Asia Pacific Management Review 21 (2016) 170–179

HOSTED BY

ELSEVIER

Contents lists available at ScienceDirect

Asia Pacific Management Review

journal homepage: www.elsevier.com/locate/apmrv

Do industry or firm effects drive performance in Taiwanese knowledge-intensive industries?

Ching Wen Chi [a, *], Pang Tien Lieu [b], Ken Hung [c], Hui Wen Cheng [a]

[a] Department of International Business, Ming Chuan University, Taipei, Taiwan, ROC
[b] Department of Business Administration, National Taiwan University of Science and Technology, Taipei, Taiwan, ROC
[c] A.R. Sanchez School of Business, Texas A & M International University, Laredo, TX, USA

ARTICLE INFO

Article history:
Received 8 February 2015
Accepted 17 May 2016
Available online 12 July 2016

Keywords:
Knowledge-intensive industries
Intellectual capital
Industry and firm effects
Variance decomposition analysis

ABSTRACT

Previous variance decomposition studies investigating the relative importance of industry and firm effects on performance have primarily focused on the economy as a whole; little research has focused exclusively on individual analysis of knowledge-intensive industries. Given the rising importance of knowledge-intensive industries, this study employs Taiwan's business database to examine whether a firm's performance in knowledge-intensive industries is driven primarily by industry effects or firm effects. To better measure overall firm performance, particularly that of knowledge-intensive firms, we use multiple measures of performance, including an intellectual capital measure of performance (value-added intellectual coefficient), an economic-based measure (economic value added), and an accounting-based measure (return on assets). The results indicate that firm effects contribute a great deal across performance measures, particularly for value-added intellectual coefficient (VAIC). Thus, our study suggests that organizational capabilities that leverage human capital are critical to the learning and growth of firms in Taiwanese knowledge-intensive industries. We also find that industry effects also have important influences on economic performance. The results imply that shareholders use industry membership as an important indicator of a knowledge-intensive firm's capability in value added by capital invested.

1. Introduction

Due to a trend among members of the Organization for Economic Cooperation and Development (OECD) toward a knowledge-based economy, knowledge-intensive industries have become the center of economic growth and competitiveness. In developed economies, especially the United States, knowledge-intensive industries sprang up quickly, beginning in the 1990s. In fact, the knowledge-intensive share of developed economies grew from 29% to 32% between 1997 and 2012; the United States has the largest knowledge-intensive share, reaching 40% in 2012 (National Science Board, 2012). A similar situation exists in developing economics. Many developing economies have made a significant effort to become major producers of knowledge-intensive goods and services. For example, the percentage of the total GDP contributed by Taiwan's knowledge-intensive industries is 20.4% in 2012, and Taiwanese high-tech industries have become the world's main supplier of IC chips, laptop computers, liquid crystal displays, and personal digital assistants (Chien, Lawler, & Uen, 2010). In fact, Taiwan ranked eighth in global competitiveness in 2010 (Chuang, 2013). This statistic shows that Taiwan faced a transformation of its industrial structure, namely by focusing on the knowledge-based economy, a key factor in Taiwan's recent economic growth.

Due to the emerging nature of its economy, Taiwan is a completely different institutional setting than the United States. Emerging economies are typically characterized by underdeveloped capital markets, extensive state intervention in business operations, and a lack of effective mechanisms to enforce contracts (Makino, Isobe, & Chan, 2004). In Taiwan, as in many emerging economies, government authorities may play a crucial role in helping industries improve their competitive positions. In the

* Corresponding author. Department of International Business, Ming Chuan University, 250 Zhong Shan N. Rd., Sec. 5, Taipei, 111, Taiwan, ROC. Tel.: +886 2 28824564x2319; fax: +886 2 2880 9751.
E-mail address: wenchi@mail.mcu.edu.tw (C.W. Chi).

Peer review under responsibility of College of Management, National Cheng Kung University.

http://dx.doi.org/10.1016/j.apmrv.2016.05.001

1990s, the Taiwanese manufacturing industry experienced a rapid structural transformation from labor-intensive industries to high-technology industries. As the structural-institutionalist school of thought explains, the recent economic development in Taiwan was the result of effective state direction of economic activity; thus, the intervention of the government explains the industrial dynamism (Chen & Lin, 2006). The Taiwanese government highly prioritizes development based on intellectual capital, relative to physical assets, for the national infrastructure to develop beyond its status as an emerging economy (Tseng & Goo, 2005). For example, to create a favorable environment for R&D activities, the government of Taiwan has instituted industrial and innovation policies to encourage investment and technology transfers in emerging and strategic industries that are expected to benefit from economic development. The Statute for Upgrading Industries (SUI), promulgated on January 1, 1991, serves as one of Taiwan's most important industrial technology policy implementations, providing tax incentives and preferential loans for the promotion of industrial R&D. Thus, firms can achieve superior performance within particular industries because industrial policies create incentives to do so.

Additionally, since the early 1990s, many Taiwanese knowledge-intensive firms have actively invested in innovation by developing in-house R&D and absorbing foreign knowledge (including patented technologies, licensed technologies, and other royalty-inducing technologies) to meet the challenges of international competition (Chang & Robin, 2012). Some studies have found empirical evidence of complementarities between R&D expenditures and technology imports (Blumenthal, 1979; Cassiman & Veugelers, 2006). Cohen and Levinthal (1989, 1990) explain that firms that import technology must have some R&D capacity to identify and select relevant technologies and effectively integrate them into their production process. Thus, regardless of whether knowledge sources were external or internal, firms' R&D capacities have important influences on firm performance. Given the brief review above, it would be natural to consider the respect to which the relative importance of the external environment (e.g., industrial policy) and internal environment (e.g., R&D capability) accounts for the difference in performance among firms in Taiwanese knowledge-intensive industries.

Traditionally, researchers in the fields of industrial-organizational economics and strategic management have disagreed about the primary source of firm performance (Porter, 1987; Rumelt, 1984; Scherer, 1980). Industrial-organizational economics researchers have suggested that industry factors are the primary determinants of firm performance, while strategic management researchers argue that firm-specific factors determine performance. In response to this debate, Schmalensee (1985) and Rumelt (1991) pioneered the use of the variance decomposition method to examine the relative importance of industry and firm effects on firm performance. Several subsequent studies along the lines of Rumelt's work continued to explore performance variations (Hawawini, Subramanian, & Verdia, 2003; McGahan, 1999; McGahan & Porter, 1997, 2002; Roquebert, Phillips, & Westfall, 1996). These previous variance decomposition studies focused primarily on the performance variation of U.S. firms; only a few recent studies have targeted emerging economies (Chang & Hong, 2002; Chen & Lin, 2006; Khanna & Rivkin, 2001). McGahan and Porter (2002) suggested that the most direct opportunity for further research lies in exploring new data in settings outside the United States to yield insight on questions about the relationships between the national economic environment and industrial performance. In this study, we focus mainly on investigating the relative importance of industry and firm factors on performance differences among firms in Taiwanese knowledge-intensive industries.

