

Determinants of firm Performance In Knowledge-Intensive Industries: A Comparative Study of Two Emerging Economies, China and Taiwan

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ABSTRACT

In light of predictions and statistics on the increasing importance of knowledge-intensive industries in China and Taiwan, this research utilizes these two emerging economies' business context to examine whether a firm's performance in knowledge-intensive industries derives from industry effects or firm effects. In this study, the approach is to 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). Findings suggest that firm effects greatly impact knowledge-intensive industries, in particular for value-added intellectual coefficient (VAIC). In this sense, it is proposed that organizational strategies which leverage human capital are critical to the continuous development of firms in Chinese and Taiwanese knowledge-intensive industries. Concurrently, industry effects also influence economic performance, suggesting overall that industry membership is an important indicator of a knowledge-intensive firm's capability in value added by capital invested. This paper contributes to a scarcity of variance decomposition studies examining the sources of variation in firm performance emphasizing on knowledge-intensive industries in developing countries.

Keywords: Knowledge-intensive industries; intellectual capital; industry and firm effects; variance decomposition analysis; performance differences

INTRODUCTION

Firm performance has been commonly matched with profit margin or increased turnover [1]. One of the most significant strands of strategy research has been to compare the relative importance of industry and firm effects on performance heterogeneity. These two effects are confronted through two fundamental research streams which aim to explain differences in firm performance: on one hand perspectives drawing from the economic tradition that emphasize external market factors and firm characteristics as primary factors of firm

performance; and on the other hand, building on the sociological and behavioural paradigm, perspectives that emphasize on the impact of organizational factors and their environment.

Over the last decades, the world economy has witnessed a revolution in terms of the nature of value creation. Towards this end, there has been a notable shift in regards to the source of value, from tangible assets to intangible assets at a fast accelerating pace. Intangible assets, also called 'intellectual assets' [2], are thought of as the lifeblood of creative and knowledge-intensive industries which have become the leading industries in the world through international dealings of service flows [3]. 'Knowledge-intensive firms' refer to the firms that undertake complex operations of an intellectual nature in which human capital is the dominant factor [4] for promoting innovation [5]. The OECD has classified business services, communication services, financial services, educational services, and healthcare services as belonging to knowledge-intensive service industries [6]. One condition for knowledge-intensive industries is how there is no dedicated R&D team or innovation department in knowledge-intensive industries, and the preferred way of operation involves teams working on a rotation basis [7]. What can be claimed is that value creation from knowledge assets is a cornerstone of firm strategy [8]. The latter refers to the conceptualization of value creation found in the value-added by each activity, namely a firm's value chain [9]. Based on this argument, it can be claimed that knowledge-intensive industries contribute significantly to economic competitiveness and growth. Concurrently, the majority of knowledge-intensive companies have emerged from traditional, small-scale businesses to becoming enterprising organizations [10].

In face of this development, it becomes meaningful to examine the sources of variation in firm performance among these knowledge-intensive organizations since it can contribute to a better understanding of the global economy. Benchmark research on the determinant of the performance in 1985 ascribed the industry factors as the main determinants of firm performance, whilst research from that point on until 2006 found that firm-specific factors determine performance to a greater extent than that of the industry factors. Researchers nevertheless are not conclusive on the primary source of firm performance in general. An increasing body of research therefore continues to explore the issue yet there has been a scarcity of research examining in particular the knowledge-intensive industries [11]. In this respect, this study can contribute to the field by addressing both the debate of industry versus firm effects on firm performance building on prior work by choosing to narrow the focus in the Chinese and Taiwanese context as emerging economies with tremendous potential as it will be explained in the following section. The internal and external environments of the firms in China and Taiwan greatly different from those in developed countries and therefore it is meaningful to examine the industry and firm effects utilizing data from different points of reference for both countries.

The context

In this research, we examine two developing economies, China and Taiwan, which have been characterized as 'awaking giants' following their transition from a labour-intensive to high-tech industries engaging in knowledge-intensive services. The international trends of the Organization for Economic Cooperation and Development (OECD) towards a more knowledge-based economy, have led to significant changes in Chinese society in recent years [10]. In fact, it is expected that China will surpass the United States as the single largest economy by the year 2050 [12] and it is anticipated that it will become the country with the largest proportion of enterprises among the world's top 500 companies [13]. In an attempt to sustain China's rapid economic growth, it has become key to enhance the capacity for innovation that will lead

to a solid industrial structure and a change to the economic growth pattern. In this respect, knowledge-intensive industries in China have been booming denoting a considerable progress among developing countries and it is expected that China will gradually continue to grow in these industries [13]. In particular, the share of China's high tech and knowledge-intensive industry in GDP rose from 23,3% in 2007 to 25% in 2010 and it is estimated to reach 30% and 35% by 2020 and 2030, respectively [13]. The intention is that China further develops as a knowledge-intensive, resource-intensive and ecologically-friendly industrial system to support sustainable development and stimulate the reform of industrial and employment structures [13].

