industry has higher requirement for its employees comparing to other industries, the corresponding higher salary leads to higher labor cost. Besides, our finance & insurance market is still immature, its market & customer development, organizational structure, management system and working process design are still in an exploration stage, resulting in that the investment companies put in intellectual capital haven’t had obvious contribution to the enhancement of company performance. In addition, finance & insurance industry is a highly intellectual capital-intensive service industry, comparatively speaking, the investment in physical capital is not as important as in intellectual capital for the companies. Finally, no matter in which industry, neither the investment companies put in intellectual capital nor physical capital has obvious impact on stock market performance, which may be due to that stock market investors don’t concern much about the efficiency of capital of the companies when they buy
stocks. Two reasons may explain this phenomenon. Firstly, the investment companies put in intellectual capital is still on a low level, stock market investors might be because of our intellectual capital in business investment is still in the lower level, investors are not willing to pay more for the low efficiency of intellectual capital. Secondly, the investment behavior of China’s stock market is still not rational; investors pay little attention on the value and potential of the companies. Correspondingly, because the stock market does not care enough about intellectual capital, companies may easily lose their enthusiasm and passion about continually invest in it. In addition, there are numerous factors that may affect the stock market, not only the operating situation of the companies, but also the psychological expectations of investors, Asymmetric and incomplete Information, floating capital and so on.

5 Summary and Limitation of the Research

From our research based on the panel data of intellectual capital-intensive manufacturing industry, information & technology industry and finance & insurance industry, we can learn that there exists difference in the efficiency of intellectual capital to create efficiency among different industries. Comparatively, the efficiency of intellectual capital of finance & insurance industry is the highest, while because that information & technology industry is still at an immature stage, the efficiency of intellectual capital is not quite clear. Besides, the driving force of capital to create value lies in human capital and structural capital, while the effect of physical capital is relatively low. In the future, companies should pay attention to the structure of the driving force to create value in order to improve the efficiency of capital. For manufacturing industry, along with maintaining the existing efficiency of human capital, companies should pay attention to the improvement of organizational structure and management system to enhance the efficiency of structural capital. Through these efforts can the companies maintain the driving force to create value inside the organizations and avoid the risk of losing high-quality employees. For information & technology industry, there is still large room for the development of intellectual capital; companies should spare no effort to enhance the efficiency of human capital and structural capital in order to become truly technology-intensive enterprises. For finance & insurance industry, along with maintaining the relatively high level of efficiency of intellectual capital, companies should strengthen the impact intellectual capital and physical capital had on company performance and hence promote the development of the industry.

Because we use the VAIC method to measure intellectual capital, we can not avoid the limitation of this method. In the future, we hope that more effective ways to measure intellectual capital can be found. In this paper we divide company performance into economic performance, financial performance and stock market performance in order to examine company performance comprehensively. However, as there are natural links among these indicators, in the future we hope through factor analysis, one single comprehensive indicator can be extracted to reflect company performance. In addition, we take the dualism theory of intellectual capital and test the relationship between company performance and intellectual capital. However, human capital can not create value on its own, to some extent; it needs to rely on structural capital to contribute to company performance. The question that whether there is mutual promotion relationship between these two kinds of capital still need further study to answer.

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