An important issue in the variance decomposition literature is the measure of performance used. Early studies primarily used traditional accounting values of return on assets (ROA) as the performance measure (Schmalensee, 1985; Rumelt, 1991; McGahan & Porter, 1997, 2002). Hawawini et al. (2003) argue that accounting-based measures neither measure cash flows nor adjust for risk, and that asset values are quoted at historic cost and not at their true replacement values; therefore, these accounting values of measures cannot reflect the true value of a firm. Using economic profit measures (economic value added and market value added) instead of accounting ratios such as ROA, Hawawini et al. (2003) generally found consistent results. However, as accounting profit neglects capital cost, some authors claim that economic value added (EVA) does not explicitly reference intellectual capital (Bontis, Dragonetti, Jacobsen, & Roos, 1999; Pulic, 2000; Tan, Plowman, & Hancock, 2008). Intellectual capital, representing one of the most relevant antecedents of innovation, has replaced physical capital and monetary capital to become a key to corporate competitiveness and value creation in the contemporary knowledge-based economy (Cabello-Medina, López-Cabrales, & Valle-Cabrera, 2011; Young, Su, Fang, & Fang, 2009). Tan, Plowman, and Hancock (2007) suggest that managers should recognize intellectual capital as a critical factor affecting a company's ability to remain competitive in the new global marketplace, especially in knowledge-intensive industries. Accordingly, the measurement of intellectual capital and its performance have become important topics.

Ante Pulic (2000) proposed a value-added intellectual coefficient (VAIC) as an indicator for measuring performance in the knowledge economy. The VAIC method allows measurement of the efficiency of value added by corporate intellectual capital and is increasingly used in both business and academic applications (Firer & Williams, 2003). Currently, Iazzolino and Laise (2013) indicate that the VAIC provides only different information measuring firms' performance as compared with EVA, and that the two thus can be maintained as complementary rather than as rivals. Despite both EVA and VAIC measuring value creation, they highlight different aspects of performance. EVA measures value creation from shareholders' point of view and reflects the financial perspective of firm performance. By contrast, VAIC measures value creation from stakeholders' point of view (beginning with employees and shareholders) and belongs to the learning and growth perspective of firm performance (Iazzolino & Laise, 2013). As Iazzolino and Laise suggest, it could be useful to integrate VAIC and EVA to measure overall firm performance. Because the high-tech and service sectors are intellectually intensive, this work implements variance components analysis to examine the relative importance of industry and firm effects on performance for the Taiwanese high-tech and service firms by adopting multiple measures of performance, including VAIC, ROA, and EVA. The present study seeks to explore whether results may differ from those of prior studies that focus on the manufacturing sectors and overall economy and how results differ across the three performance measures.

This paper is structured as follows. In the next section, we briefly review the relevant literature and explore differences among the various studies. We then discuss the data, performance measures, and methodology used in this research. This section is followed by empirical analysis results and the implications of the differences in results between our study and previous studies. Finally, we conclude with a discussion of the results and offer final remarks.

2. Literature review

The researchers in both the industrial organization and strategic management fields have long considered the determinants of firm performance. An industrial-organization economics perspective favored a theoretical framework known as the structure-concept-performance (SCP) model, which suggests the existence of a deterministic relationship between market structure and performance. That is to say, the structural characteristics of an industry inevitably constrain common patterns of behavior of its component firms, which in turn leads to industry-specific performance differences between firms (Bain, 1956; Scherer, 1980). Thus, the industrial organization view focuses on the performance differences across industries and suggests that industry structure is a central determinant of firm performance. Because industrial organization theory can't explain intra-industry performance differences, theoretical orientations shifts to the strategic management field. In contrast to the industrial organization field, the strategic management view focuses on the firm itself to explain performance difference and suggests that firm-specific attributes drive performance outcomes (Andrews, 1980; Porter, 1987; Rumelt, 1984). In response to this debate between the industrial organization and strategic management fields, Schmalensee (1985) and Rumelt (1991) pioneered the use of variance decomposition methodology to study differences in performance derived from industry and firm effects. Using the FTC database, Schmalensee (1985) and Rumelt (1991) reported contradictory findings. Schmalensee found that industry effects have an important impact on performance, while Rumelt found that firm effects are significantly larger than industry effects in determining firm performance. Subsequently, Roqubert et al. (1996) and McGahan and Porter (1997, 2002) conducted studies aimed at resolving this controversy by using another database, the Compustat Business Segment Reports. Compustat covers more comprehensive data, thus allowing all sectors of the American economy to be included in the analysis (the FTC dataset included only manufacturing). And since McGahan and Porter (2002) reconciled the results of all the studies by exploring differences in methods and data, the findings on this issue confirmed for the United States that firm factors have a dominant influence on performance and industry factors a negligible one.

However, all of these aforementioned studies used ROA as the financial performance measure. McGahan and Porter (2002) suggest the potential value of exploring alternative measures of firm performance and new data, especially data outside the United States. With both accounting measures and two economic measures (EVA and MVA), Hawawini et al. (2003) and Chen and Lin (2006) employed the U.S. Stern Stewart dataset and Taiwan Economic Journal (TEJ) dataset, respectively, to revisit the question of the relative importance of industry and firm effects on firm performance. Both of the results confirm the previous finding that, on average, industry factors have little effect on firm performance, regardless of whether performance is assessed using economic-based or accounting-based measures and whether data comes from advanced or emerging economies.

The findings from previous empirical studies based on only manufacturing or the economy as a whole generally have proved to be robust. McGahan and Porter (2002) found that the importance of various effects on profitability differed across sectors. For example, industry effects are less important in manufacturing, but the service sector shows considerably significant industry effects. Acknowledging the growing importance of knowledge-intensive industries in the new global marketplace, it is necessary to examine this issue with an exclusive focus on knowledge-intensive industries. In these industries, intellectual capital is the most important strategic resource for organizations, one that directly affects their market competition and their performance. Thus, measuring and valuing intellectual capital is important to enabling knowledge-intensive firms to realize their true value. Ante Pulic (2000) claims that conventional accounting or economic measures do not take into account information linked to intellectual capital; therefore, he developed the VAIC method, which explicitly considers intellectual capital to measure the value-creation efficiency of intellectual capital within a company. However, Iazzolino and Laise (2013) argue that each measurement criterion measures firm performance from different perspectives and that no criterion dominates the others from all points of view. The EVA highlights the financial perspective of firm performance, whereas the VAIC can be included in the learning and growth perspective. Therefore, Iazzolino and Laise suggest that VAIC can be used to complement the traditional accounting or economic measures rather than considering it separately.

