Determinants of industry performance: region vs. country effects in knowledge-intensive service industries

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Recent variance decomposition studies have started trying to determine the relative importance of industry and firm on profitability, but little research has been done to investigate exactly how much the difference in regions and countries could explain the variation in industry performance. This study explores the sources of knowledge-intensive service industry performance by comparing the relative importance of region, country, and industry effects. Using a variance components model fitted to a new data set, we find that while the country effects dominate industry performance around the world and in all regions (North America, South America, West Europe, East Europe, and Asia), industry effects too play a role in developing the worldwide knowledge-intensive service industries. We also find that regional effects have little significant influence on industry performance.

Keywords: industry organisation; performance; strategic management; international economics; knowledge-intensive service industries

Introduction

There is a clear trend in the Organisation for Economic Co-operation and Development (OECD) (2001) area towards a knowledge-based economy that is echoed in the economic and innovative performance of high-tech sectors – both in manufacturing and services. In many OECD countries, especially the United States, the knowledge-intensive service industries developed quickly during the 1990s and became the leading industries in the world through international transactions and service flows. In fact, knowledge-intensive service industries are key contributors to service-sector growth around the world (National Science Board, 2006). Knowledge-intensive service industries are defined as sectors comprising service, engineering, and technology in their services or in the delivery of those services. Five knowledge-intensive service industries, as classified by the OECD, are business services, communication services, financial services, educational services, and health services. Business services, which include computer and data processing and research and engineering services, is the largest of the five knowledge-intensive service industries and accounts for 34% of global service revenues in 2003 (National Science Board, 2006). Communication services, which include telecommunication and broadcast services, is considered as the most technology-driven service sector. Although industry boundaries of these knowledge-intensive service industries have been characterised as having dynamic dimensions of markets and technologies (McGee & Thomas, 1986), an international standard used to judge a nation’s competitiveness rests on the ability of its
industries to produce goods that find demand in the marketplace (OECD, 1996), and industry has been traditionally treated as the basic unit of analysis when evaluating firm and market performance.

What matters most to profitability? Scholars of industrial organisation (IO) economics and the resource-based view (RBV) of the firm have disagreed over this question for more than 60 years. Recent variance decomposition studies have started trying to determine the relative importance of industry, corporate parent, and business segment on profitability, but little research has been done to resolve this debate. Although these variance decomposition studies have significantly advanced our understanding of the antecedents of firm profitability, they have tended to focus on firms with diversified business segments in a single-country context (i.e., the United States), treating country effects as external to firm performance (Makino, Isobe, & Chan, 2004). While recognising the contributions of IO and RBV to the analysis of competitive advantage, Peng (2001) and Makino et al. (2004) argue that scholars in the field of international business and international management have highlighted the importance of economic, political, social, cultural, and institutional differences across countries and claimed that countries do matter in explaining the variation in behaviour and performance of multinational corporations (MNCs). While some have shifted the focus of research from multiple-business firms within a single country to MNCs, to explore the extent to which country effects explain the variation in the performance of foreign affiliates (Makino et al., 2004), few scholars have investigated exactly how much country differences can actually explain the variation in industry performance. Therefore, this study shifts the focus of attention from firm performance to industry performance and examines how much country effects explain the variance in the performance of the knowledge-intensive service industry.

Understanding the sources of performance differences is a key theoretical and empirical issue in the fields of IO and the strategic management perspective of the RBV. It has long been conventional to treat the industry as a basic unit of analysis when considering the performance of firms and markets. IO has provided the main theoretical basis for strategic management research into the determinants of firm performance. During the 1970s, two prominent views – the industry view and the firm-efficiency view – emerged as the sources of extraordinary profits. The industry view of IO holds that industry structure is important in shaping the conduct of member businesses, which in turn drives their profitability. Several studies have compared average levels of profitability across industries and investigated factors explaining the consistent differences in performance between industries by looking for significant differences associated with variations in the level of industry concentration, and other market structure variables (Scherer, 1970). At the time, the IO economists’ favourite theoretical framework was the structure-conduct-performance (SCP) paradigm, which proposes the existence of a deterministic relationship between market structure and profitability. In other words, the structural characteristics of an industry inevitably constrain the behaviour (i.e., the conduct or strategies) of its component firms, which in turn leads to industry-specific performance differentials between firms (Mason, 1939). In this framework, the central argument is that the structural characteristics of industries are the primary determinants of performance (Porter, 1980).

In the early 1980s, there were major shifts in the strategic management field regarding the unit of analysis. While IO considers the industry as the main unit of analysis, strategic management focuses increasingly on the firm itself to explain profitability differentials. In this firm-efficiency view, companies achieve extraordinary profits in a line of business when they operate more efficiently than their competitors do. Superior performance may arise through skill or luck, and poor performance may result from commitment to
a position that is subsequently revealed to be unfavourable. The main reason for this shift of the unit of analysis is that the IO is unable to provide a rigorous explanation for intra-industry heterogeneity in performance. The firm-efficiency view argues that the firm’s internal environment drives its competitive advantage.

Since the late 1980s, the more overt stance of national governments towards competing in a global market has led to a focus on international competitiveness. By combining the factor endowments theory, the IO and the RBV perspectives, Porter (1990) adds the intervention role of national government to formulate a national level of competitiveness to interpret ‘how to do better than your rivals’. Shifting the focus of attention from firm performance to nation performance, Porter’s (1990) *The Competitive Advantage of Nations* is an important book that bridges the gap between strategic management and international economics while contributing substantially to both. Porter’s analysis of the impact of national environment on international competitive performance demonstrates the potential for the theory of competitive strategy to rescue international economics from its slide into refined irrelevance, while simultaneously broadening the scope of the theory of competitive strategy to encompass both the international dimension and the dynamic context of competition.

