



The effects of intellectual capital accumulation of Taiwan-listed electronics companies on financial performance: Meta analysis

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Abstract

The primary purpose of this study is to understand the effects of the intellectual capital accumulation on the financial performance in Taiwan-listed Electronics Companies, and data in this study are collected based on previous studies done by domestic and international scholars using Meta Analysis to analyze the collected data. A conclusion has been made by this study, that the “intellectual capital accumulation” of Taiwan-listed Electronics Companies indeed makes a significantly positive effect on the “financial performance”.

Keywords: Intellectual capital, financial performance, meta analysis

Introduction

The semiconductor industry is the key project of national economic development and a high capital- & technology-intensive industry. Among major producing countries of semiconductors, Taiwan is the only country that has a professional vertical disintegration system, establishing science parks under active support by policy-making, strengthening productive forces as a core for producing a huge cluster effect, which solemnly makes a successful model of the semiconductor industry development for the whole world. Moreover, the semiconductor field has been a high capital-intensive industry, wanting to master advantages in a rapidly changing era of knowledge economy; it has been indicated from domestic and international research that the intellectual capital accumulation will make positively significant effects on the enhancement of a company’s financial performance and bring it competitive advantages.

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Therefore, this study used “Meta Analysis” as its research method, aiming to understand the effects of the intellectual capital accumulation on the financial performance in Taiwan-listed Electronics Companies. It is the main purpose of this study.

Literature review

To understand the general status of literature and research relevant to the topic, herewith, the literature reviews relevant to the topic are respectively done as follows:

Relevant literature of intellectual capital

Stewart (1997) considered intellectual capital is a total stock of the collective knowledge and capabilities each employee contributes to the company’s competitive advantage.

Masoulas (1998) believed that intellectual capital is the combination of intangible assets that adds value to its effort to achieve its goals. An organization which understands intangible assets such as skills, experience, attitude and information of the employees can obtain added value from work.

Lynn (1998) divided intellectual capital into (1) human resource capital: employees of an organization; (2) structural capital: formal and informal systems that are basis of efficiency and effectiveness of organizational operations; and (3) relationship capital: relationships between organization and external agency, such as supplier and customer.

Knight (1999) noted that intellectual capital includes human capital, structural capital, external capital and financial performance.

According to studies by Huang (2008), intellectual capital is classified as follows: (1) customer capital: the measuring variables are number of main customer,, market growth, and acceptance rate of product; (2) process capital: the measuring variable are the increase rate of management fee, inventory turnover, and the average management fee of each employee; (3) human capital: the measuring variables are employee productivity, employee value-added, ratio of executive employees holding an advanced academic degree, and business profits of each employee; and (4) innovation capital: its measuring variables are R&D staff ratio, R&D intensity, R&D productivity, and R&D costs.

Overall, definitions of elements, measuring variables and variance of intellectual capital in this study adopt classification and definition by Huang (2008).

Financial performance

There are many domestic and international studies on the measurement indices of financial performance and the literature pertinent to this essay are described briefly below:

Huang (2008) used indices of ROE, ROA and EVA to measure financial performance. In delving into the effects of intellectual capital on financial performance, Firer & Williams (2003), Liao (2004) and Lin (2004) indicated that ROE and ROA are indices used to analyze financial performance traditionally.

With regard to studies on the effects of intellectual capital on financial performance, EVA is less used for measurement. In view of objectivity of measurement index, this study also adopts EVA for measurement.

Lee *et al.* (2011) had shareholders' Return on Equity (ROE), Price-Book Ratio (P/B, PBR) and Tobin Q value integrated to produce a Comprehensive Index of Financial Performance (PERF), hereby indicating the financial performance of the organization.

In short, with respect to measuring variables of financial performance, this study adopts part of measurement indices of Huang (2008) on financial performance, i.e. ROA.

Relationships between intellectual capital and financial performance

The hypothesis by Tsan (2002) that an organization with stronger intellectual capital outcomes will achieve better financial performance has been partially supported.

Lin and Li (2004) believed that stronger structural capital and relationship capital of an organization will increase its effectiveness, and an organization that lays greater stress on innovation strategy will improve organizational performance, and the adoption of innovation strategy can drive the interaction effects of intellectual capital on organizational performance.

In addition to laying stress on intellectual capital accumulation, Lin and Li suggested that multinational corporations should enhance applications of innovation strategies to increase corporate competitiveness in addition to emphasizing intellectual capital accumulation.

Research by Wang and Chang (2004) indicate that intellectual capital affects an organization's operation performance. In addition to directly affecting performance, elements of intellectual capital indirectly affect business performance through casual relations among these elements.