Since the VAIC method is easy to understand and use, it increasingly has been applied in academia and business (Firer & Williams, 2003; Pulic, 1998, 2000). For instance, using a sample of 75 South African publicly traded firms from industry sectors extensively reliant on intellectual capital (namely the bank, electronic, information, and service sectors), Firer and Williams (2003) adopted the VAIC approach to investigate the association between intellectual capital and traditional measures of firm performance. Following Firer and Williams (2003) and Chen, Cheng, Hwang (2005) also use VAIC as the measure of a firm's intellectual capital to examine the relationship between intellectual capital, market value, and financial performance, based on a large sample of Taiwanese listed companies. The results show that firms' intellectual capital is positively related to market value and financial performance, thus supporting the role of intellectual capital in the enhancement of firms' value and profitability. Also, Tan et al. (2007) found a positive correlation between a firm's IC and its performance by using data from 150 publicly listed companies on the Singapore Exchange and Pulic's VAIC. Based on measurement using the VAIC method, Muhammad and Ismail (2009) investigated the efficiency of intellectual capital and its performance in Malaysian financial sectors. They found that intellectual capital has greater influence in banking institutions than in insurance companies and security brokerage companies. They also found that intellectual capital has a positive relationship with firm performance. Iazzolino, Laise, and Migliano (2014) investigate the link between VAIC and EVA on firms in northern Italy and find no significant relationship. In addition, the VAIC method was also used to assess the performance of the Australian banking sector (Pulic & Bornemann, 1999), the Japanese banking sector (Mavridis, 2004), and so on. Young et al. (2009) adopted VAIC to measure and compare the intellectual capital performance of commercial banks in eight Asian economies and found that the value-creating efficiency of human capital is the major driving force of performance. To conclude, VAIC has become an important indicator in helping researchers measure firms' intellectual capital performance (Young et al., 2009). Therefore, this study examines the relative importance of industry and firm effects on firm performance in Taiwan's knowledge-intensive industries by applying the indicator of VAIC as an intellectual capital performance measure in order to explore whether certain types of firms or industries are more likely to focus on managing intellectual capital in Taiwanese knowledge-intensive industries.

3. Performance measure

Three performance measures are used in this study: the intellectual capital measure "value-added intellectual coefficient" (VAIC), the economic measure EVA, and the accounting measure ROA. Previous studies primarily have used traditional accounting values of ROA as the performance measure. ROA is measured by the operating income divided by total assets. This ratio reflects firms' efficiency in using total assets, holding constant firms' financing policy, and is generally considered to be an important indicator of financial performance (Chen et al., 2005). However, Chen and Lin (2006) indicated that accounting-based measures such as ROA do not measure the cost of capital; in addition, some conceptual problems arise from accounting conventions. Under current Generally Accepted Accounting Principles, most expenditures that invest in value-creation activities, such as research and development or advertising, are immediately expensed, because accounting practices do not provide for the capitalization of such activities. As a result of these shortcomings, ROA provides almost no information on either past economic profitability or the firm's future profitability (Hawawini et al., 2003).

The Stern Stewart Co. (1991) developed EVA and MVA as economic measures of performance. Both measures reflect the concept of residual income—that is, the fact that a firm achieves sustainable value creation only when its returns on capital exceed its capital costs. Considering capital cost, risk, and the time value of money, these two measures can better reflect the economic value of a firm than ROA can (Mouritsen, 1998). Haspeslagh, Noda, and Boulos (2001) suggest that the adoption of the EVA performance measure has increased pressure on managers to focus their strategies on economic performance. Moreover, since EVA is intended to offer improvements to the MVA calculation (Bontis et al., 1999), this study will consider the role of EVA only in the valuation of firms.

Stern Stewart defines EVA as net operating profit after taxes (NOPAT) less the cost of the capital of both equity and debt employed to produce those profits. The formula is expressed as follows:

$$\text{EVA} = \text{NOPAT} - \text{WACC} \times \text{ICE} \tag{1}$$

NOPAT is net operating profit after tax, WACC is weighted average cost of capital, and ICE is invested capital employed.

Stern Stewart has identified 164 different "performance measurement issues" related to a company's accounting system that must be considered when computing EVA methodology. Nevertheless, most firms that adopt EVA restrict the number of adjustments to fewer than 10 to make the performance system manageable (Hawawini et al., 2003). Due to limitations of the TEJ dataset, we examined five of the most common accounting adjustments in the formulation of EVA for Taiwan's knowledge-intensive firms. These adjustments are:

- Capitalization of research and development with subsequent amortization over three years;
- Capitalization of advertising with subsequent amortization over three years;
- Representation of actual bad-debt cash expense rather than the accrual expense;
- Representation of actual taxes cash expense rather than the accrual expense; and
- Excluding construction in progress from capital.

But, just as Hawawini et al. argue that examining what drives ROA is not equivalent to examining what drives economic performance, so as to examining what drives EVA (or ROA) not equivalent to examining what drives intelligence capital performance. In general, a firm's market value is created by capital employed (i.e., physical and financial capital) and by intellectual capital, which consists of human capital and structural capital. Human capital is a source of innovation and strategic renewal in a business, so the value created by human capital is considered primarily when assessing the intellectual capital performance of firms. Accordingly, human capital should be treated as an investment rather than a cost (Young et al., 2009). Instead of directly measuring firms' intellectual capital, Pulic (2000) developed the VAIC to efficiently monitor and evaluate the efficiency of value added (VA) to a firm's resources. The VAIC method primarily measures the efficiency of firms' three types of inputs: capital employed (CE), human capital (HC), and structural capital (SC), namely the Capital Employed Efficiency, the Human Capital Efficiency, and the Structural Capital Efficiency. The sum of the three measures is the value of VAIC.

The VAIC approach has five basic steps. First, it looks at how the competence of a firm creates VA, which is calculated as the difference between output (OUT) and input (IN):

$$\text{VA} = \text{OUT} - \text{IN} \tag{2}$$

OUT represents the overall revenues from all products and services sold on the market. IN includes all the expenses of a firm with the exception of labor expenses. Stewart (1997) defines intellectual capital as the knowledge and ability that employees bring to their firms and argues that it increases firms' competitive advantage. Taking this into consideration, an organization's employees need to be seen as a critical strategic resource. Consequently, a key aspect of the Pulic model is that labor expenses are considered an investment − a value-creating entity − and not a cost. Hence, labor expenses are not included in IN. Because VA results from how the business uses its total resources, including physical capital, human capital, and structural capital, it is necessary to assess the relationship between VA and a firm's three types of capital.

The second step is to assess the relationship between VA and physical capital employed (CA).

$$\text{VA}/\text{CA} = \text{VACA} \tag{3}$$

VACA, the Value Added Capital Coefficient, indicates how much new value has been created by one invested unit of capital employed.

The third step is to assess the relationship between VA and employed human capital (HC), which indicates the ability of HC to create value in a firm. According to Pulic, HC refers the amount of capital invested in knowledge workers (wages, salaries, training, etc.)

$$\text{VA}/\text{HC} = \text{VAHC} \tag{4}$$

VAHC, the Value Added Human Capital Coefficient, shows how much VA has been created by one monetary unit invested in employees. It means the productivity of knowledge workers in a firm.

The fourth step is to find the relationship between VA and employed structural capital (SC). In Pulic's paper, SC is the share of value added after deducting investment in HC.

$$\text{SC}/\text{VA} = \text{STVA} \tag{5}$$

STVA, the Value Added Structural Capital Coefficient, measures the share of SC in the creation of value added.

