

Knowledge Management, Education and Firm's Performance

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Abstract - In this paper, we examine how new CIO's education affects the association between knowledge management and firm's operating performance. Using OLS regression analysis, we find that the positive relationship between the effectiveness of knowledge management and firm's operating performance is more prominent when the firm's new CIO has a PHD degree. Our results therefore provide evidence that CIO's education facilitates the application of knowledge management.

Keywords - Knowledge Management, Education, Performance

Data Availability - Data is publicly available.

I. INTRODUCTION

Early studies indicate that effective knowledge management is positively associated with firm's value and operating performance [1, 2, 3]. Recent studies further suggest that individual level innovation may lead to knowledge management success in an organization (e.g. [4]). Extending from these findings, the purpose of this study is to expand the knowledge management literature by investigating how individual's professional ability affects the association between the effectiveness of knowledge management and firms' operating performance. More specifically, we examine the impact of new CIO's education on the association between the level of research and development expenses and firm's financial performance measurements.

By using OLS regression analysis on a sample of 103 firms that appointed new CIO from 2007 to 2008, we find that the positive relationship between the effectiveness of knowledge management and firm's operating performance is more prominent when the firm's new CIO has a PHD degree. Our study contributes to the knowledge management literature by providing empirical evidence that CIO's education facilitates the application of knowledge management. To our knowledge, this is the first study showing the CIO's education has influences on firms' knowledge and financial performance. Our study should therefore be of interest to researchers and academia since it provides evidence to suggest that education of the management plays a significant role in enhancing the knowledge management process and firm's financial performance.

The remainder of this paper is organized as follows. Section 2 discusses prior research and hypothesis development. Section 3 presents the research design. Section 4 describes the sample selection process. Section 5 presents the empirical results and Section 6 provides the conclusion and limitations.

II. PRIOR RESEARCH AND HYPOTHESIS DEVELOPMENT

A. Knowledge Management, Firm's Value and Operating Performance

Extant research shows that effective knowledge management has a positive effect on firm's value and financial performance. [1] examine the short-term impact of announcements of information technology based knowledge management efforts on firm value and find that firms' cumulative abnormal returns are positively associated with these knowledge management events. [2] investigates how knowledge management capability affects firm performance and suggests that the synergies created by the information technology relatedness and managerial knowledge resources increase the financial performance of the firm. [3] explore the introduction of knowledge management practices and find that these practices are able to improve firm's performance. In summary, firm's effective knowledge management is found to be associated with better financial performance.

B. Knowledge Management, CIO and Education

Prior research shows that hiring new managers with MBA degrees leads to short-term improvements in operating performance [5] and management change is an important factor of business performance [6]. Besides, education level is often employed as a measurement for intellectual capital in empirical research [7]. Knowledge management is largely driven by the information technology department, where CIO plays a critical role in the entire process. CIO is responsible to integrate firm's limited information technology resources as well as human capitals. In addition, CIO has to combine business operation and e-commerce for future knowledge formations, sharing and applications. Especially in today's global economy and complex business environment, the education level of CIO should be a suitable proxy for firm's ability of knowledge creation and innovation.

[4] further suggest that individual's conceptual knowledge increases operational and contextual knowledge, and in turn improves operational knowledge. Since individual knowledge innovation is documented to help organizations to be more productive, CIO with better education should be more innovative in facilitating the effectiveness of knowledge management process and therefore enhances firm's financial performance.

C. Hypothesis Development

Since effective knowledge management has a positive effect on firm's performance, and better education of CIO is expected to strengthen this effect, we thus develop the following research hypothesis:

H: The positive relationship between the effectiveness of knowledge management and firm's operating performance is more prominent when the firm's new CIO has a PHD degree.