The second country under scrutiny for this research was Taiwan. Taiwan is an interesting example of a country whose rapid economic growth and industrialization after the early 1960s and in particular following the new millennium has been remarkable. The development of knowledge-intensive industries in Taiwan at a rapid pace as the Council for Economic Planning and Development suggests, has been a determining factor that triggered Taiwan's economic transformation. The percentage of the total GDP contributed by Taiwan's knowledge-intensive industries is 20.4% in 2012 [11]. Taiwan's rather recent economic development would not have been possible without the local government's contribution. The Taiwanese government prioritizes development deriving from intellectual capital, which relates to physical assets, based on the belief that this can lead to develop its status as an emerging economy [14]. In addition, firms in Taiwan, in contrast with those in China, possess tangible and intangible knowledge, in particular when it comes to the high-technology industry. Taiwan is strong in keeping 'strategic assets' such as human capital, brand reputation and managerial capabilities to a high standard [15]. Capabilities, described as bundles of organizational processes in a company, have been said to determine the firm-specific heterogeneity through different ways [16]. Taiwanese knowledge-intensive firms have been systematically investing in innovation through development of in-house R&D and absorbing foreign knowledge as a means to effectively cope with international competition [17]. It has been empirically proven that firm's R&D capacities greatly influence firm performance regardless of whether knowledge sources are external or internal.

This paper addresses the aforementioned dilemma first by reviewing relevant literature and exploring the differences in various studies. Then, a discussion of performance measures is analysed including the proposed approach for this study which is further explained in the data and sampling and methodology section. These sections are followed by the empirical analysis results and the discussion of implications from the differences arising between this study and previous research in the field. Finally, the paper concludes with a discussion of the results and final remarks.

Determinants of firm performance

As already mentioned in the introduction of this paper, researchers across the industrial organization and strategic management fields have diachronically addressed the determinants of firm performance. The industrial organization economics perspective adheres to a theoretical framework known as the structure-concept performance (SCP) model. In this perspective, it is proposed that the structural characteristics of an industry inevitably restrict common patterns of behaviour of its component firms, which on the other hand leads to industry-specific performance differences between firms [18-21]. In other words, the belief is that industry structure is a central determinant of firm performance. In this conceptualization, an important line of work involved examining the role of firm size as a factor to explain differences in profitability [22], acknowledged as a source of competitive advantage. Conversely, the strategic management view emphasizes on the firm itself to explain differences

in performance and cohorts that firm-specific attributes drive performance outcomes [23-25]. This shift in reasoning was the result of inability of the industrial organization theory to offer sustainable explanation for intra-industry differences in performance.

Schmalensee [26] and Rumelt [27] introduced the use of variance decomposition methodology to study differences in performance derived from industry and firm effects. When comparing findings from the two studies, contradictory findings emerge. Schmalensee found a significant impact of the industry effects on performance, whereas Rumelt argued that his results suggested firm effects have a larger impact on firm performance. Ever since the seminal work of Schmalensee [26] and Rumelt [27], there have been over 25 further attempts to resolve this controversy on the assessment of the relative importance of various drivers of heterogeneity in firm performance. Empirical studies along the lines of Rumelt's work included: Powell [28] examined the influence of industry effects only; Roquebert, Phillips, and Westfall [29]; McGahan and Porter [30]; Cubbin and Geroski, [31]; Mauri and Michaels [32] looking into the influence of industry and firm effects together; or the influence of industry and organisational effects together [33].

A distinct difference in some of these studies is how for instance Roquebert, Phillips and Westfall [29] and McGahan and Porter [30] followed a similar methodology however using another database, the Compustat Business Segment Reports. This software covers a more extensive array of data through analysis from all sectors of the American Economy allowing service industries to be included in the analysis, whereas the FCT data set was based on manufacturing industries alone. In addition, and distinct from the work of Schmalensee and Rumelt, using the Compustat database reported the data at the level of the business segment and not the business unit level. Hough [34], also employed analysis of business segment effects and found twice as much variance in performance as corporate effects. In addition, findings from Hough's [34] study suggested that corporate effects had four times more variance in business segment performance than industry effects and finally, that segments explained eight times more variation when compared to industry effects. Brush, Bromiley, and Hendrick [35] and Ruefli and Wiggins [36] utilized different approaches. The former use a two-stage least squares model (2SLS) and the latter uses a non-parametric, ordinal variable approach. On the other hand utilizing the business unit level found that firm factors overruled industry factors. Mcnamara, Aime, and Vaaler [37] also cohort that firm effects have a significantly larger influence on firm profitability compared to industry effects.

Regardless of whether these studies utilized business unit or business segment effects, all confirmed that firm factors predominantly influence performance in contrast to the scarce effect of industry factors. A significant proportion of these studies used ROA as the financial performance measure. Nevertheless, it has been proposed that it is worthwhile to explore alternative measures of firm performance and new data[38]. Towards this end, Hawawini, Subramanian, and Verdia [39] and Chen and Lin [40] 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. In alignment with previous findings, these studies further confirmed that industry factors have a minimal impact on firm performance. Notably though, Hawawini et al. [39] concluded that industry in fact mattered for firms with average managerial capabilities and performance.