The final step is the calculation of the intellectual ability of a firm, which is the sum of the previously mentioned three components of VA efficiency coefficients.

$$\text{VAIC} = \text{VACA} + \text{VAHC} + \text{STVA} \tag{6}$$

VAIC indicates the value-creation efficiency of a firm's total resources, including its intellectual capital. The higher the VAIC coefficient, the better management has used the firm's value-creation potential. Therefore, the VAIC method provides decisive information as to whether managers leverage their firm's potential and maximize its value in the marketplace (Pulic, 2000).

4. Data and sample

In this study, the source of data on performance, including all information necessary to calculate VAIC, EVA, and ROA, are the datasets provide by the *Taiwan Economic Journal* (TEJ). The TEJ database does not report information on business units; rather, it provides the complete corporate-level financial information owned by the corporations listed and traded on the Taiwan Stock Exchange (TAIEX). Given that the TEJ dataset does not provide business-level data, it suffers from a lack of specificity. As Hawawini et al. (2003) indicated, the lack of specificity implies two consequences for this study. First, because firms are assigned according to their primary industry classifications, the results of the analysis will underestimate industry effects. Second, we will not be able to distinguish corporate- and business-level effects in this study. To prevent confusion, we use the term "firm" instead of the term "corporate" to denote an autonomous competitive unit within an industry. Thus, the term "firm effects" comprises both business unit and corporate effects, and captures both the part of performance variety attributed to differences within industries among firms and differences among firms that are not explained by their patterns of industry activities (Chen & Lin, 2006; Hawawini et al., 2003; Rumelt, 1991) Therefore, the objective of this study is to examine the relative importance of industry and firm effects on firm performance in Taiwanese knowledge-intensive industries.

In a similar study that analyzes Taiwan's database, Chen and Lin (2006) use data from 1998 to 2003. For purposes of comparability with Chen and Lin (2006), we start with Chen and Lin's sample period, and append data from the years 1996, 1997, 2004, 2005, 2006, 2007, and 2008. Thus, our sample set of Taiwan's high-tech and service sectors covers the 13-year period from 1996 to 2008. According to the standard industrial classification system of the Directorate-General of Budget Accounting and Statistics (DGBAS) of Executive Yuan in Taiwan, we use the three-digit level of industry classification as a definition of industry and then join each firm to its primary industry classification. Due to government restrictions, the accounting policies and conventions of financial institutions differ radically from those of other industries. Therefore, we excluded firms designated as "financial institutions" because their returns are not comparable with those in other industries. This study drew 4795 preliminary records for firm data. We then excluded 164 records that reported results with missing values. The final sample consisted of 4631 observations for 386 firms across 25 industry classifications. Table 1 presents the descriptive statistics of our samples by economic sector. A list of the industries included in our analysis is provided in the Appendix.

5. Model and methodology

Our analysis is based on the following descriptive model of firm performance, which is similar to the model in Hawawini et al. (2003):

$$r_{ikt} = \mu + \alpha_i + \beta_k + \gamma_t + \varepsilon_{ikt} \quad (7)$$

where r_{ikt} is the performance in year t for firm k in industry i, and performance is measured as EVA, VAIC, and ROA, respectively. The first right-hand-side term is μ, which is the average performance over the entire period for all firms. The next three terms represent the random industry, firm, and year effects. Industry effects (α_i) derive from the differences in the average performance to individual firm within each different industry and reflect industry-specific factors such as differing competitive behavior, conditions of entry, and asset utilization rate impacts on the performance of the firm. Firm effects (β_k) include both corporate and business unit effects, which derive from the differences in the average annual performance to each firm. Firm effects reflect the influence of firm-specific factors such as heterogeneity among firms in tangible and intangible assets due to differences in reputation, operational effectiveness, organizational effectiveness, organizational processes, and managerial skills (Hawawini et al., 2003). Year effects (γ_t) derive from the differences in the average performance of individual firms in each year and capture the influence of factors with broad economic trends. The final term, ε_{ikt}, is a random error term. The classes of effects in this model are dummy variables. In particular, the model offers no causal inferences or structural explanation for performance difference across industries, firms, or years, but it allows us to focus directly on the existence and magnitude of differences in performance associated with these categories.

The difference between our model and that of Hawawini et al. (2003) is that the "industry–year interaction" term has been discarded. Following Rumelt (1991), Hawawini et al.'s (2003) model includes a transient industry effect, but not similar transient effects for firm–year interactions. McGahan and Porter (1997) argued that the industry–year interaction term might replace the interactions between the other types of effects and year effects. Understanding that the inclusion of all transient effects may result in the model being overspecified, McGahan and Porter (1997) allow for the first-order serial correlation on the errors term in their model and acknowledge that the results are comparable only with the stable effects in Rumelt's work. The purpose of this study was to identify the relative importance of industry and firm effects on performance. For comparability with the previous studies, we do not model a general first-order autoregressive process on the error term. In addition, we exclude all the "interaction effect" terms because the model would be overspecified if we equally represented transient industry effects (the industry–year interaction) and transient firm effects (the firm–year interaction).

Past studies use two main statistical methods to decompose the variance of performance: analysis of variance (ANOVA) and variance components analysis. Under the ANOVA approach, we first estimate a null regression model of no independent effect on the dependent variable and then add the independent effects one by

Table 1
Descriptive statistics of VAIC, EVA, and ROA by economic sector.

	All			High-tech sector			Service sector		
	EVA (in NTD millions)	VAIC	ROA (%)	EVA (in NTD millions)	VAIC	ROA (%)	EVA (in NTD millions)	VAIC	ROA (%)
Average	−4,454,071.12	12.08	7.71	817,725.19	15.83	8.71	−13,969,487.83	5.30	5.92
Standard deviation	30,673,417.01	111.13	11.61	15,577,804.87	138.29	12.73	45,400,310.36	7.45	8.99
Number of firms	386			251			135		
Number of industries	25			11			14		
Total number of observations	4631			2980			1651		
Year included	1996–2008			1996–2008			1996–2008		

Note: VAIC, Value-Added Intellectual Coefficient; EVA, economic value added; ROA, return on asset.

one. The increment to the adjusted R^2 of the regression is then calculated as an unbiased estimate of the fraction of the variance explained by each independent variable. The order of entry of the independent variables can have a large impact on the results. Typically, the first entries explain a large proportion of the variance because ANOVA analysis inherently imputes all of the covariance to the first introduced effect.