III. RESEARCH DESIGN

A. OLS Regression Test

We use a multivariate OLS regression model to test the impact of new CIO's education on the association between the effectiveness of knowledge management and firm's financial performance measurements. The effectiveness of knowledge management is measured by the level of research and development expenses in this study. The level of support for research and development activities has been documented as a major influencing factor (knowledge generation) of successful knowledge management process and infrastructure [8]. Additionally, [3] find that there is a positive relationship between the development of an innovative culture that encourages research and development projects and firm performance. Prior research also show that the level of research and development may decide the competitive advantage of firms in terms of higher quality, reduced cycle time and lowered costs [9]. In addition, a company invests lower research and development outlay than its competitors is more likely to lose its competitiveness of products and services which will shortly be reflected in its operating performance [10]. Further, [10] finds that firms experience a consistent five-year positive operating performance as well as positive stock returns following their research and development expenditures increase. Therefore, we expect that any new management occurring in IT firms will utilize IT advantages through promoting research and development use. In this study, we investigate whether new CIO with a PHD degree enhances individual level innovation in an organization and in turn strengthens the positive relationship between research and development projects and firm performance. Based on prior research, we also control for traditional variables related to firm's financial performance (e.g., [8, 10, 11]). We therefore use the following logistic regression model:

$$\text{Performance} = \alpha + \beta_1 \text{NI/REV} + \beta_2 \text{RESTR} + \beta_3 \text{LEV} + \beta_4 \text{SQSEG} + \beta_5 \text{GROWTH} + \beta_6 \text{PHD} + \beta_7 \text{RD/REV} + \beta_8 \text{PHD*RD/REV} + \varepsilon \quad (1)$$

Performance is measured by the following financial variables:
EPSDiluted = Diluted earnings per share¹;
EPSBasic = Basic earnings per share²;
ROA = Returns on assets.

Control variables include:

NI/REV = Net income ratio measured by net income over total revenues;
RESTR = 1 if firm had restructuring, 0 otherwise;
LEV = Percentage of total debts over total assets;
SQSEG = Square root of the number of business segments reported on *Compustat*;
GROWTH = Sales growth (percent change in sales from prior year);
PHD = 1 if the new CIO has a PHD degree, else 0;
RD/REV = Ratio of research and development expense to total revenues;
*PHD*RD/REV* = Interaction of research and development activities and CIO's education.

We used several measures of financial performance to investigate our research question, resulting in three separate OLS regression models. We first control the company's profitability (NI/REV) which is expected to have positive influence on financial performance. Consistent with prior research, we use RESTR and LEV to proxy for firm's financial condition. Rapidly growing firms (GROWTH) and firms with diverse operations (SQSEG) which have higher business risks are also controlled. The positive effect of research and development expense on firm's performance is also controlled [3, 9, 10]. For our variable of interest, we expect CIO's better education may facilitate the effectiveness of research and development activities so the coefficient of PHD*RD/REV is positive.

IV. SAMPLE SELECTION PROCEDURES

We select our sample of 103 firms hiring new CIO reported in *AuditAnalytics* in the recent two years. The sample includes firms satisfying the following criteria: (1) the firm has CIO turnover data for 2007 and 2008 (2) the CIO's education data is presented, and (3) financial data are available on *Compustat*.

¹ This item represents basic earnings per share for common shares after allowing for the conversion of convertible senior stock and debt, and the exercise of warrants, options and agreements for issuance of common shares upon satisfaction of certain conditions.

² The basic earnings figures should be reported by the company (as outlined in Accounting Principles Board Opinion No. 15) after the effect of conversion of convertible preferred, convertible debentures and option and warrants that have been identified as common/ordinary stock (capital) equivalents and before extraordinary items.

Table 1 reports the sample distribution by industry. The 103 sample firms span several two-digit SIC codes, with the maximum number of firms being 30 (29.1%) in the computers industry.

< Insert Table 1 here >

V. EMPIRICAL RESULTS

A. Descriptive Statistics

Table 2 reports the means, medians and standard deviations of the variables for our sample firms³. The means and medians of research and development level are 0.30 and 0.02, respectively.

< Insert Table 2 here >

In table 3, the descriptive data of research and development level is reported separately in two groups: CIO with a PHD degree and CIO without a PHD degree. The means and medians of research and development level in PHD group (non-PHD group) are 0.63 (0.28) and 0.11 (0.01), respectively. Table 3 also reports univariate tests of differences between the two groups using the parametric t-test and the Wilcoxon ranksum test. The median of research and development level is significantly higher in the PHD group than the non-PHD group ($p=0.01$, two-tailed). This is consistent with our expectation that CIO with a higher degree facilitates effective knowledge management applications.