McGahan and Porter's [30, 38] study demonstrated that there is a difference of the importance of various effects on profitability across sectors. The most critical strategic resource of organizations, with direct impact on their market competition and their performance has been

intellectual capital [11]. It is therefore imperative to measure and value intellectual capital to enable knowledge-intensive firms to reach their true potential. Pulic [41], taking this consideration into account, developed the VAIC method, which explicitly considers intellectual capital to measure the value creation efficiency of intellectual capital within a company. It is important to note however that each measurement criterion measures firm performance from different perspectives while no criterion dominates over others [42]. Iazzolino and Laise [42] suggest that VAIC can be used to complement the traditional accounting or economic measures rather than considering it separately. The VAIC method has been vastly used in academia and business, becoming an important indicator in helping researchers to measure firms' intellectual capital performance [43].

More recent studies have expanded this strand of research by incorporating new variables and cross-country differences [44-51]. Despite the majority of these studies, in particular variance decomposition indicate the dominance of firm effects over industry effects contributing to determining effects in firm profitability, still it is meaningful to conduct a new study on the impact of industry and firm effects, since it is possible that the results are influenced by the specific performance measure used. More particular, it is not absolute that the performance measure used in previous studies forms a reliable indicator of economic value. In addition, the generic view that firm effects are relatively more important than industry effects does not necessarily hold true for all firms. For instance, it is not definite that industry and firm effects are the same among different classes of firms within the same industry. In addition, it is meaningful to conduct a research which examines the knowledge-intensive service industries sector which has seen unprecedented development over the last two decades and also a sample from developing countries since most of the studies conducted so far are based on US data and a significantly less number examines emerging economies. Among the few is a study by Abdullahi, Abubakar, Aliyu, and Umar [52], who conducted an empirical review were different variable or factors that influence firm performance in developing countries were retrieved. The majority of these studies do not explicitly state their sample size, method of data collection, and the theories that support or direct their studies. Importantly, the studies examined did not focus specifically on knowledge-intensive service industries. However, it is crucial to determine these variables as they are amongst the determinants of firm performance in developing countries. With regards to China, there have been certain insufficiencies of current Chinese domestic studies [53] examining the determinant of firm performance.

Taking the previous into consideration, this paper contributes to the debate of the relative importance of firm versus industry effects, focusing in particular on knowledge-intensive service industries performance in China and Taiwan as emerging economies by applying the indicator of VAIC as an intellectual capital performance measure.

Performance measure

Until the early 2000s, most studies focused on return of total assets as a measure of performance. Nevertheless, several disadvantages have been identified to arise from accounting conventions such as the inability to measure cash flows, and how returns are not adjusted for risk. In this sense, accounting ratios were inaccurate in providing information on either past economic profitability or the firm's future profitability [39].

Taking the previous into consideration, this study drawing on Chi et al.'s [11] approach, utilizes three different performance measures: the intellectual capital measure 'value-added intellectual coefficient' (VAIC), the economic measure EVA, and the accounting measure ROA (returns on assets). The former is estimated by measuring the operating income divided by total assets. This ratio is considered to be an important indicator of financial performance [54].

Nevertheless, this approach has been judged as not measuring the cost of capital, while also some conceptual problems arise from accounting conventions. In this sense, ROA, due to shortcomings in capitalization of accounting practices, does not provide with any information on either past economic profitability or the firm's future profitability [39].

EVA and MVA have been developed as economic measures of performance already from 1991 by The Stern Stewart Co. Both types of measurement refer to residual income, which concerns the way a firm achieves sustainable value creation only when its capital returns exceed its capital costs. Instead of using ROA, it is considered best to address capital cost, risk and the time value of money, to better reflect the economic value of a firm. It has been proposed that the adoption of the EVA performance measure leads to the need to focus on strategies for economic performance. In addition, as the EVA aims to offer improvements to the MVA calculation [55], this paper will consider the role of EVA only in the valuation of firms.

Importantly, just as Hawawini et al. [39] argue that what drives ROA does not equal to what drives economic performance, in the same vein what drives EVA does not equal what drives intelligence capital performance. A firm's market value is the result of capital employed and intellectual capital, consisting of human capital and structural capital. Human capital should be perceived as an investment and not a cost [43]. Rather than directly measuring firms' intellectual capital, Pulic [41] developed the VAIC to efficiently monitor and evaluate the efficiency of value added (VA) to a firm's resources. This approach primarily measures the efficiency of firms' three types of inputs: physical capital employed (CA), 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. Within a conceptualization of intellectual capital as the knowledge and ability that employees bring to their firms, it is derived that it increases their competitive advantage [56]. As such, an organization's employees' should be seen as a critical strategic source [11].

In this respect, key to the Pulic model is that labor expenses are considered an investment - a value creating entity- and not a cost. VAIC demonstrates the value-creation efficiency of a firm's total resources, including its intellectual capital. The estimate is that the higher the VAIC coefficient, the better management has made use of the firm's value-creation potential. Hence, the VAIC method elicits important information as to whether managers leverage their firms' potential and maximize its value in the marketplace [41].