The other popular method is the variance components approach under the random-effects assumption, sometimes termed the random-effects ANOVA. The random-effects assumption means that all effects in the model, like the error term, are drawn randomly from an underlying population distribution with mean zero and unknown variance. Once drawn, each effect is regarded as fixed. Therefore, our dataset does not require the inclusion of the whole population in the random effects model. We can still make an inference about a population of effects from those in the data that are considered to be a random sample (Searle, 1971, p. 383). Further, the random-effects assumption assumes that random processes independently generate each effect, so each effect is not correlated with other effects. Thus, each of the effects has a variance in its own right, and the variance of an observation is the sum of the variance of each effect. The variances of various effects are accordingly called variance components (Searle, 1971, p. 379). We can identify the relative importance of various effects by estimating these variance components. The equation for estimating variance components is developed based on the descriptive statistical model of Equation (7) by decomposing the total variance of performance into its components, as follows:

$$\sigma_r^2 = \sigma_\alpha^2 + \sigma_\beta^2 + \sigma_\gamma^2 + \sigma_\varepsilon^2 \tag{8}$$

In Equation (8), the total variance σ_r^2 of performance was expressed as the sum of the population variances in industry, firm, and year effects. We use the PROC VARCOM procedure in SAS software to estimate the different variance components. There are four estimation methods for the PROC VARCOMP in SAS. As recommended by Searle, Casella, and McCulloch (1992), we estimate our model with the restricted maximum likelihood (REML) method, which is generally preferred over any sum of squares methods for unbalanced data such as ours. The restricted maximum likelihood estimators have useful properties—consistency and asymptotic normality—and the asymptotic sampling dispersion matrix of the estimators is also known.

One inherent disadvantage of the variance components estimation is that the procedure does not provide reliable tests for the significance of the independent effects (Hawawini et al., 2003). In this regard, Schmalensee (1985), Rumelt (1991), and McGahan and Porter (1997) resolve the limitation by using nested ANOVA techniques that consider the effects to be fixed. The nested ANOVA approach generates F-statistics for the presence of the independent effects. However, these studies also argue that an ANOVA test for significance is not a prerequisite to variance components estimation, as their main interest lies in estimating the relative magnitude of each type of effect, and significance results are only of secondary importance. Thus, we also offer variance component analysis as our flagship approach.

6. Empirical results

Table 2 shows the variance components estimation of Equation (8) based on our sample for each of the performance measures, expressed as a percentage of the total variance. All estimates were elevated at the 5% level by the nested ANOVA procedure for statistical significance. The results in Table 2 indicate that the performance measures EVA, VAIC, and ROA explain 80.99%, 69.31%, and 36.75% of the total variance in firm profit, respectively. The total explained variation in VAIC and EVA are both high; by contrast, that in ROA is low, with only about half of the total explained variations in VAIC and EVA. The results show that there is more variation in accounting profit ROA than in VAIC and EVA.

As can be seen from Table 2, the estimated variance component of the firm effects for EVA, VAIC, and ROA are 40.26%, 68.39%, and 31.11%, respectively. In comparison, the corresponding figures for industry effects are 40.25%, 0.81%, and 3.21%. Firm effects are much larger than industry effects for VAIC and ROA, while are almost the same as industry effects for EVA. The results indicate that firm factors contribute much across all three measures of performance in Taiwanese knowledge-intensive industries. Additionally, the high industry effects for EVA indicate that industry factors have important influences on a firm's economic performance. Our results are different from those of previous studies that focus on the overall economy. We find some difference in importance of industry effects among different performance measures; however, previous research found that industry effects contribute less to variance across various performance measures. Year effects for EVA, VAIC, and ROA are 0.48%, 0.11%, and 2.42%, respectively. The results show that year-to-year fluctuations in macroeconomic conditions have a relatively small influence on overall movement of firm performance in Taiwanese knowledge-intensive industries equally.

Table 3 compares our estimates to the results of Schmalensee (1985), Rumelt (1991), McGahan and Porter (1997), Hawawini et al. (2003), and Chen and Lin (2006) on the various effects. In the case of ROA, our results on the dominance of firm effects to firm performance are in line with those for ROA reported in past studies. It is worth noting that our estimate of industry effects for EVA is much larger than those obtained in Hawawini et al. (2003) and Chen and Lin (2006). It is hard to directly compare the sizes of industry effects between the Hawawini et al. (2003) and our study due to different sources of data and different institutional environments. However, using the same TEJ database, industry effects for EVA are 40.3% in this study, and the estimate is considerably higher than in Chen and Lin's study (6.6%). A possible reason is that differences in sample compositions influence the results. Chen and Lin (2006) have focused on overall economy (including manufacturing and services), while this study has focused exclusively on knowledge-intensive industries (including high-tech industries and services). In comparison, our study was based on relatively less manufacturing firms of data. As McGahan and Porter (1997, 2002) point out, the results for manufacturing understate the importance of industry effects; therefore, industry effects that are remarkably smaller in Chen and Lin (2006) may be attributed to the inclusion of more manufacturing firms in the data. In the case of ROA, similarly, we find a higher influence of industry effects (3.2%) than reported by Chen and Lin (0.6%). In addition, the previous studies showed that the error term ranged from Chen and Lin's (2006) 30.3% to Schmalensee's (1985) 80.4%. In comparison, we find a relatively smaller error term in this study, specifically 18.9%–30.7%, in terms of EVA and VAIC measures, respectively. The greater model fit for Taiwanese data might be due to the fact that the number of sectors in Taiwan is relatively smaller than the number of U.S. sectors (Chen & Lin, 2006).

Because McGahan and Porter (2002) argued that the relative importance of various effects differs across sectors of the economy, we further investigate how results differ between the high-tech and service sectors using our COV model. Table 4 presents the results of the COV analysis. First, it shows that firm effects have a large impact on firm performance in both high-tech and service sectors across all three measures of performance. In high-tech sectors, firm effects for EVA, VAIC, and ROA are 39.08%, 68.19%, and 31.97%, respectively. In service sectors, the corresponding figures for firm

Table 2
Variance components results.

Variance component	VAIC		EVA		ROA	
	Estimate	%	Estimate	%	Estimate	%
Firm effects (σ_β^2)	11,570.70	68.39	9.46E + 14	40.26	43.15	31.11
Industry effects (σ_α^2)	137.47	0.81	9.46E + 14	40.25	4.45	3.21
Year effects (σ_γ^2)	18.96	0.11	1.13E + 13	0.48	3.36	2.42
Model	11,727.13	69.31	1.90E + 15	80.99	50.96	36.75
Error (σ_ε^2)	5192.50	30.69	4.47E + 14	19.01	87.72	63.25
Total (σ_r^2)	16,919.63	100.00	2.35E + 15	100.00	138.68	100.00
Number of observations	4631		4631		4631	

Note: VAIC, Value-Added Intellectual Coefficient; EVA, economic value added; ROA, return on asset.

Table 3
Comparison of variance components results (percent of total variance by various effects).