In addition, the role of culture, and in particular the impact of differing national cultures, (Hofstede, 1980, 1991) is ignored as an important element in international business theorising and empirical studies. The interplay of national cultures and organisational cultures, including the organisational culture of multinational organisations that might augment, transcend, or conflict with particular national cultural traits, represents a research agenda with much life left in it (Buckley, 2002). The question of whether an industry’s performance is driven primarily by nation or industry factors in international competitiveness is highly relevant at a time when the globalisation of markets has raised questions about the influences of national environments, including the impact of national cultures, and the appropriateness of domestic industrialisation policy towards competition. In the light of these arguments, exploring the sources of performance differences among national knowledge-intensive service industries is an important issue in international economics and strategic management research.

**Identifying the determinants of firm performance**

The current empirical debate about the importance of industry, corporate-parent, and business-segment effects on firm profitability began with a study by Schmalensee (1985), followed by studies by Wernerfelt and Montgomery (1988), Kessides (1990), Rumelt (1991), Roquebert, Phillips, and Westfall (1996), McGahan and Porter (1997, 2002), Brush and Bromiley (1997), Brush, Bromiley, and Hendrickx (1999), Bowman and Helfat (2001), Hawawini, Subramanian, and Verdin (2003), Ruefli and Wiggins (2003), Hough (2006), and Misangyi, Elms, Greckhamer, and Lepine (2006). All of these studies decompose the variance of business or firm returns (or business market share, in one study) into components associated with industry, corporate-parent, and business-segment effects, some including year effects and interaction terms as well. Later studies have weighed the influence of industry effects only (Powell, 1996), the influence of industry and firm effects together (Cubbin & Geroski, 1987; Mauri & Michaels, 1998), or the influence of industry and organisational effects together (Hansen & Wernerfelt, 1989). Some recent studies have extended this line of research by incorporating new variables or cross-country differences, for example, the effects of business groups on Korea’s Chaebol member firms (Chang & Hong, 2002), the effects of institutional
changes on firm heterogeneity (Walker, Madsen, & Carini, 2002), the performance effects of business groups across emerging countries (Khanna & Rivkin, 2001), the effects of country- and industry-specific variables as well as the interaction of country and industry variables, to cross-national differences in MNCs’ profitability (Brouthers, 1998), and the impact of the extent of the geographic scope on MNCs performance (Christmann, Day, & Yip, 1999; Goerzen & Beamish, 2003; Yip, 1991). Although these studies, particularly variance decomposition, have made a significant contribution to determining differences in firm profitability, they have provided limited insights regarding how much industry performance differs among countries.

Why region and country matter
Most existing variance decomposition studies have investigated the source of business segment performance among domestic firms, and only a few recent studies have begun investigating how much country matters in explaining foreign subsidiary performance. Building on previous studies, we attempt to explain why region, country, and industry effects are considered as determinants of knowledge-intensive service industry performance.

Region vs. country effects
How much does region matter to economic performance? Since the 1990s, economic regionalisation in the world has begun to take off. For example, the formation of an expanded and strengthened European Union and the North American Free Trade Area (NAFTA) as formal structures enhanced interest in some of regionalisms in Asia, for example, the Asia Pacific Economic Co-operation (APEC) and the Association of South East Asian Nations (ASEAN), where some countries have demonstrated their massive inflows of foreign direct investment (FDI), significant increases in intra-regional trade, and strengthening links to the global economy. After investigating the relationship between geographic scope and performance, Yip and Madsen (1996) argue that regional scale economies or scope economies are important when single-country markets are not large enough to allow competitors to achieve optimum scale. Thus, regional impacts are expected to be prevalent due to social, cultural, economic, political, and geographical linkages. The key characteristic of economic regionalism is the tendency for greater economic, social, and political links between countries in the region, suggesting greater regional impacts on the economies of the region and possibly on the knowledge-intensive service industries as well.

‘The effects of increasing economic integration on regional growth and development derive from increases in trade, removal of barriers to the movement of capital and labour, and reductions in transaction costs’ (Martin & Tyler, 2000, p. 602). Where integration involves movement towards cost reduction, the ease and lower costs of providing value-added goods and services across countries reinforce these developments. There are essentially two main views about the regional implications of these changes. First, the evolution of institutions that create a hospitable environment for cooperative solutions to complex exchange provides for economic growth (North, 1990). Traditionally, in the conventional economic theory inherited from Adam Smith, the gains from trade made possible by increasing specialisation and division of labour have been realised regardless of the costliness of exchange process. However, this assumption in the exchange process has been criticised by recent transaction cost economics, which insist that the total costs of
production are the sum of transformation costs, the resource of land, labour, and capital involved in transforming the physical attributes of a good (size, weight, colour, location, chemical composition, and so forth), and transaction costs, the costs of measuring the valuable attributes of what is being exchanged and of protecting rights and policing and enforcing agreements. Institutions are defined as the written and unwritten rules, norms, and codes of conduct that human beings devise to shape human interaction to reduce uncertainty and control their environment (North, 1990). Therefore, regional institutions together with the technology employed determine those transaction costs and play a key role in the costs of production. Institutions can provide the structure for an exchange process involving transaction costs, whether political, social, or economic, and suggest significant modifications in economic theory and very different implications for economic performance (North, 1990).

Since national institutions differ in creating a hospitable environment for cooperative solutions to complex transactions, as the stability and efficiency of such institutions determine the costs of doing business in a given country, the effects of institutions on the performance of firms varies significantly across countries (Bergara, Henisz, & Spiller, 1998; Delios & Henisz, 2000; Henisz, 2000; Kostova & Zaheer, 1999; Makino et al., 2004; North, 1990; Westney, 1993; Zaheer & Zaheer, 1997). For example, Coase (1937), from the perspectives of the firms, argues strongly that institutions matter in capturing the potential gains from trade when an exchange process is costly to transact. Knack and Keefer (1997) found that social capital and norms vary widely across countries and strong norms of trust and trustworthiness facilitate economic outcomes and development, or firms can lower the cost of monitoring and enforcing contracts and hence improve their performance (La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 1997).