Due to the fact that VA is estimated based on how a certain business uses its total resources, which include physical, human and structural capital, it becomes essential to enquire into the relationship between VA and the aforementioned types of capital. Consequently, at first the relationship between VA and physical capital employed (CA) were examined.

$$VA=CA \frac{1}{4} VACA \quad (1)$$

VACA, namely the Value Added Capital Coefficient, represents the figure of new value which has been created by one invested unit of capital employed. Following this procedure, the focus is on the relationship between VA and employed human capital (HC), which gives insights into the potential for HC to create value in a firm. Pulic argues that HC represents the amount of human capital invested in knowledge workers.

$$VA=HC \frac{1}{4} VAHC \quad (2)$$

In this equation, VAHC, represents the Value Added Human Capital Coefficient, and indicates the proportion of VA created by one monetary unit invested in employees, In other words, this coefficient concerns the productivity of knowledge workers in a firm. The next step entails to retrieve the facts on the relationship between VA and employed structural capital (SC). Pulic proposes that SC is the share of value added following deducting investment in HC.

$$SC = VA - \frac{1}{4} STVA \quad (3)$$

STVA, the Value Added Structural Capital Coefficient, aims to measure the share of SC in the creation of value added. Finally, it is significant to calculate the intellectual ability of a firm, which is the sum of the three components mentioned before.

$$VAIC = \frac{1}{4} VACA + VAHC + STVA \quad (4)$$

VAIC demonstrates the value-creation efficiency of a firm's total resources. This includes its intellectual capital. The higher the VAIC coefficient is, it suggest better management of the firm's value-creation potential. Hence, the VAIC method ultimately provides information on how managers leverage their firm's potential and maximize its value in the marketplace [41].

DATA AND SAMPLING

The source of data for this research, including all information essential to calculate VAIC, EVA, and ROA, have been drawn from the CEIC China Premium Database and the datasets provided by the National Science Board Science and Engineering Indicators – 2016 reports are used. Regarding the Chinese context, the CEIC database provides with complete corporate-level financial information owned by the enterprises listed and traded on the Shanghai Stock Exchange (SSE), one of the two major stock exchanges in mainland China. The National Science Board Science and Engineering Indicators on the other hand entail information on production, value added, consumption, imports, and exports from 70 countries and represents 97% of global economic activity [57].

The term 'firm' instead of the term 'corporate' was preferred to denote an autonomous competitive unit within an industry. In this way, the term 'firm effects' comprises both business unit and corporate effects. Concurrently, it covers both performance variety attributed to differences within industries among firms and differences among firms which cannot be explained by their patterns of industry activities [40, 39, 27].

The latter declared, the objective in this study has been to cross-check and compare the relative importance of industry and firm effects on firm performance in two emerging economies, in particular in the context of Chinese and Taiwanese knowledge-intensive industries. In a similar research by Gu, Guan and Wu [58] on the listed companies in China, the findings were different from previous researches: it seemed that the industry factors have notable effect on short-term payoff of the listed companies. In contrast, firms' resource and capacities appeared to be the dominant determinants of firm values and development potential for performance leaders and losers in the industry. Our sample covers a 5 years period from 2009 – 2014 on Chinese and Taiwanese high-tech and service sectors. According to the Guidelines for the Industry Classification of Listed Companies issued by the China Securities Regulatory Commission ('CSRC'), they divide the economic activities of listed companies into two levels: categories and classes, with reference to the Industry classification for the National Economy (GB T4754—2011). We use the four levels of the Industrial Classification for National Economic Activities revised under the leadership of the National Bureau of Statistics of PRC and organized by the relative departments of State Council. This research drew

9239 preliminary records for firm data. We then excluded 137 records that reported results with missing values. The final sample consisted of 4781 observations for 434 firms across 38 industry classifications for China and 4321 observations for 425 firms across 31 industry classifications for Taiwan.

Among the few research studies examining variance decomposition in regards to country and region effect, Chen [46] examined found that country effects dominate industry effects as far as industry performance around the world and in all regions examined (North America, South America, West Europe, East Europe, and Asia) accounting for over three fifths of the overall variation in industrial production worldwide of knowledge-intensive service industries [46]. Nevertheless, Chen [46] also found that the effects of industry are important, accounting for over one-third of performance differences among knowledge-intensive service industries. In contrast, it appeared that region effects had a very small yet significant impact on knowledge-intensive service industry performance [46]. Finally, Chen's systematic review indicated that year effects have a scarce influence on the performance of knowledge-intensive service industries. Table 1 and Table 2 show the descriptive statistics for the economic sector in China and Taiwan respectively.

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

	All			High-tech sector			Servicesector		
	EVA(inNTD millions)	VAIC	ROA (%)	EVA(inNTD millions)	VAIC	ROA (%)	EVA(inNTD millions)	VAIC	ROA (%)
Average	5,152,171.28	11.16	7.60	826,725.21	14.67	7.54	16,219,325.61	4.21	3.78
Standard deviation	31,959,272.23	113.26	13.03	17,166,734.75	129.37	11.02	42,452,211.63	7.44	7.76
Number of firms	434			287			147		
Number of industries	38			25			13		
Total number of observations Year included	4781 2009-2014			2760 2009-2014			2021 2009-2014		

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

Table 2. Descriptive statistics of VAIC, EVA, and ROA by economic sector in Taiwan.