	Schmalensee (1985)	Rumelt (1991)	McGahan and Porter (1997)	Hawawini et al. (2003)			Chen and Lin (2006)			This study		
	Manufacturing	Manufacturing	All sectors[b]	Manufacturing & services			Manufacturing & services			High-tech & services		
Variance component	ROA	ROA	ROA	EVA/CE	MVA/CE	ROA	EVA	MVA	ROA	EVA	VAIC	ROA
Firm effect[a]	0.6	47.2	36.6	27.1	32.5	35.8	62.4	59.8	41.6	40.3	68.4	31.1
Industry effect	19.6	16.1	21.7	10.7	14.3	11.2	6.6	7.1	0.6	40.3	0.8	3.2
Year effect	N/A	N/A	0.4	1.9	1.3	1.0	0.7	0.5	2.5	0.5	0.1	2.4
Error	80.4	36.7	41.3	60.3	51.9	52.0	30.3	32.6	55.3	18.9	30.7	63.3
No. observations	1775	6932	58,132	5620			2058			4631		

VAIC: Value-Added Intellectual Coefficient, EVA: economic value added, ROA: return on asset, CE: capital employed, EVA/CE: economic value added per dollar of capital employed.
[a] Firm effects include both corporate and business-level effects.
[b] Results from Rumelt model on McGahan and Porter' all sectors of the economy. (1997, Table 3, p.25).

Table 4
Variance components results by economic sector.

Variance component	High-tech sector						Service sector					
	VAIC		EVA		ROA		VAIC		EVA		ROA	
	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent
Firm effects	17,735.20	68.19	106,290.40	39.08	53.17	31.97	22.51	38.94	9.70E+14	37.51	24.05	29.07
Industry effects	179.73	0.69	2059.10	0.76	2.31	1.39	9.79	16.93	1.16E+15	44.73	3.28	3.96
Year effects	38.31	0.15	452.95	0.17	5.17	3.11	0.88	1.52	1.13E+13	0.44	1.26	1.52
Model	17,953.24	69.03	108,802.45	40.00	60.65	36.47	33.18	57.39	2.14E+15	82.68	28.59	34.55
Error	8054.10	30.97	163,190.90	60.00	105.64	63.53	24.63	42.61	4.48E+14	17.32	54.15	65.45
Total	26,007.34	100.00	271,993.35	100.00	166.29	100.00	57.81	100.00	2.58E+15	100.00	82.74	100.00
Number of observations	2980		2980		2980		1651		1651		1651	

effects are 38.94%, 37.51%, and 29.07%. In high-tech sectors, firm factors dominate industry factors across performance measures. The dominance of firm effects is more pronounced when firm performance is measured by VAIC. In service sectors, however, firm effects do not dominate for EVA. In comparison, firm effects are more important in high-tech sectors than in service sectors. Second, our results show a remarkable variation in the importance of industry effects between high-tech and service sectors. In high-tech sectors, industry effects contribute less to total variance across all three measures of performance. In service sectors, however, industry effects contribute considerably more to the variance for EVA and VAIC. In the case of EVA, industry effects are even 7.22% larger than firm effects. These effects arise when the average EVA within an industry remains abnormally high or low for the sample period of coverage. For example, the air transport industry had a significantly lower-than-average EVA for the entire 1996–2008 period. The computer systems design services industry, by contrast, had a significantly higher-than-average EVA. Because EVA reflects the ability of the firm to add value on the capital invested in the firm, an industry may have a permanently high (or low) value of EVA because of the capability of incumbents in value created by physical and financial capital. Thus, the greater importance of industry effects to EVA than firm effects indicates that shareholders emphasize industry information when making their assessments about management strategies on a service firm's value creation of capital invested. Third, the effects of year are smaller than firm and industry effects in the high-tech and service sectors across the three performance measures.

7. Discussion

In this study, we reexamine the relative importance of industry- and firm-level effects on performance in two ways. First, we focus primarily on Taiwan's high-tech and service sectors. Second, we test for the effects using a new measure of firm performance, VAIC, in addition to the economic measure EVA and the accounting measure ROA. This study finds several notable results.

First, firm effects are important across all three measures of performance. Firm effects are much larger than industry effects for VAIC and ROA and are almost the same as industry effects for EVA. These results support the idea that organizational resources and capabilities have important influences on performance in Taiwan's knowledge-intensive industries. In high-tech sectors, firm effects dominate industry effects across performance measures, particularly for VAIC. However, the dominance of firm effects is not found for EVA in service sectors. Thus, firm effects are more dominant for firm performance in high-tech sectors than in service sectors.

Second, industry effects have a large impact on economic performance. Our results show a remarkable variation in the importance of industry effects among different performance measures. Industry effects are relatively less important for VAIC and ROA, while are comparable to firm effects for EVA. The results provide evidence that industry effects contribute importantly to firms' value creation by capital invested, but don't contribute significantly to firms' value creation by intellectual capital in knowledge-intensive industries. We find that industry factors are at least as important to economic performance as firm factors in knowledge-intensive industries. By comparison, previous studies that focused on the overall economy indicated that industry effects contribute less to variance across various performance measures. Additionally, our results suggest that industry factors may have different meaning for firm performance across economic sectors. In high-tech sectors, industry effects account for less variation across all measures of performance but account for a very large part of variation for both EVA and VAIC in service sectors. When performance is measured with EVA, industry effects even dominate firm effects in service sectors. These results imply that shareholders use industry membership as an important indicator of a service firm's capability in value added by capital invested.

Finally, we find that year effects have very little impact on firm performance. Year effects account for a very small variation in the high-tech and service sectors across the three performance measures.

Overall, our results suggest that organizational capabilities that leverage potential are very important across performance measures, while industry structural characteristics also have important influences on economic performance in Taiwan's knowledge-intensive industries. In particular, firm effects are considerably more important to VAIC than EVA and ROA in the high-tech sector. This implies that organizational capabilities that leverage human capital are particularly important to the learning and growth of high-tech firms. Additionally, industry effects dominate for EVA in the service sector, indicating that shareholders emphasize industry structural differences when making their assessments about a service firm's economic value.

8. Conclusions

This study examines the relative importance of year, industry, and firm effects on firm performance in Taiwan's knowledge-intensive industries (high-tech and service sectors) from 1996 to 2008. Because the ability to develop human capital is crucial for knowledge-intensive firms, we use an alternative measure of performance, VAIC, to complement EVA and ROA. Our results suggest that firm effects matter greatly across performance measures in Taiwanese knowledge-intensive industries, especially for VAIC. The empirical results imply that organizational capabilities that leverage human capital are considerably important to knowledge-intensive firms' learning and growth.

Because knowledge-intensive industries faces a dynamic competitive environment, organizations must completely exploit their human resources to create innovation capabilities in order to retain a competitive advantage and survive (Chow & Gong, 2010). Because the innovative capacity of a firm resides in its employees' intelligence, imagination, and creativity, and HRM practices influence employees' motives and behavior as well as facilitating their willingness to learn, share, and create knowledge, HRM can promote creativity among employees (Chow & Gong, 2010; Jiménez and Sanz-Valle, 2008). In fact, improvement in R&D activities depends primarily on management's capacity to adopt appropriate human resource management (HRM) policies to fit the firm's innovation goals (Ángel & Sánchez, 2009). Therefore, a firm that wants to enhance performance through innovation should pay attention to its HRM practices.