Second, recent researchers pay attention not only to the important role played by institutional factors in promoting localised growth and development, but also to other determinants of economic performance such as the geography of production, another perspective to explain the influence of region and country environment on industry performance. Economic geography defined as the location of factors of production in space has a long history (Clark, Gertler, & Feldman, 2000; Krugman, 1991, 2000), is currently enjoying a renaissance (Scott, 2000), and emphasises endogenous agglomeration forces generated by the interaction of increasing returns and transport costs. There is a long tradition to this perspective. For example, Marshall (1890) argues about the importance of geography in the competitive process. The essence of concentrations of mutually supportive industries – clusters or industrial districts – goes back to the work of Marshall (1919) who seized on the ability of firms in close proximity to capture the external economies that might otherwise not be appropriated (Asheim, 2000). Support for research developments in this area has been fostered by the recent trend towards an increasingly borderless world economy, including the integration of national economies within new trading blocks such as the European Union. There are close connections here with mainstream work in international business, notably John Dunning’s OLI paradigm, with a focus on the L for location (Dunning, 1977, 1995, 2000). Similarly, Buckley and Ghauri (2004) review the literature linking ownership and location strategies to economic geography and theories of globalisation to explore new areas of international business research.

Country vs. industry effects

The rapid growth in geographically dispersed competitors fighting for new markets since the 1970s is a familiar trend, and international competition (Levitt, 1983; Porter, 1986;
Prahalad & Doz, 1987) and globalisation (Bartlett & Ghoshal, 1989; Porter, 1986; Prahalad & Doz, 1987; Yip, 1992) at the industry level have also been increasing in intensity over this period. Why do some nations and industries succeed and others fail in international competition? For example, why does Japan do so well in the automobile industry? Why does Switzerland excel in the production and export of precision instruments and pharmaceuticals? Why do Germany and the United States do so well in the chemical industry? This theme, however, is not a new issue. The same question inspired Adam Smith to write *Wealth of Nations* in 1776 and has been a central theme motivating the development of economic science since then. Below are the approaches used to explain how different country attributes can influence an industry.

First, there is the theory of comparative advantage. Observing how countries differed from each other, British economist David Ricardo in the early nineteenth century explained international trade insightfully in terms of international differences in labour productivity. A country is said to have a comparative advantage in such an industry and tends to specialise in and export the outputs of the goods produced in that industry. If labour is the only factor of production, as the Ricardian model assumes, comparative advantage could arise only because of international differences in labour productivity (Krugman & Obstfeld, 2000). In the real world, however, international differences in countries’ resources do not just rely on labour but also on other production-related factors, including land, capital, and mineral resources.

Second, by including all countries’ resources, two Swedish economists, Eli Heckscher and Bertil Ohlin, proposed a model in the 1930s emphasising the interplay between the proportions in which different factors of production are available in different countries and the proportions in which they are used in producing different goods. This theory is often referred to as the Heckscher–Ohlin theory or the factor endowments theory (Krugman & Obstfeld, 2000). Due to the differences in their relative abundance in specific countries, the prices of factors of production and relative production costs vary across countries. In particular, the Heckscher–Ohlin theory proposes that a country can produce goods relatively cheaply in an industry that uses relatively intensively the factors with which the country is relatively abundantly endowed. Following World War II and the re-establishment of the international economy, the renewal and increase of international flows of FDI was a key feature behind the dynamism of Western economies. However, the Heckscher–Ohlin theory assumes that immobile factors of production (labour and capital) and macro-explanations of capital moving in response to differential rates of interest are not feasible and do not deal with important industrial differentials within these flows, for example, the steel industry remaining largely domestic but automobile industry quickly internationalising.

Third, while multinationality permits access to global scale economies and the resource advantages available in different countries, the new trade theory began to emerge in the 1970s. The new trade theory argues that for those products where economies of scale are significant and represent a substantial proportion of world demand, the first movers in an industry can gain a scale-based cost advantage that later entrants find almost impossible to match. With regard to the first-mover advantages and international trade, Chandler (1990) suggests that the existence of first-mover advantages is an important factor in explaining the dominance of firms from certain nations in specific industries. Besides stressing the role of luck, entrepreneurship, and innovation in providing a firm first-mover advantages, perhaps the most contentious implication of the new trade theory is the argument that it generates for government intervention and strategic trade policy (Hill, 2007).
Fourth, while recognizing the nation and industry environments as the primary determinants of performance, Porter’s (1990) *Competitive Advantage of Nations* addresses a question that lies at the heart of economic and managerial science: ‘why do some social groups, economic institutions, and nations advance and prosper?’ (Porter, 1990, p. xi). For Porter, the essential task was to explain why a nation achieves international success in a particular industry. Like the work of the new trade theorists, Porter’s research was driven by a belief that existing theories of international trade, the theory of comparative advantage and the Heckscher–Ohlin theory, told only part of the story (Hill, 2007).

Shifting the focus of attention from the performance of the firm to the performance of the nation and industry, Porter’s (1990) ability to dramatically expand the scope of existing theory concerning international trade and investment is derived from this integration of competitive strategy with that of international trade and investment. Porter (1990) argues that the influence of the nation on the international competitive performance of firms occurs through the ways in which ‘a firm’s proximate environment shapes its competitive success over time’ (Porter, 1990, p. 29). Thus his framework highlights how productivity in a particular industry varies across countries not only in terms of naturally inherited factors of production, as traditional trade theory insists, but also of different capabilities to create, upgrade, and sustain the innovation and technology that enhance the competitive advantages of indigenous firms over foreign firms in an industry (Makino et al., 2004). The primary role of the nation is that of ‘home base’ that it provides for the technological development and innovation from which firms draw to compete against foreign rivals in domestic and foreign markets. According to Makino et al. (2004, p. 1031), ‘firms based in particular countries can achieve a superior performance in distinct industries because these countries have greater capacity to help their firms improve and innovate faster than foreign rivals in a particular industry’.