	All			High-techsector			Servicesector		
	EVA(inNTD millions)	VAIC	ROA (%)	EVA(inNTD millions)	VAIC	ROA (%)	EVA(inNTD millions)	VAIC	ROA (%)
Average	4,321,026.34	11.88	7.57	804,653.24	14.72	7.56	12,740,368.45	5.24	4.87
Standard deviation	32,897,332.22	110.24	11.44	14,539,714.53	129.16	11.53	44,378,208.67	6.95	8.78
Number of firms	425			279			146		
Number of industries	31			17			14		
Total number of observations Year included	4321 2009-2014			2439 2009-2014			1882 2009-2014		

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

MODEL AND METHODOLOGY

In this research the analysis results from the descriptive model of firm performance similar to that of Chi et al. [11] and Hawawini et al. [39]:

$$rikt = \frac{1}{4}m + ai + bk + gt + \varepsilon_{ikt} \quad (5)$$

At the above, $rikt$ represents 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 m , which represents the average performance over the entire period for all firms. The next three terms represent the random industry, firm, and year effects. Industry effects (ai) are the result of the differences in the average performance to individual firm within each different industry. These effects reflect industry specific factors, for instance differing competitive behaviour, conditions of entry, and asset utilization rate impacts.

Firm effects (bk) represent both corporate and business unit effects, the result of the differences in the average annual performance for each firm. These effects include heterogeneity among firms in tangible and intangible assets reflecting the influence of firm specific factors. Year effects (gt) is the sum of the differences in the average performance of individual firms in each year and correspond to the influence of factors sharing broad economic trends. Finally, ε_{ikt} , is a random error term. The model employed here makes use of classes of effects as dummy variables, offering no casual inferences or structural explanation for variation in performance across industries, firms, or years. However, it does allow a focus on the existence and magnitude of differences in performance which relate to these categories. A decision was made to follow Chi et al.'s [11] approach who did not include the 'industry-year interaction' term used by Hawawini et al. [39] and Rumelt [27]. This transient industry effect, does not include similar transient effect for firm-year interactions. McGahan and Porter [30] posit that the use of the industry-year interaction term might replace the interactions between the other types of effects and year effects. They allowed for a first order serial correlation on

the errors term in their model and acknowledged that the results are comparable only with the stable effects in Rumelt's work. In this study, we do not utilize a general first-order autoregressive process on the error term while we exclude the 'interaction effect' terms thinking that the model would have been over specified if we equally represented transient industry effects and transient firm effects.

Previous studies utilized two main statistical methods for variance decomposition of firm performance: analysis of variance (ANOVA) and variance components analysis. Under the ANOVA approach, first the intention is to estimate a null regression model without no independent effect on the dependent variable. Next, the independent effects are added one by one. The following step is to calculate the increment to the adjusted R² of the regression and regard it as an unbiased estimate of the fraction of the variance explained by each independent variable. Importantly, the way of introducing the independent variables largely affects the results. Traditionally, the first entries reflect a large proportion of the variance due to the fact that ANOVA analysis shares a feature where it introduces all of the covariance to the first introduced effect.

The second popular method is the variance components approach which is often called the random-effects ANOVA due to the fact that there is a random-effects assumption. The former means that the error term, as well as all other effects in the model, are derived in a random order using an underlying population distribution with mean zero and no variance. Once this effect is drawn, it is considered fixed. In this manner there is no need to include the whole population in this model. It is still possible to draw an inference about a population of effects when using data from a random sample [59]. In addition, it is considered that random processes generate each effect in an independent way, so that each effect is not linked with other effects. Hence, estimating these variance components can reflect the relative importance of various effects. The equation utilized for the aforementioned estimation is based on Chi et al.'s [11] conceptualizations using the descriptive statistical model of Equation (5) which was decomposed as follows:

$$s^2_r = \frac{1}{4} s^2_a + s^2_b + s^2_g + s^2_\epsilon \quad (6)$$

The total variance s^2_r of performance represents the sum of the population variances in industry, firm, and year effects. Similar to Chi et al. [11], the preferred approach involved the use of PROC VARCOM procedure in SAS software to estimate the different variance components. Among the four estimation methods proposed for PROC VARCOMP in SAS, following the example of Searle et al. [60], in this study we employed the restricted maximum likelihood (REML) method, a strategy preferred for dealing with any sum of squares methods for unbalanced data such as ours. There are sets of useful properties in the restricted maximum likelihood such as consistency and asymptotic normality and the asymptotic sampling dispersion matrix. On the other hand, the inherent disadvantage of the variance component estimation used is the unreliability when it comes to testing the significance of the independent effects [11]. In addressing this issue, Schmalensee [26], Rumelt [27], and McGahan and Porter [30] used nested ANOVA techniques that consider the effects to be fixed. This approach allows for F-statistics to be produced which delineate the presence of the independent effects. Nevertheless, it was highlighted in the aforementioned studies that the use of the ANOVA test for significance is not a prerequisite to variance components estimation. The primary concern is to estimate the relative magnitude of each type of effect. In this perspective, we adhere to variance component analysis as our main approach.

