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

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## 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.

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## 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

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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 (Fier & 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

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