According to studies by Hung (2008), intellectual capital has significant positive influence on traditional business performance, especially process capital being the most significant.

According to studies by Lee (2008), intellectual capital is an important factor for an organization's competitive advantage. In comparison to traditional tangible assets, intellectual capital is one intangible asset including human resources, innovation, customer relationship and business process that further brings value and competitive advantage to an organization (Guthrie, 2001; Chen, 2001; Kuo, 2004).

Huang (2008) described that human capital, innovation capital and customer capital are positively correlated with financial performance.

Studies by Lee *et al.* (2011) indicate that organizational capital shows no direct explanatory power on financial performance, but shows indirect effects on financial performance through human capital and customer capital.

In summary, this study adopts classification by Huang (2008) with respect to the affects of dimensions of intellectual capital on organizational performance. Measures of intellectual capital include (1) dimension of human capital: operating profit of each employee used as a measure; (2) dimension of customer capital: market growth used as a measure; (3) dimension of process capital: inventory turnover used as a measure; (4) innovation capital: R&D productivity used as a measure, and (5) financial performance: return on assets (ROA) used as a measure.

Research method

Figure 1 illustrates how motivations, research objectives and literature review cited in the previous passages led to this study's hypotheses and conceptual research framework:

Research framework

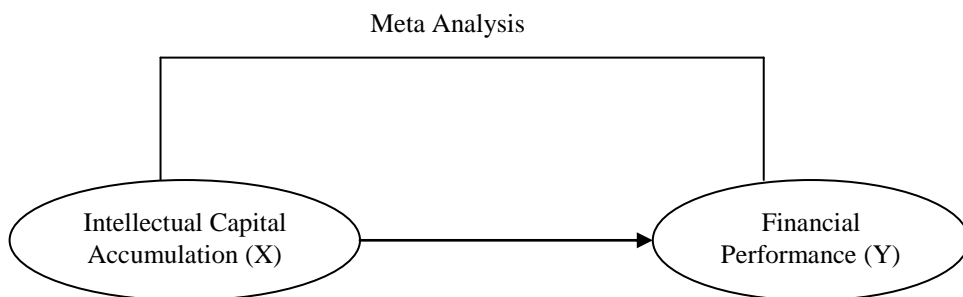


Figure 1: Conceptual framework diagram of this study

Data collection and methods

Data collection of this study is based on the database of Taiwan Economic Journal (TEJ). Meta Analysis is the research model of this study, which uses Stata. This study supposes the estimated parameters conform to Normal Distribution (N.D.), and when its heterogeneity (standard error) is greater, the use of Random Effects is better than that of Fixed Effects (Du, 2014; Lee, 2014). This study adopts Random Effects to compare diverse effects.

Theoretical foundation of Meta analysis (Michael *et al.*, 2009)

1. The Highlight of Der Simonian & Laird Method (Random effect method)

- (1) For binary or continuous outcomes
- (2) Effect size q_i for study i could be In (OR), In (RR), RD, difference in means or standardized mean difference.
- (3) Note that the effect sizes for OR and RR are logged.
- (4) Assumption that there is a single true answer that all studies are trying to estimate is relaxed.
- (5) Now assume that each study has a different true answer that they are trying to estimate.
- (6) Assume true effect sizes θ_i have normal distribution with mean θ and variance τ^2 .
- (7) τ^2 is the between-study variance.
- (8) Between study variance:

$$\tau^2 = \frac{Q - (k - 1)}{\sum_i w_i - \left[\frac{\sum_i w_i^2}{\sum_i w_i} \right]}$$

Where:

w_i are weights from the fixed effect inverse-variance method

Q is the heterogeneity test statistic form before (either form inverse-variance method or Mantel-Haenszel method)

K is the number of studies, and

τ^2 is set to zero if $Q < k - 1$

- (9) Random effect pooled estimate is weighted average:

$$\theta_{DL} = \frac{\sum_i w'_i \theta_i}{\sum_i w'_i}$$

- (10) Weights used for the pooled estimate are similar to the inverse-variance, but now incorporate a component for between-study variation:

$$W_i' = \frac{1}{SE(\theta_i)^2 + \tau^2}$$

- (11) When there is little heterogeneity, so Q is smaller than $k-1$, $\tau^2=0$ and the weights are the same as the inverse-variance method.
- (12) When $\tau^2>0$ the weights are smaller and more similar to each other than in a fixed effect model.
- (13) Because the weights are smaller, the sum of weights will be smaller, and so the SE will be bigger, CIs wider, and p-values less significant.
- (14) Small studies will have relatively greater influence.
- (15) Advantages:

- a. As widely applicable as the inverse-variance fixed effect model
b. Incorporates heterogeneity into the model

2. Confidence interval for pooled estimate

A 95% CI for the pooled estimate θ is:

$$\theta - (1.96 * SE(\theta)) \text{ to } \theta + (1.96 * SE(\theta))$$

For ratios, θ is the log-transformed estimate.