< Insert Table 3 here >

B. Logistic Regression Results

Table 4 reports the OLS regression results for our three models. Model 1 measures financial performance using diluted earnings per share. Model 2 uses basic earnings per share, and Model 3 uses the returns on assets. All the three models are significant at $p < 0.01$ (two-tailed) and show satisfactory R-squares.

The interactive variable $PHD*RD/REV$ is significantly positive at $p < 0.10$ (two-tailed) in all the three models. The variable RD/REV is also positively significant at conventional levels. The significantly positive coefficients indicate that the level of research and development benefits firm's financial performance and this relationship is further strengthened by the CIO's education level. This empirical result is consistent with our hypothesis.

Consistent with our expectations, NI/REV is significant and positive at $p < 0.01$ (two-tailed) in all the models. Besides, $RESTR$ is negatively significant in model 1 and model 2 showing higher business risks may result in poorer financial outcomes.

< Insert Table 4 here >

VI. CONCLUSION AND LIMITATIONS

In this paper, we examine how new CIO's education affects the association between knowledge management and firm's operating performance. Using OLS regression analysis, we find that the positive relationship between the effectiveness of knowledge management and firm's operating performance is more prominent when the firm's new CIO has a PHD degree. Our results therefore provide empirical evidence that CIO's education facilitates the application of knowledge management, which is never explored in prior studies.

Our study is subject to several limitations. First, while we control for factors we believe are associated with firm's financial performance in our models, there is still a possibility of omitted variables. Second, the power of our tests is subject to the small sample size of firms with available CIO and education data. Third, around one-third of our sample firms are in computer industry. The uneven distribution of numbers of company types may lead to sample selection bias. Future research could investigate if CIO education has similar effects on the other knowledge management proxies.

REFERENCES

- [1] Sabherwal R., S. Sabherwal. 2005. Knowledge management using information technology: Determinants of short-term impact on firm value. *Decision Sciences*: Vol. 36, Iss. 4; p. 531-548.
- [2] Tanriverdi H. 2005. Information technology relatedness, knowledge management capacity, and performance of multi-business firms. *MIS Quarterly*: Vol. 29, Iss. 2; p. 311-335.
- [3] Marqués D. P., F. J. G. Simón. 2006. The effect of knowledge management practices on firm performance. *Journal of Knowledge Management*: Vol. 10, Iss. 3; p. 143.
- [4] Muhammed S., W. J. Doll, X. Deng. 2009. A model of interrelationships among individual level knowledge management success measures. *International Journal of Knowledge Management*: Vol. 5, Iss. 1; p. 1-16.
- [5] Bhagat S., B. J. Bolton and A. Subramanian. 2010. CEO education, CEO turnover, and firm performance. Working Paper at SSRN: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1670219.
- [6] Muravyev, A. (2003). Turnover of senior managers in Russian privatised firms. *Comparative Economic Studies*: 45: 148-172.
- [7] Barro, R. and J-W. Lee. 2010. A new data set of educational attainment in the world, 1950-2010, National Bureau of Economic Research: Working Paper.
- [8] Zaim H., E. Tatoglu, S. Zaim. 2007. Performance of knowledge management practices: a causal analysis. *Journal of Knowledge Management*: Vol. 11, Iss. 6; p. 54.
- [9] Mendelson, H. (2000). Organizational architecture and success in the information technology industry. *Management Science*: 46 (4): p. 513-529.
- [10] Tubbs, M. 2007. The relationship between R&D and company performance. *Research Technology Management*: Vol. 50, Iss. 6; p. 23-31.
- [11] Ohlson J. (1995). Earnings, book value, and dividends in security valuation. *Contemporary Accounting Research* 11: 161-82.

³ In order to eliminate the outlier effects, we winsorize 5% for all control variables.