Porter’s (1990) theory of how national factors influence competitive advantage within individual industries extends well beyond current theories of competitive advantage based upon resource endowments and integrates and broadens contributions to trade theory based upon IO and the product life cycle. However, the breadth and relevance of Porter’s analysis have been achieved at the expense of precision and determinacy (Grant, 1991). Grant (1991) argues that the versatility and richness of Porter’s theory is achieved partly through theoretical relationships that are indeterminate and sometimes inconsistent, and at the empirical level, Porter’s theory is applied selectively and qualitatively and without resort to rigorous testing of its predictive validity.

Finally, recognizing the importance of institutions to economic performance, cultural distance – that is, differences between national cultures – also leads to differences in economic growth. National culture is defined as the collective programming of the mind that distinguishes the members of one group or category of people from another (Hofstede, 1980). Differences in the relative cultural distance between countries have not only been an important concern at the national level (Ghemawat, 2001; Hofstede, 1980; Rokeach, 1973; Trompenaars & Hampden-Turner, 1998), but also in the study of strategies and organisational characteristics of MNCs (Barkema, Bell, & Pennings, 1996; Brouthers & Brouthers, 2001). For example, countries that stress Confucian dynamism and group cohesion perform economically better than other countries that do not (Franke, Hofstede, & Bond, 1991).

Schwartz (1999) found that adapting to local cultural values that are transmitted through a nation’s political economy, education, religion, and language might create an additional burden for multinational enterprises operating in different countries. Prior research has provided mixed empirical evidence regarding the specific influence of
cultural distance. Whereas some studies have indicated a negative relationship between cultural distance and MNCs’ performance (e.g., Luo & Peng, 1999), other studies have found a positive effect (Gomez-Mejia & Palich, 1997; Morosini, Shane, & Singh, 1998; Park & Ungson, 1997).

Although the above mainstream approaches have significantly advanced our understanding of the antecedents of what about a country matters, no single perspective – the comparative advantage, the Heckscher–Ohlin factor endowments theory, the new trade theory, the competitive advantage of nations, the structural-institutionalism, cultural distance, and economic geography – can satisfactorily explain the extent to which country and region affect industry performance. Drawing on the comparative advantages and the Heckscher–Ohlin theory that countries differ in the availability of production factors, which influences the relative production costs across industries within a country, we could argue further that industry effect on industry performance would vary across countries and change over time. This is the concept of *inter-industry* distribution of industry performance. Moreover, if Makino et al. (2004) are right, then a single-country study of the industry effect would not be able to separate the effect of industry from at least two country-specific effects: the country-specific effect that systematically influence the variation in knowledge-intensive service performance across industries in each country and the country-specific effect that influences the variation in knowledge-intensive service performance across countries in an industry. To examine precisely the industry effect on knowledge-intensive service industry performance, a multi-country study is needed to examine the country effect separately from industry effect.

As countries also differ in their capabilities, the competitive advantage of the indigenous firms over foreign firms can be enhanced within a particular industry by the effect of countries. Therefore, we could argue that the new trade theory and Porter’s competitive advantage of nations implies that the country effect on industry performance would vary across countries and change over time. Additionally, the industry performance across countries is not only influenced by the attributes of that country but also by its institutional environment. Based upon the theory of structural-institutionalism, national differences in institutional environments create incentives and barriers that could lead to differences in industry performance. Besides, the distance in cultural and social orientations across countries creates a barrier to social networks in local business communities, thus limiting the chance of gaining access to the intangible assets and know-how shared among particular local firms and government authorities, and could lead to differences in performance (Chen & Chen, 1998; Ghemawat, 2001; Kogut, 1991; Luo, 2001; Peng & Luo, 2000). Finally, because countries differ in the cumulative process of industrial clustering in spatial contexts, we can, from the point of view of economic geography, argue that country attributes, that is the location effect, on industry performance would vary across countries. Taken together, these points of view illustrate the concept of *intra-industry* distribution of industry performance.

The above brief review suggests that industry performance varies not only between industries but also between countries that have different competitive advantages, institutional environments, cultural distances, and economic geographies. In this context it is natural to ask, with respect to the relative importance of industry, country, and region environments, what accounts for the differences in performance among knowledge-intensive service industries?

The picture emerging from our analysis of whether knowledge-intensive service industries’ performance is driven primarily by region, country, or industry factors is thus quite different from that presented by mainstream variance decomposition studies. It is our hope
that this different understanding of knowledge-intensive service industry development will help shed light on how potentially the regional and national environments may influence the conditions for knowledge-intensive service industries in different countries to find common ground as they work to build an internationally competitive industry.