Specific examples of HRM practices to influence technological innovation capabilities in organizations include selective staffing, comprehensive training, and equitable rewards. Current human resources practices focus on providing various learning mechanisms to encourage knowledge workers' collaboration and information sharing (Cho, Song, Yun, & Lee, 2013; Hsu, 2007). For instance, Media Tek uses “pecking order” strategies to recruit employees and build work teams that can cooperate with one another. Through mutual learning, employees are able to improve their skills and knowledge and have their creativity stimulated. Furthermore, they become more willing to devote themselves to working toward the goals of the organization, a shift that results in increased customer satisfaction and better firm performance. Additionally, as Johns, Avci, and Karatepe (2004) indicated, the training of employees might increase their feeling of ownership of the service encounter and result in more personalized and accountable services for customers. It is impossible for firms to offer superior guest experiences to customers without well-trained and knowledgeable employees (Altinay, Altinay, & Gannon, 2008). For example, the President Chain Store Corporation (PCSC) stresses the importance of organizational learning and spends nearly 10 million NT dollars annually on employee training. By establishing a systematic training mechanism, PCSC is able to provide proper training courses to its employees to help them improve their professional skills, and it then further trains them to be good professional managers. Thanks to these professional managers, PCSC is able to use the duplicate marketing model to continue to successfully expand its marketing network in Taiwan, China, and other countries.

With respect to rewards policy, Chien et al. (2010) suggest that performance-based pay can enhance R&D professionals' job performance, and that high-tech organizations therefore should adopt performance-based pay, such as a bonuses based on individual or firm performance, as an extrinsic reward to motivate R&D professionals. In Taiwan, many high-tech companies distribute bonuses to employees as rewards. A recent study by Lin, Ko, and Chien (2010) investigates the relationship between employees' reward plans and firm performance using Taiwanese firms. The empirical results show that the incentive effect of stock bonuses for firm performance is stronger in the electronics industry than in more traditional industries. Because stock bonuses allow firms to attract or keep talent and eliminate agency problems by combining employees' profits with shareholders' profits, they can stimulate employees to make an effort to pursue firm performance. In addition, Chunghwa Telecom established the “Chunghwa Telecom innovation network” to encourage employees to develop creative strategies. After employees' proposals are adopted and launched, they are entitled a reward of up to NT$30 million based on the actual operations (Chunghwa Telecom, 2013 Corporate Social Responsibility Report). To summarize, a common feature of successful knowledge companies is an emphasis on human resource management in Taiwan. When an organization invests in its employees as a critical asset, it naturally will enhance the organization's competitiveness and performance.

Appendix. Industry classification

High-tech sector		Service sector	
Industry name	3-digit codes	Industry name	3-digit codes
Manufacture of Semi-conductors	C261	Wholesale of Machinery and Equipment	G464
Manufacture of Electronic Passive Devices	C262	Retail Sale in Non-specialized Stores	G471
Manufacture of Bare Printed Circuit Boards	C263	Freight Truck Transport	H494
Manufacture of Optoelectronic Materials and Components	C264	Ocean Transportation	H501
Manufacture of Other Electronic Parts and Components	C269	Air Transport	H510
Manufacture of Computers and Peripheral Equipment	C271	Service Activities Incidental to Water Transportation	H525
Manufacture of Communication Equipment	C272	Short Term Accommodation Activities	I551
Manufacture of Audio and Video Equipment	C273	Restaurants	I561
Manufacture of Magnetic and Optical Media	C274	Software Publishing	J582
Manufacture of Measuring, Navigating, Control Equipment, Watches and Clocks	C275	Motion Picture, Video and Television Programme Activities	J591
Manufacture of Optical Instruments and Equipment	C277	Telecommunications	J610
		Computer Systems Design Services	J620
		Real Estate Development Activities	L670
		Architecture and Engineering Activities and Related Technical Consultancy	M711

Additionally, our results show that industry factors matter little for VAIC. Government can play an important role in helping knowledge-intensive firms upgrade their stock of human capital by developing various national regulations, policies, strategies, and a set of training subsidies for manpower cultivation (Chuang, 2013). In Taiwan, the rapid economic growth and transformation of economic structures have stimulated demand for a skilled technical workforce. The Taiwanese government has put considerable effort into encouraging private enterprises to offer more training opportunities to their employees in order to upgrade their overall knowledge and skills. For example, the Council of Labor Affairs (CLA) has offered enterprises grants to set up appropriate training programs for their employees. However, many enterprises have received only a very small proportion of government subsidies because of a policy that required the enterprises to spend an additional self-funded NT$300,000 (US$8823) on training before becoming eligible for government subsides (Lee & Hsin, 2004). As suggested by Chuang (2013), the Taiwanese government should contrive policy mechanisms to encourage enterprises to use various kinds of subsidies for employee training.

Furthermore, we find that industry effects are particularly large for EVA in the service sector. This result is similar to McGahan and Porter's (1997) finding that industry effects contribute significantly to explaining performance in the service sector, which suggests that whether in the United States or Taiwan, industry effects have an important influence on performance in service industries. In general, there are significant differences in profit among the different types of service industries. For instance, domestic service industries cannot seek to open up overseas markets with Taiwan's market saturation, as compared with export-oriented service industries, so revenue growth is more limited. Therefore, the profitability of domestic service industries is different from that of export-oriented service industries.

Finally, there are some restrictions in this study. First, due to data limitations, we cannot distinguish between corporate- and business-level effects; hence, industry effects may be underestimated. Furthermore, our model excludes the transient effects terms in order to avoid overspecifying the model by equally representing transient industry effects and transient firm effects. Finally, with the current model, we cannot estimate the industry/firm interaction effect because the firm factor is nested within the industry.

References

Altinay, L., Altinay, E., & Gannon, J. (2008). Exploring the relationship between the human resource management practices and growth in small service firms. *The Service Industries Journal, 28*(7), 919–937.

Andrews, K. (1980). *The concept of corporate strategy*. Homewood, IL: Irwin.

Ángel, P. O., & Sánchez, L. S. (2009). R&D managers' adaptation of firms' HRM practices. *R&D Management, 39*(3), 271–290.

Bain, J. (1956). *Barriers to new competition*. Cambridge, MA: Harvard University Press.

Blumenthal, T. (1979). A note on the relationship between domestic research and development and imports of technology. *Economic Development and Cultural Change, 27*(2), 303–306.

Bontis, N., Dragonetti, N. C., Jacobsen, K., & Roos, G. (1999). The knowledge toolbox: A review of the tools available to measure and manage intangible resources. *European Management Journal, 17*, 391–401.

Cabello-Medina, C., López-Cabrales, Á., & Valle-Cabrera, R. (2011). Leveraging the innovative performance of human capital through HRM and social capital in Spanish firms. *The International Journal of Human Resource Management, 22*(4), 807–828.

Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external technology acquisition. *Management Science, 52*(1), 68–82.

Chang, S. J., & Hong, J. (2002). How much does the business group matter in Korea? *Strategic Management Journal, 23*(3), 265–274.

Chang, C. L., & Robin, S. (2012). Knowledge sourcing and firm performance in an industrializing economy: The case of Taiwan (1992–2003). *Empirical Economics, 42*, 947–986.