EMPIRICAL RESULTS

The results in Tables 3 and 4 express the percentage of the total variance components estimation of Equation (6) for each of the performance measures in China and Taiwan. Using the nested ANOVA procedure, all figures were elevated at the 5% level for statistical significance. It appears that the performance measures VAIC, EVA and ROA are respectively 68.11%, 79.75% and 35.71% of the total variance in firm profit for China (Table 3). In respect to Taiwan, the performance measures VAIC, EVA and ROA are 68.28%, 79.87% and 30.38% of the total variance in firm profit (Table 4). When comparing the figures across the two countries, it appears that the first two variations for EVA and VAIC are quite high for both countries. In contrast, the ROA is low and in fact it is almost about half of the total explained variations in VAIC and EVA. It can be derived therefore that there is more variation in accounting profit ROA than in VAIC and EVA.

Table 3. Variance components results for China.

Variance component	VAIC		EVA		ROA	
	Estimate	%	Estimate	%	Estimate	%
Firm effects	10,468.56	67.28	9.45E+13	39.34	42.12	33.04
Industry effects	125.36	0.78	9.45E+13	38.43	3.34	2.43
Year effects	19.12	0.22	1.12E+12	1.54	3.36	1.89
Model	11,736.34	68.11	1.98E+14	79.75	49.89	35.71
Error	5012.41	21.89	4.47E+13	11.25	85.65	64.29
Total	16,748.75	100.00	2.34E+14	100.00	135.54	100.00
Number of observations	4781		4781		4781	

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

Table 4. Variance components results for Taiwan.

Variance component	VAIC			EVA			ROA	
	Estimate	%		Estimate	%		Estimate	%
Firm effects	10,967.99	67.15		9.44E+14	39.97		42.25	30.71
Industry effects	125.32	1.11		9.44E+14	39.85		4.57	3.32
Year effects	13.87	0.19		1.14E+13	0.46		3.24	2.12
Model	10,816.03	68.28		1.89E+15	79.87		48.75	30.38
Error	5435.41	31.71		4.45E+14	20.13		88.72	69.62
Total	16,251.44	100.00		2.33E+15	100.00		137.47	100.00
Number of observations	4321			4321			4321	

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

According to Table 3, the estimated variance component of the firm effects for VAIC, EVA and ROA are 67.28%, 39.34%, and 33.04%, respectively for Chinese firms, whereas in the case of Taiwan these figures are 67.15%, 39.97%, and 30.71%, respectively for VAIC, EVA and ROA (Table 4). The latter suggests similar results across China and Taiwan regarding the importance of firm effects. Comparatively, the corresponding figures in China as far as industry effects are 0.78%, 38.43%, and 2.43%, whilst for Taiwan the estimated variance component of the industry effects are 1.11%, 39.85%, and 3.32%. The inference from this comparison across the two countries and across effects is that for these developing countries, the effect of firm effects is similar. In particular in both countries the highest score is found in VAIC. Nevertheless, when comparing with industry effects, it is evident that firm effects both in China and Taiwan have a far greater influence for VAIC and ROA, whilst they are similar as industry effects for EVA. It is derived therefore that firm factors contribute to a far greater extent across all three measures of performance for both Chinese and Taiwanese knowledge-intensive industries. Conversely, the high estimated variance components observed for industry effects in EVA (both in China and Taiwan), suggest that industry factors contribute significantly to a firm's economic performance. The above results differ from the majority of findings from previous studies which focus on economy as a whole. Indeed, there was a noticeable difference in importance of industry effects among the three performance measures. However, previous research claimed that industry effects contribute less to variance across performance measures. For instance, year effects for VAIC, EVA and ROA across the two countries are 0.22%, 1.54%, and 1.89% for China (Table 3), and 0.19%, 0.46%, and 2.12% for Taiwan (Table 4), respectively. The inference is that year to year fluctuations in macroeconomic conditions do not substantially influence overall movement of firm performance in Chinese and Taiwanese knowledge-intensive industries.

The findings of the COV analysis are presented in Table 5 and 6 for the two countries. It appears that firm effects significantly impact firm performance in both high-tech and service sectors across all three measures of performance. In particular for high-tech sectors in China, firm effects for VAIC, EVA and ROA are 67.35%, 38.12%, and 32.23%, respectively (Table 5). In terms of the Taiwanese firms, VAIC, EVA and ROA form 66.76%, 39.16%, and 31.89% (Table 6). With regards to the service sectors, the corresponding figures for firm effects in China are 37.78%, 35.43%, and 28.14% (Table 5) and 39.12%, 36.63%, and 27.02% for Taiwan (Table 6). In the case of high-tech sectors, firm factors dominate industry factors across performance measures in both China and Taiwan. This prevalence of firm effects is more profound when

firm performance is measured by VAIC. However, notably firm effects do not dominate for EVA in service sectors in either country. Looking at China, firm effects are more important in high-tech sectors when comparing to service sectors to a significant degree. The same stands for Taiwan although to a lesser degree.

Table 5. Variance components results by economic sector in China.