The model and its operationalisation

The model

The analysis of the effects of country, industry, region, and year factors relies on the following descriptive model, which is similar to Schmalensee (1985) and Rumelt (1991):

$$r_{ijkt} = \mu_{...} + \alpha_i + \beta_j + \delta_k + \gamma_t + e_{ijkt}$$

where $i = 1, \ldots, m$ refers to countries, $j = 1, \ldots, n_i$ refers to industries ($n_i$ is the number of industries within country $i$), $k = 1, \ldots, p$ refers to regions, and $t$ years, and $r_{ijkt}$ the accounting or economic profit in year $t$ for industry $j$ in country $i$ and region $k$. The first right-hand side term is $\mu_{...}$, which is the average profit over the entire period for all industries (the four dots indicate averages over indices $i, j, k,$ and $t$). The next three terms $\alpha_i$, $\beta_j$, $\delta_k$, and $\gamma_t$ represent the random country, industry, region, and year effects, respectively, and the final term $e_{ijkt}$ random error term. The term $\alpha_i$ is the increment to profit associated with participation in country $i$ and reflects national influences, including national economic structures, values, cultures, institutions, and histories, on the competitive advantage of industries. Country effects derive from differences in the average returns to individual industry within each different country. The term $\beta_j$ is the increment to profit associated with the specific situation of industry $j$ and represents the influence of structural characteristics, including seller concentration, advertising, and R&D intensity, of industries on the performance of industries. Industry effects derive from differences in the average annual returns to each different industry. The term $\delta_k$ is the increment to profit associated with participation in region $k$ and reflects regional influences, which derive from differences in the average returns to individual industry within each different region. The term $\gamma_t$ represents the difference between $\mu_{...}$ and the average profit of all industries in year $t$ and captures the impact of broad economic trends. Year effects derive from differences in the average returns to individual industry in each observation year.

The assumption of this descriptive model is that random disturbances $e_{ijkt}$ are drawn independently from a distribution with a mean of zero and unknown variance $\sigma_{e_{ijkt}}^2$. Furthermore, this descriptive model makes the additional assumption that all the other main effects ($\alpha_i$, $\beta_j$, $\delta_k$, and $\gamma_t$), like the error term, are realisations of random processes with a mean of zero and constant variances, $\sigma_{\alpha_i}^2$, $\sigma_{\beta_j}^2$, $\sigma_{\delta_k}^2$, and $\sigma_{\gamma_t}^2$. These four sources of variation in industry performance represent random country, industry, region effects, yearly macroeconomic fluctuations, and random disturbances. The advantage of this random-effects assumption is, as Rumelt’s (1991, p. 172) states, ‘that the differences among effects, whatever their source, are “natural”, not having been controlled or contrived by the research design, and are independent of other effects’. In other words, random effects occur when observations are drawn from an underlying and unobservable probability distribution. In summary, this variance decomposition model, or descriptive model, makes its estimations using dummy variables for countries, industries, regions, and year effects. The strength of this descriptive model using four relevant effects is that it requires no causal or structural explanation for profitability differences across
years, regions, countries, or industries. It simply posits the existence of differences in profitability associated with these categories.

Although this model of industry performance, or Equation (1), is similar to the descriptive models of Schmalensee (1985) and Rumelt (1991), there are two key differences between the current and previous descriptive models. First, while the previous descriptive models analyse the effects of industry, firm, and year factors on firm performance, the current descriptive model would like to explore the effects of country, industry, region, and year factors on industry performance. Second, all the ‘interaction effect’ terms have been discarded because the model would be overspecified if we equally represented transient country effects (the country–year interaction) and transient industry effects (the industry–year interaction).

**Operationalisation of the model**

The performance measure used in this study is industrial revenues (production). Examining limited domestic and worldwide gross revenues data, which is only available for the knowledge-intensive service industries, assesses the global competitiveness of a nation’s industry. Combined global sales in knowledge-intensive service industries exceeded $14.1 trillion in 2003 and have risen every year since 1980 (National Science Board, 2006). Comparing with the extensive data available for the high-tech manufacturing industries, national data that track activity in many rapidly growing knowledge-intensive service sectors are limited in the level of industry disaggregation and types of data collected.

**Data sample and statistical methodology**

**Data**

To use industrial production as the performance measure to examine the sources of performance differentials among knowledge-intensive service industries, this study needed a reliable database. The National Science Board *Science and Engineering Indicators – 2006* reports are used. This database provides production, value added, consumption, imports, and exports data for 70 countries and accounts for over 97% of global economic activity (National Science Board, 2006), and is particularly desirable for its exhaustive scope.

**Sample**

The sample set of five knowledge-intensive service sectors covers the 9-year period from 1995 to 2003. The sample was screened in various ways. This study excluded industries that did not contain a primary industry classification; industries that reported results with missing values; and industries that were not reported to be active in the same industry classification over the 9-year period. The final sample contains 1665 observations for five knowledge-intensive service industries across 37 countries. To ensure uniform definitions of knowledge-intensive service industries across countries, International Standard Industrial Classification (ISIC) codes are employed to classify the five knowledge-intensive service industries as illustrated in Table 1.
Netherlands, Portugal, Spain, Sweden, the United Kingdom, Czech Republic, Hungary, Poland, Slovakia, Japan, China, South Korea, Taiwan, Singapore, Hong Kong, India, Malaysia, Thailand, Philippines, Indonesia. In order to control for a broader geographical region effect, we analysed by categories similar to those used by Chen (2006) to classify 37 countries into five regions: North America (NA), South America (SA), West Europe (WE), East Europe (EE), and Asia (AS), for cross-region comparisons of each effect on knowledge-intensive service industry performance. A description of region classification is provided in Table 2.

**Statistical methodology**

In general, most of the variance decomposition studies use two statistical methods to decompose the variances of profitability: nested analysis of variance (ANOVA) and

### Table 1. Knowledge-intensive service industries classifications.

<table>
<thead>
<tr>
<th>Service industry</th>
<th>ISIC Rev. 3.1</th>
<th>Class description</th>
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<tbody>
<tr>
<td>Communication services</td>
<td>6420</td>
<td>Telecommunication services</td>
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<tr>
<td></td>
<td>9210</td>
<td>Broadcast services</td>
</tr>
<tr>
<td>Financial institutions</td>
<td>65</td>
<td>Financial intermediation, except insurance and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pension funding</td>
</tr>
<tr>
<td></td>
<td>66</td>
<td>Insurance and pension funding, except compulsory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>social security</td>
</tr>
<tr>
<td></td>
<td>67</td>
<td>Activities auxiliary to financial intermediation</td>
</tr>
<tr>
<td>Business services</td>
<td>72</td>
<td>Computer and related activities</td>
</tr>
<tr>
<td></td>
<td>73</td>
<td>Research and development</td>
</tr>
<tr>
<td></td>
<td>74</td>
<td>Other business activities</td>
</tr>
<tr>
<td>Educational services</td>
<td>80</td>
<td>Educational services</td>
</tr>
<tr>
<td>Health services</td>
<td>85</td>
<td>Health services</td>
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</tbody>
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Note: The International Standard of Industrial Classification (ISIC) Revision 3.1 system was released by the United Nations in May 2002.