Chen, M. C., Cheng, S. J., & Hwang, Y. (2005). An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance. *Journal of Intellectual Capital, 6*(2), 159–176.

Chen, Y. M., & Lin, F. J. (2006). Sources of superior performance: Industry versus firm effects among firms in Taiwan. *European Planning Studies, 14*(6), 734–751.

Chien, M. S., Lawler, J. S., & Uen, J. F. (2010). Performance-based pay, procedural justice and job performance for R&D professionals: Evidence from the Taiwan high-tech sector. *The International Journal of Human Resource Management, 21*(12), 2234–2248.

Cho, S. H., Song, J. H., Yun, S. C., & Lee, C. K. (2013). How the organizational learning process mediates the impact of strategic human resource management practices on performance in Korean organizations. *Performance Improvement Quarterly, 25*(4), 23–42.

Chow, I. H. S., & Gong, Y. (2010). The linkage of HRM and knowledge-related performance in China's technology-intensive industries. *The International Journal of Human Resource Management, 21*(8), 1289–1306.

Chuang, S. F. (2013). Evaluating training and development practices in Taiwan: Challenges and opportunities. *Human Resource Development International, 16*(2), 230–237.

Chunghwa Telecom. (2013). *Chunghwa Telecom 2013 corporate social responsibility report* (Taiwan).

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: The two faces of R&D – Implications for the Analysis of R&D Investment. *Economic Journal, 99*(3), 569–596.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly, 35*, 128–195.

Firer, S., & Williams, S. M. (2003). Intellectual capital and traditional measures of corporate performance. *Journal of Intellectual Capital, 4*(3), 348–360.
Haspeslagh, P., Noda, T., & Boulos, F. (2001). Managing for value: It is not just about the numbers. *Harvard Business Review, 79*(7), 64–73.
Hawawini, G., Subramanian, V., & Verdia, P. (2003). Is performance driven by industry-or firm-specific factors? A new look at the evidence. *Strategic Management Journal, 24*(1), 1–16.
Hsu, S. H. (2007). Human capital, organizational learning, network resources and organizational innovativeness. *Total Quality Management, 18*(9), 983–998.
Iazzolino, G., & Laise, D. (2013). Value added intellectual coefficient (VAIC): A methodological and critical review. *Journal of Intellectual Capital, 14*(4), 547–563.
Iazzolino, G., Laise, D., & Migliano, G. (2014). Measuring value creation: VAIC and EVA. *Measuring Business Excellence, 18*(1), 8–21.
Jiménez, D., & Sanz, R. (2008). Could HRM support organizational innovation? *International Journal of Human Resource Management, 19*(7), 1208–1221.
Johns, N., Avci, T., & Karatepe, O. (2004). Measuring service quality of travel agents: Evidence from Northern Cyprus. *The Service Industries Journal, 24*(3), 82–100.
Khanna, T., & Rivkin, J. W. (2001). Estimating the performance effects of business groups in emerging markets. *Strategic Management Journal, 22*(1), 45–74.
Lee, J. S., & Hsin, P. L. (2004). Employee training and human capital in Taiwan. *Journal of World Business, 39*, 362–376.
Lin, W. H., Ko, P. S., & Chien, H. F. (2010). An empirical study on issues in Taiwanese employee reward plans. *Review of Pacific Basin Financial Markets and Policies, 13*(1), 45–69.
Makino, S., Isobe, T., & Chan, C. M. (2004). Does country matter? *Strategic Management Journal, 25*(10), 1027–1034.
Mavridis, D. G. (2004). The intellectual capital performance of the Japanese banking sector. *Journal of Intellectual Capital, 5*(1), 92–115.
McGahan, A. M. (1999). The performance of U.S. corporations: 1981–1994. *The Journal of Industrial Economics, 67*(4), 373–498.
McGahan, A. M., & Porter, M. E. (1997). How much does industry matter, really? *Strategic Management Journal, 18*, 15–30. Summer Special Issue.
McGahan, A. M., & Porter, M. E. (2002). What do we know about variance in accounting profitability? *Management Science, 48*(7), 834–851.
Mouritsen, J. (1998). Driving growth: Economic value added versus intellectual capital. *Management Accounting Research, 9*, 461–482.
Muhammad, N. M. N., & Ismail, M. K. A. (2009). Intellectual capital efficiency and firm's performance: Study on Malaysian financial sectors. *International Journal of Economics and Finance, 1*(2), 206–212.
National Science Board. (2012). *Science and engineering indicators 2012*. NSB 12–01. Arlington VA: National Science Foundation.
Porter, M. (1987). From competitive strategy to corporate strategy. *Harvard Business Review, 65*(3), 43–59.
Pulic, A. (1998). *Measuring the performance of intellectual potential in knowledge economy*. Available at: http://www.vaic-on.net Accessed 4.04.10.
Pulic, A. (2000). VAIC™-an accounting tool for IC management. *International Journal Technology Management, 20*(5/6//7/8), 702–714.
Pulic, A., & Bornemann, M. (1999). *The physical and intellectual capital of Austrian banks*. Available at: http://www.vaic-on.net Accessed 4.04.10.
Roquebert, J. A., Phillips, R. L., & Westfall, P. A. (1996). Market versus management: What 'drives' profitability? *Strategic Management Journal, 17*(8), 653–664.
Rumelt, R. P. (1984). Toward a strategic theory of the firm. In R. Lamb (Ed.), *Competitive strategic management* (pp. 556–570). Englewood Cliffs, NJ: Prentice-Hall.
Rumelt, R. P. (1991). How much does industry matter? *Strategic Management Journal, 12*(3), 167–185.
Scherer, F. M. (1980). *Industrial market structure and economic performance*. Boston, MA: Houghton-Mifflin.
Schmalensee, R. (1985). Do markets differ much? *The American Economic Review, 75*(3), 341–351.
Searle, S. R. (1971). *Linear models*. New York, NY: John Wiley & Sons.
Searle, S. R., Casella, G., & McCulloch, C. E. (1992). *Variance components*. New York, NY: John Wiley & Sons.
Stewart, G. B. (1991). *The quest for value*. New York, NY: Harpen Collins.
Stewart, T. A. (1997). *Intellectual capital: The New wealth of organization*. New York, NY: Bantam Doubleday Dell Publishing Group.
Tan, H. P., Plowman, D., & Hancock, P. (2007). Intellectual capital and financial returns of companies. *Journal of Intellectual Capital, 8*(1), 76–95.
Tan, H. P., Plowman, D., & Hancock, P. (2008). The evolving research on intellectual capital. *Journal of Intellectual Capital, 9*(4), 585–608.
Tseng, C. Y., & Goo, Y. J. J. (2005). Intellectual capital and corporate value in an emerging economy: Empirical study of Taiwanese manufacturers. *R&D Management, 35*(2), 187–201.
Young, C. S., Su, H. Y., Fang, S. C., & Fang, S. R. (2009). Cross-country comparison of intellectual capital performance of commercial banks in Asian economies. *The Service Industries Journal, 29*(11), 1565–1579.