	VAIC		EVA		ROA		VAIC		EVA		ROA	
	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent
Firmeffects	15,134.20	67.35	101,189.32	38.12	52.26	32.23	22.32	37.78	9.67E+13	35.43	23.21	28.14
Industryeffects	169.66	0.78	2162.21	0.82	2.23	1.56	9.67	15.87	1.15E+14	43.62	3.31	3.87
Yeareffects	38.14	0.21	449.83	0.15	4.28	3.12	0.84	1.43	1.12E+12	0.42	1.23	1.42
Model	16,694.45	68.15	115,781.21	37.63	62.53	35.87	33.18	56.45	2.14E+14	81.81	27.71	33.61
Error	8112.13	31.85	160,190.78	62.37	104.83	64.13	23.58	43.55	4.49E+13	18.19	53.32	66.39
Total	24,806.58	100.00	275,971.42	100.00	167.36	100.00	56.76	100.00	2.55E+14	100.00	81.03	100.00
Numberofobservations	2760		2760		2760		2021		2021		2021	

Variancecomponent

High-techsector

Servicesector

Table 6. Variance components results by economic sector in Taiwan.

Variancecomponent	High-techsector						Servicesector					
	VAIC		EVA		ROA		VAIC		EVA		ROA	
	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent
Firmeffects	16,146.11	66.76	111,179.30	39.16	53.17	31.89	23.42	39.12	9.78E+11	36.63	22.76	27.12
Industryeffects	189.62	0.78	2117.21	0.75	2.31	1.26	9.81	17.43	1.15E+14	42.75	2.18	3.87
Yeareffects	35.27	0.20	445.51	0.16	5.17	3.21	0.76	1.47	1.12E+13	0.24	1.16	1.47
Model	16,943.67	67.12	107,563.655	37.89	60.65	35.17	32.01	58.15	2.14E+14	78.38	31.62	35.79
Error	8132.35	32.88	165,568.56	62.11	105.64	64.83	25.43	41.85	4.46E+13	21.62	53.21	64.21
Total	25,076.02	100.00	273,132.21	100.00	166.29	100.00	57.44	100.00	2.57E+14	100.00	84.83	100.00
Numberofobservations	2439		2439		2439		1882		1882		1882	

One inference which is in common with Chi et al.'s study is a proportional variation in the importance of industry effects between high-tech and service sectors. More specifically, industry effects contribute more to total variance across the three measures of performance in the case of service sectors than high-tech sectors. These effects are considerably larger for EVA when the average EVA within an industry maintains abnormally high or low for sample period of coverage. This phenomenon is explained because EVA corresponds to the value-added ability of the firm on capital and it is possible to have a permanently low or high value due to the capability of incumbents resulting from physical and financial capital. The inference is that the dominance of industry effects over firm effects to EVA suggests that shareholders pertain industry information when making their assessments about management strategies when deciding on a service firm's value creation of invested capital. Lastly, year effects in this study are similar for China and Taiwan and do not take substantial portion in comparison to firm and industry effects in both high-tech and service sectors across the three performance measures.

DISCUSSION

This research examined in particular the relative importance of industry and firm-level effects on performance focusing primarily on China's and Taiwan's high-tech and service sectors. In addition, the research focused on firm performance, using VAIC, a tool in addition to the economic measure EVA and the accounting measure ROA. The analysis yielded some important findings which are noted below.

To begin with, it appears with regards to this study that firm effects are significant across all three measures of performance for both countries. Specifically, firm effects present much greater value than industry effects for VAIC and ROA whilst they are almost identical for EVA. The previous are complementary to the view that organizational resources and capabilities greatly influence on performance in Chinese and Taiwanese knowledge-intensive industries.

This is the case in terms of measurement using VAIC in high-tech sectors where firm effects seem to dominate over industry effects. In contrast, when it comes to service sectors, this dominance of firm effects is not found for EVA. It can be claimed therefore that firm effects prevail in high-tech sectors unlike the service sectors.

Secondly, it is evident from the findings in this research that industry effects have a substantial impact on economic performance. Data derived from the analysis indicate a succinct variation in the importance of industry effects across different performance measures for both China and Taiwan. What was evident is that industry effects are at a lower rate when it comes to VAIC and ROA, whereas for EVA, findings suggest they are comparable to firm effects. The inference from the results is that industry effects are contributing to firm's value creation by capital invested, yet this is not the same as far as the firm's value creation by intellectual capital in knowledge-intensive industries. This research suggested that industry factors are of equal importance to economic performance as firm factors in knowledge-intensive industries. It appears that this finding does not comply with previous research suggesting that industry effects contribute less to variance across different performance measurements. Another important inference deriving from this research is that industry factors may vary in their meaning for firm performance across economic sectors. For instance, while industry effects account for less variation across all measures of performance, the figures are considerably large in terms of the variation for EVA and VAIC in service sectors. In fact, when performance is measured with EVA, industry effects overcome firm effects in service sectors. The aforementioned could be explained by looking at the industry membership as an important indicator of a service firm's capability in value added by capital invested. In addition, it was found that year effects minimally affect firm performance ascribing for a very small variation in the high-tech and service sectors across the three performance measures.