### Table 2. Regions classifications.

<table>
<thead>
<tr>
<th>NA</th>
<th>SA</th>
<th>WE</th>
<th>EE</th>
<th>AS</th>
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<tbody>
<tr>
<td>Canada</td>
<td>Argentina</td>
<td>Austria</td>
<td>Czech Republic</td>
<td>China</td>
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<td>Mexico</td>
<td>Brazil</td>
<td>Belgium</td>
<td>Hungary</td>
<td>Hong Kong</td>
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<td>United States</td>
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<td>United Kingdom</td>
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<td></td>
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</tbody>
</table>

Note: NA, North America; SA, South America; WE, West Europe; EE, East Europe; AS, Asia.
variance components analysis (VCA). Nested ANOVA estimates an ordinary linear regression model using dummy variables. In the previous variance decomposition studies, the dependent variable can be business profitability and the dummy variables such as independent variables like industry, corporate-parent, business-segment, and other effects. The importance of an effect is measured by the percentage variance arrived at by comparing the influence of these dummy variables on profitability. To perform ANOVA, we start with a null regression model to which the independent variables are added one by one. The increment to the adjusted $R^2$ of the regression is then calculated as an unbiased estimate of the fraction of the variance (Schmalensee, 1985). The order of entry of the independent variables can have a large impact on which variable explains the most variance. For example, to distinguish between influence from country and industry, the dummy variable representing the country effect must be included in the model before the one representing the industry effect. Typically, the first entries explain a large proportion of the variance, whereas variables introduced later explain progressively less.

While the fixed-effects version of ANOVA is common, the VCA approach, sometimes termed random-effects ANOVA, is a popular method of estimating the relative effect of each factor on profitability. Schmalensee (1985) uses VCA to decompose the variance of business profitability into components of variance. This method treats each effect as though it is generated by an independent, random sample drawn from an underlying population of the class of effects. Estimation of random effects incorporates the assumption that each effect represents a random sample of the true population effect and that each effect is independent of the other effects in the model (Neter, Kutner, Nachtsheim, & Wasserman, 1996). Additionally, in SAS packages, the VCA can control for biases that arise from the order of entry of independent effects by rotating entries and adjusting estimates of the variables.

The equation for estimating variance components is developed using the descriptive model of Equation (1) and decomposing the total variance of profitability into its components as follows:

$$\sigma^2_r = \sigma^2_a + \sigma^2_b + \sigma^2_g + \sigma^2_d + \sigma^2_e$$

(2)

The dependent variable $r_{ijkl}$ in the descriptive model has constant variance and is normally distributed because it is a linear combination of independent normal random variables. This work uses the VARCOMP procedure in SAS to estimate the different variance components. The VCA estimation is particularly suited to this study because it does not require a data set covering the whole population while at the same time allowing the results to be generalised. This is useful since it is impossible to construct a data set that covers all industries in each region and country.

There are some differences in the use of nested ANOVA and VCA to access variances in profitability. First, VCA uses a similar model to ANOVA to arrive at its estimations. However, while ANOVA estimate the actual influence of each dummy variable, VCA estimates the variance among a set of implicit dummy variables. Second, while the nested ANOVA results establish whether each set of effects is significant, VCA results evaluate the relative importance of each type of effect. Therefore, while the nested ANOVA approach generates $F$-statistics for each independent effect, VCA does not. The use of VCA is controversial because it assumes the random processes that generate the effects are independent from each other, and some dislike the idea that this assumed independence
does not allow for the endogeneity of relationships between the levels of effects and subsequent entry. However, Schmalensee (1985) prefers to include the VCA analysis along with his ANOVA estimates because it allowed the effects of the various independent variables to be generalised over the population as a whole. Schmalensee (1985), Rumelt (1991), and McGahan and Porter (1997) argue that an ANOVA test for significance is not a prerequisite to VCA estimation, since their main interest lies in estimating the relative magnitudes of the different effects, and significance results are only of secondary importance. Therefore, this relatively simple statistical method is the flagship approach for this type of model (e.g., Hawawini et al., 2003; McGahan & Porter, 1997; Rumelt, 1991).

**Empirical results**

Using the National Science Board’s *Science and Engineering Indicators – 2006* database, we test whether the magnitude of region, country, and industry effects are sensitive to knowledge-intensive service industries performance. Table 3 shows the variance component estimates for the predictor variables that sum to the variance in the response variable for industrial revenues. Table 3 also reports the percentages of the total variance of the response variable explained by the effects of the predictors in the descriptive model. All estimates are evaluated at the 5% level by the nested ANOVA for statistical significance. The results in Table 3 indicate that the descriptive model explains 97.98% of the total variance in knowledge-intensive service industries performance. One reason for the greater model fit might be that this study only focuses on the knowledge-intensive service sectors around the world rather than on all industries.