Table 1: Distribution of Sample Firms			
By Industry: Defined by SIC Code	N		%
Mining and Construction (1000-1999, excluding 1300-1399)	2		1.9%
Food (2000-2111)	1		1.0%
Textiles and Printing & Publishing (2200-2799)	4		3.9%
Chemicals (2800-2824, 2840-2899)	4		3.9%
Pharmaceuticals (2830-2836)	4		3.9%
Durable manufactures (3000-3999, excluding 3570-3579, and 3670-3679)	19		18.4%
Transportations (4000-4899, excluding 4810-4819)	4		3.9%
Telecommunications (4810-4819)	1		1.0%
Retail (5000-5999)	11		10.7%
Finance (600-6999)	12		11.7%
Services (7000-8999, excluding 7370-7379)	11		10.7%
Computers (3570-3579, 3670-3679, 7370-7379)	30		29.1%
Total	103		100.0%

Table 2: Descriptive Statistics											
		<u>ROA</u>	<u>EPSDiluted</u>	<u>EPSBasic</u>	<u>NI/REV</u>	<u>RESTR</u>	<u>LEV</u>	<u>SQSEG</u>	<u>GROWTH</u>	<u>PHD</u>	<u>RD/REV</u>
N=103											
Mean		-0.01	0.61	0.63	-0.06	0.43	0.49	1.38	0.11	0.07	0.30
Std. Deviation		0.16	1.60	1.61	0.29	0.50	0.25	0.49	0.21	0.25	1.25
Percentiles	25	-0.03	-0.25	-0.25	-0.08	0.00	0.25	1.00	0.02	0.00	0.00
	50	0.03	0.55	0.57	0.03	0.00	0.46	1.00	0.11	0.00	0.02
	75	0.08	1.42	1.45	0.10	1.00	0.67	1.73	0.22	0.00	0.16

Performance is measured by the following financial variables:

EPSDiluted = Diluted earnings per share;

EPSBasic = Basic earnings per share;

ROA = Returns on assets.

Control variables include:

NI/REV = Net income ratio measured by net income over total revenues;

RESTR = 1 if firm had restructuring, 0 otherwise;

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PHD = 1 if the new CIO has a PHD degree, else 0;

RD/REV = Ratio of research and development expense to total revenues;

*PHD*RD/REV* = Interaction of research and development activities and CIO's education.

Table 3: RD/REV Mean & Median Tests: PHD VS Non PHD				
<u>RD/REV</u>	<u>PHD</u>	<u>Non PHD</u>	<u>T-test</u>	<u>Non-parametric Test</u>
Mean	0.63	0.28	0.47	
Median	0.11	0.01		0.01
Std. Deviation	0.99	1.27		

Variables are the same as defined in Table 2.

Table 4: Regression Analysis: Knowledge Management, Education and Firm's Performance									
Dependent Variable	Performance-EPSDiluted			Performance-EPSBasic			Performance-ROA		
	Coefficients	t	p-value	Coefficients	t	p-value	Coefficients	t	p-value
(Constant)	-0.26	-0.54	0.59	-0.25	-0.50	0.62	0.01	0.37	0.71
PHD	-0.32	-0.52	0.60	-0.30	-0.49	0.63	-0.02	-0.63	0.53
RD/REV	0.36	2.43	0.02	0.37	2.47	0.02	0.02	2.08	0.04
PHD*RD/REV	1.02	1.73	0.09	1.01	1.70	0.09	0.07	1.82	0.07
NI/REV	4.00	5.82	0.00	4.04	5.82	0.00	0.53	12.2	0.00
RESTR	-0.53	-1.98	0.05	-0.54	-1.97	0.05	-0.03	-1.55	0.13
LEV	0.35	0.64	0.52	0.36	0.66	0.51	0.00	0.01	0.99
SQSEG	0.71	2.58	0.01	0.71	2.56	0.01	0.00	0.04	0.97
GROWTH	0.30	0.45	0.65	0.29	0.45	0.66	0.07	1.61	0.11
Adjusted R Square	34.3%			34.2%			72.9%		
F	7.7			7.6			35.3		
p-value	0.00			0.00			0.00		
N	103			103			103		

Variables are the same as defined in Table 2.