Overall, the comparative findings derived suggested that for both China and Taiwan, industry structural characteristics greatly influence China's and Taiwan's knowledge-intensive industries. The indication was that firm effects were considerably more important to VAIC than EVA and ROA in the high-tech sector. It is therefore assumed that organizational capabilities which leverage human capital are incremental towards the learning and growth of high-tech firms. Furthermore, it appears that industry effects prevail for EVA in the service sector, which can lead to the inference that shareholders pay additional attention to industry structural differences when making their assessments on the economic value of a service firm's.

CONCLUSIONS

The intention in this study was to take deep insights into the determinants of firm performance in knowledge-intensive industries across two emerging economies, that of China and Taiwan, focusing on year, industry and firm effects. The study yielded data from a five year period between 2009 and 2014. Given that developing human capital is a major input factor in knowledge-intensive business services [61], it was considered best to implement an alternative measure of performance, namely VAIC, as a means to supplement the analysis using EVA and ROA. The overall findings suggested similar results for China and Taiwan in respect to firm effects. It was found that for both countries, firm effects have substantial value across performance measures, with an increased degree in Taiwanese knowledge-intensive industries, although they are almost equally important as it appears for China as well, especially for VAIC. Hence, it can be claimed that organizational capabilities that leverage human capital play an important role in developing learning and growth in knowledge-intensive industries.

Similar to other research findings, this study suggested that firm's resources and capability have greater impact than industry factors when it comes to industries with higher degree of marketization. Different studies suggest that individual companies 'utilize their own internal knowledge resources in combination with that of their partners' [61]. In a study by Chow and Gong [62] examining the role of HRM in China's technology-intensive industries, it was found that the firm's innovation capability was an important determinant of firm performance. The latter finding points to the need for both Chinese and Taiwanese firms to invest in the development of their resources and capability. Due to the fact that knowledge-intensive industries have to make their way in a complex and competitive environment, it is essential for organizations to exploit their human resources to produce innovation capabilities so that they retain a competitive advantage and survive [62]. Human resources management (HRM) strategies are critical when it comes to promoting creativity among employees [62, 63]. In fact, it has been empirically proven that investing in R&D activities helps release innovation potential [64, 65] since this process is closely depended to the capability of a firm to adopt proper human resource management policies relevant to succeeding the company's innovation goals [66]. In addition, training of employees can potentially raise their feeling of ownership and can lead to more personalized and accountable services for customers, which is not possible without well-trained and knowledgeable employees [67]. In a study by Nguyen, Truong and Buyens [68] examining training and firm performance in economies in transition, the review results indicated that training is positively related to firm performance.

Taking the previous into consideration, establishing a systematic training mechanism can improve the level of training courses provided to employees enhancing their professional managerial skills. PCSC is such an example of a company utilizing this strategy successfully to expand its marketing network in Taiwan, China, and other countries. As far as rewards policy, Chien et al. [69] posit that it is meaningful to address performance-based salary as a means to enhance R&D professionals' job performance. In this way, it is important for high-tech organizations to adopt performance-based pay, as a reward to motivate R&D professionals. Already, this is taking place in Taiwan, as it was exhibited by the study of Lin et al. [70] investigating the relationship between employees' reward plans and firm performance among Taiwanese firms. On the other hand, this combination of commitment and control HR practices reflects the unique context and trajectories of Chinese business today [71]. Wei [72] examining pay of performance (PFP) in China's non-public sector knowledge-intensive industries, found that it is a highly preferred practice widely adopted.

In addition, the results from this study indicate that industry factors have little importance for VAIC both in the case of China and Taiwan. In Taiwan and China likewise, the unprecedented economic growth and transformation of economic structures have led to increased demand for skilled technical workforce [73]. Towards this end, the Taiwanese government has encouraged private enterprises to offer more training opportunities to their employees seeking to step up in terms of their overall knowledge and skills, a tactic to which the Taiwanese government should pertain on a more systematic base [74]. In the case of China, both the government and enterprises have emphasized on the job training as a possible solution to address the skill shortage [75-77]. Nevertheless, it has been empirically proven that workplace-based training in China is underperforming in terms of quality and quantity [78, 79, 77, 80] as a means to avoid poaching when succeeding to train high-skilled professionals [77].

The findings from this study also suggested that industry effects are considerably larger when it comes to EVA in the service sector, in accordance with McGahan and Porter's [30], and Chi et al.'s [11] findings. The latter suggests that whether in the United States or Taiwan and China, industry effects do impact performance in service industries. There is a consensus that

significant differences exist among the different types of service industries, such as in the case of domestic service industries and export-oriented industries.

There were certain limitations in this research which should not go unnoticed. The model excludes the transient effects terms in an attempt to avoid over specifying the model by equally representing transient industry effects and transient firm effects. Most importantly, the fieldwork for this study involved data from Chinese and Taiwanese listed companies which represent only a small portion of companies in the respective countries. Secondly, although based on the findings from this research it is possible to generalize for other countries, still future work is needed in a number of developing countries to determine the extent to which industry or firm effects influence firm performance in knowledge-intensive industries in these emerging economies. On the other hand, it should be noted that the sample used was considered substantial for the purposes of this study whilst the data for analysis were derived from a rather recent and long period, focusing on the previous five years. This suggests that one interesting strand to take future research would be however to focus on sources of variance in firm performance focusing on identical specific industries and compare the findings between developed and developing economies.

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