For the knowledge-intensive service industries around the world, it is evident that country effects dominate long-term performance. Country effects account for 59.69% of variance, industry effects account for 36.39%, and region effects account for 1.73% of the variance in knowledge-intensive service industry performance. The results provide strong support for the idea that country factors, including national economic structures, cultures, values and institutions, and industry factors, including industry membership and structural characteristics, exert the greatest influences on the knowledge-intensive service industry’s international competitiveness, whereas regional environments have smaller but important impact on knowledge-intensive service industry performance. Therefore, when seeking to explain the sources of performance differentials among knowledge-intensive service industries, country-related effects dominate industry and region effects. The effects of year, on the other hand, have a very small influence on knowledge-intensive service industry performance. By definition, year effects are macro-economic fluctuations that affect all knowledge-intensive service industries to the same degree in a particular year.

Table 3. Absolute values and percentages of the variance contributed by predictor variables for years 1995–2003 worldwide.

<table>
<thead>
<tr>
<th>Variance component</th>
<th>Variance estimate for variable</th>
<th>Percentages of total variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year effect</td>
<td>54,253,443</td>
<td>0.18</td>
</tr>
<tr>
<td>Region effect</td>
<td>536,078,122</td>
<td>1.73</td>
</tr>
<tr>
<td>Country effect</td>
<td>1.85E+10</td>
<td>59.69</td>
</tr>
<tr>
<td>Industry effect</td>
<td>1.13E+10</td>
<td>36.39</td>
</tr>
<tr>
<td>Model</td>
<td>30,369,931,565</td>
<td>97.98</td>
</tr>
<tr>
<td>Error</td>
<td>626,975,404</td>
<td>2.02</td>
</tr>
</tbody>
</table>
How much does country matter within each region?

Our empirical results revealed that country effects dominate industry and region effects. It raises the interesting question of whether country effects still dominate industry effects within each region. Therefore, this study explores further the sources of the variation in knowledge-intensive service industry performance across countries within each region, with a particular interest in comparing the relative importance of the country effects and those of industry.

The results shown in Table 4 provide the variance component estimates of the independent effects, the percentages of the total variance in knowledge-intensive service industry performance explained by the independent effects, and several noticeable patterns between regions. First, the country effects are greater in all regions, NA, SA, WE, EE, and AS. The results indicate that in the NA, SA, WE, EE, and AS regions the country effects account for 60.89%, 84.89%, 60.04%, 60.11%, and 64.50% of the variation on knowledge-intensive service industry performance, respectively. Second, the industry effects in the NA, SA, WE, EE, and AS regions account for 36.87%, 13.88%, 37.47%, 36.27%, and 33.86% of the variation on knowledge-intensive service industry performance, respectively. Third, the year effects have little impact on knowledge-intensive service industry performance across countries within each region.

Table 4. Absolute values and percentages of the variance contributed by predictor variables for regions.

<table>
<thead>
<tr>
<th>Variance component</th>
<th>Variance estimate for variable</th>
<th>Percentages of total variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year effect</td>
<td>1,592,949,514</td>
<td>0.48</td>
</tr>
<tr>
<td>Country effect</td>
<td>2.01E+11</td>
<td>60.89</td>
</tr>
<tr>
<td>Industry effect</td>
<td>1.22E+11</td>
<td>36.87</td>
</tr>
<tr>
<td>Model</td>
<td>3.24809E+11</td>
<td>98.24</td>
</tr>
<tr>
<td>Error</td>
<td>5,819,334,763</td>
<td>1.76</td>
</tr>
<tr>
<td>SA</td>
<td></td>
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</tr>
<tr>
<td>Year effect</td>
<td>1,094,503.9</td>
<td>0.16</td>
</tr>
<tr>
<td>Country effect</td>
<td>567,972,618</td>
<td>84.89</td>
</tr>
<tr>
<td>Industry effect</td>
<td>92,864,888</td>
<td>13.88</td>
</tr>
<tr>
<td>Model</td>
<td>661,932,009.9</td>
<td>98.93</td>
</tr>
<tr>
<td>Error</td>
<td>7,147,230.4</td>
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<td>WE</td>
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<tr>
<td>Year effect</td>
<td>41,198,178</td>
<td>0.69</td>
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<tr>
<td>Country effect</td>
<td>3,597,616,913</td>
<td>60.04</td>
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<tr>
<td>Industry effect</td>
<td>2,244,918,115</td>
<td>37.47</td>
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<tr>
<td>Model</td>
<td>5,883,733,206</td>
<td>98.20</td>
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<tr>
<td>Error</td>
<td>107,922,643</td>
<td>1.80</td>
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<tr>
<td>EE</td>
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<tr>
<td>Year effect</td>
<td>102,658.9</td>
<td>0.89</td>
</tr>
<tr>
<td>Country effect</td>
<td>6,950,737.1</td>
<td>60.11</td>
</tr>
<tr>
<td>Industry effect</td>
<td>4,193,916.9</td>
<td>36.27</td>
</tr>
<tr>
<td>Model</td>
<td>11,247,312.9</td>
<td>97.26</td>
</tr>
<tr>
<td>Error</td>
<td>316,452</td>
<td>2.74</td>
</tr>
<tr>
<td>AS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year effect</td>
<td>23,001,956</td>
<td>0.27</td>
</tr>
<tr>
<td>Country effect</td>
<td>5,432,291,809</td>
<td>64.50</td>
</tr>
<tr>
<td>Industry effect</td>
<td>2,851,748,225</td>
<td>33.86</td>
</tr>
<tr>
<td>Model</td>
<td>8,307,041,990</td>
<td>98.64</td>
</tr>
<tr>
<td>Error</td>
<td>114,648,081</td>
<td>1.36</td>
</tr>
</tbody>
</table>
service industry performance for each region. Finally, the results in Table 4 indicate that the descriptive models explain 98.24%, 98.93%, 98.20%, 97.26%, and 98.64% of the total variance in knowledge-intensive service industry performance for NA, SA, WE, EE, and AS, respectively. A variance components model is also fitted to a new data set for five regions.