3. Test for overall effect

Overall significance test for whether the pooled estimate is significantly different from zero (no effect):

$$z = \frac{\theta}{SE(\theta)}$$

Look up z in tables of the normal distribution to get the p-value.

For ratios, θ is the log-transformed estimate?

4. Test for heterogeneity

- (1) Look up Q in tables of the chi-squared distribution on $k-1$ degrees of freedom. The null hypothesis is that the true effect size is the same for all studies.
- (2) A statistically significant result means that there is strong evidence against there being one common effect size, so we take it that there is heterogeneity.

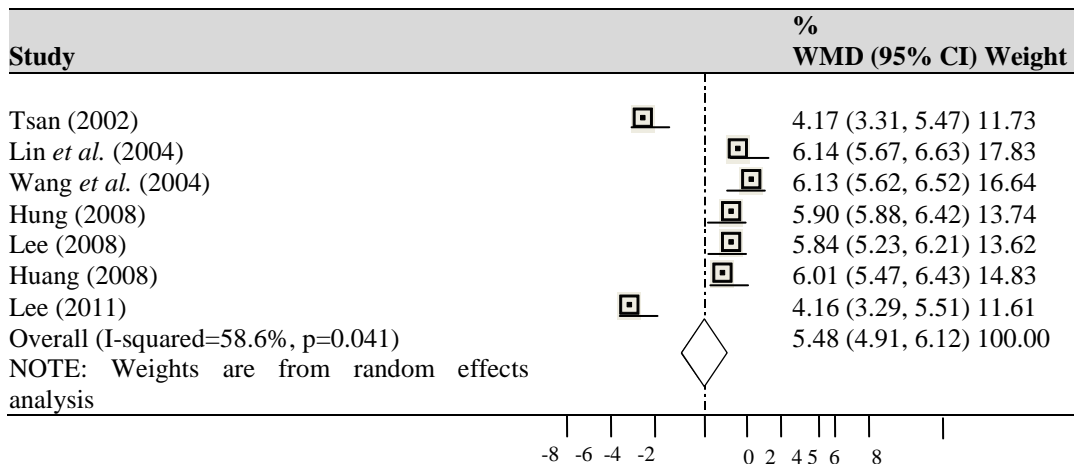
5. Getting data into Stata

- (1) Easier to enter into Excel then cut & paste into Stata's data editor
(2) Ensure each numeric column contains only numbers
(3) Leave cells empty if data missing
(4) One row per study

Results and analysis

The Random Effects have been processed through the Meta Analysis to gain the results as shown in Table 1:

Table 1: Random effects



Based on the I-squared = 58.6% and p-value = 0.041 of Overall from the report above, it has been known that independent variables have made positively significant effect on dependent variables in this research model.

Conclusions and suggestions

Conclusions

From the above analysis, we can see that the intellectual capital accumulation of Taiwan-listed Electronics Companies has significant positive effects on financial performance. This result is the same as the research studies by Wen-Nan Tsan (2002), Miao-Que Lin *et al.* (2004), Wen-Ying Wang *et al.* (2004), Feng-Chu Hung (2008), Yu-Zhe Lee (2008), Hao-Chen Huang (2008), and Chao-Hsiung Lee *et al.* (2011) but differs in weight.

Contributions of the study

According to the past literature reviews pertinent to this study, most multiple regression analyses were applied in Exploratory Factor Analysis (EFA) or Confirmatory Factor Analysis (CFA) with less consideration given to the Meta Analysis for a research method; therefore, the Meta Analysis research method used in this study is relatively innovative.

Additionally, the results from this study can also be delivered to Taiwan-listed *Semiconductor* Companies for the reference of sustainable development; therefore, this study's results have extremely practical reference value.

Limitations and recommendations

Based on the discussion previously, this study focused on the primary research objective of Taiwan-listed Electronics Companies, analyzing old domestic and international literature reviews by the Meta Analysis to understand the effects of intellectual capital accumulation on the financial performance. Here is a suggestion for subsequent researchers that they can try to consider researching other industries or different sizes of the same industry.

Acknowledgement

For undertaking this research project we were helped by Shu-Te University, and Takming University of Science and Technology, Taiwan. We much appreciate their full support for providing us good research environment.

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