Discussion

This study investigates how much region-, country-, and industry-level factors can explain the variation in the performance of knowledge-intensive service industries. It extends recent variance decomposition research in two ways. First, this work considers knowledge-intensive service industries. They are important because they have become very competitive and performed outstandingly since the 1990s. Second, this work tests the effects of region, country, and industry on industry performance using industrial revenues in five regions. This study found the following:

- **The effects of country are important.** The effects of country account for over three-fifths of the overall variation in industrial production of knowledge-intensive service sectors in all regions, NA, SA, WE, EE, and AS between 1995 and 2003. We conclude that the effects of country are more important than the effects of industry on the performance of companies in knowledge-intensive service industries worldwide.
- **The effects of industry are important.** Industry effects account for over one-third of performance differences among knowledge-intensive service industries in NA, WE, EE, and AS. In these regions, although industry effects explain less variation in knowledge-intensive service industry performance than country effects, they are still influential in determining differences in industrial performance.
- **Region effects have a very small but significant impact on knowledge-intensive service industry performance.** Among all knowledge-intensive service industries, region effects are statistically significant but relatively small.
- **Year effects have very little influence on knowledge-intensive service industry performance.** Across all regions, the effects of year account for a very small part of variation in industrial revenues.

From these results, it can be concluded that both country-level factors (e.g., institutions) and industry-level factors (industry structural characteristics) are important in shaping the strategy and performance of companies in the knowledge-intensive service industry. These findings provide further evidence that knowledge-intensive service industries have gained in global competitiveness by using fairly sound microeconomic fundamental strategies with their countries’ aggressive intervention to ensure economic activity across industry boundaries.

Concluding remarks

This study explores the sources of the variation in knowledge-intensive service industry performance with a particular interest in investigating the relative importance of region, country, and industry effects. Economics and strategy researchers have long been interested in understanding the determinants of firm profitability when approaching the question of how and why certain private enterprise firms build competitive advantage in environments in which technology is changing rapidly (Teece, Pisano, & Shuen, 1997). A lot of previous research, however, has treated the country effect as a constant and
failed to identify country-specific conditions that influence industry performance. Thus our interpretation of performance differences diverges from mainstream perspectives, IO economics, strategic management, and especially the RBV of the firm, in that we do not start from firms but rather from industries. This work is undertaken because finding the sources of performance differentials among knowledge-intensive service industries in international competitiveness is of importance to both national development policies (country effects) and unique industry structure characteristics (industry effects).

Our results have several implications. First, our findings suggest that country does matter, and, in fact, it has an important and significant impact on knowledge-intensive service industry performance. Our findings support a critical argument in conventional international business literature and the institutional theory, which is that national contextual factors do influence firm behaviour and economic performance. Similarly, the empirical results imply that location and economic geography-related insights are important, as suggested by Dunning (1993) and Buckley and Ghauri (2004). Therefore, future research might want to incorporate country effects as an additional determinant of firm performance into the same model to advance our understanding of the antecedent of firm profitability.

Second, our results show that the ‘external’ effects (country influences) are more important in all regions, NA, SA, WE, EE, and AS. One possible explanation for this finding is that although countries with advanced economies in NA and WE are more integrated in terms of market transactions, infrastructure, institutional rules, and enforcement mechanisms (Makino et al., 2004), governments can and do play a crucial role in helping knowledge-intensive service industries to improve their competitive positions. In SA, EE, and AS, where public institutions and macroeconomic environment are all developing differently and playing fairly aggressive roles in directing economic activity (Hernandez, 2004), the country influences explain more variation in knowledge-intensive service industry performance; they ultimately play the dominant role in driving their success. An interesting question might be whether country effects persist longer than industry effects. Or are the competitive advantages of industries within their countries sustained longer than country influences? Further study is needed to examine the persistence of incremental country- and industry-specific effects on knowledge-intensive service industry performance.

Third, the importance of industry on the performance differentials explains how much IO economics and RBV of the firm matter within knowledge-intensive service industries. While IO economics, proposing the SCP framework, considers industry as the main unit of analysis, strategic management focuses increasingly on the individual firm to explain intra-industry performance differentials. For example, in the late 1930s, Nourse and Drury (1938) suggest that firm-specific influences, such as management skills, basically determine firm advantages and performance. Firms are not simply seen as identical ‘black boxes’ in a given industrial structure, but as dynamic collections of idiosyncratic attributes representing sources of competitiveness and relative performance. In this light it is also worth considering Porter’s (1990) account of how different facets of the national ‘diamond’ can interact to facilitate the global expansion of a nation’s industries or a discipline’s intellectual products. Since company strategies differ between firms within an industry, the bundle of idiosyncratic attributes that each firm possesses comes to differ (Nelson, 1991). Future cross-national comparisons of industry performance may want to examine the same effects in industries other than knowledge-intensive service industries.

Finally, although region effects have a very small but significant impact on knowledge-intensive service industry performance, our analysis may be subject to aggregation problems, which might come from the definition of region. The main difference from
the earlier studies is the meaning given to the term ‘region’ in the new research. Whereas the traditional literature was concerned with the effects of transaction-intensive networks on regions within a national economy, current research is mostly concerned with the effects of rising regional scope across countries on industry performance. We treat a region as a geographical location that could exert externalities and increasing returns across nations, and do not capture regional differences within a country in our analysis. Regional economists, however, argue that regional differences might be more salient within rather than between countries (e.g., Krugman, 1991; Lenartowicz & Roth, 2001; Markusen, 1995). Therefore, future studies may try incorporating regional effects within a country that is apt to exhibit strong increasing-returns effects with dynamic learning capabilities to examine whether regional influences explain a larger portion of the variation in industry performance than do country effects.

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References


