The Dynamics of Professional Services Internationalization: A Longitudinal Study of UK Engineering Consultancies

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Abstract

Despite the overwhelming importance of services in modern economies there is a dearth of research on the way in which service firms pursue international diversification strategies. This paper addresses the patterns of service internationalisation and its determinants in the context of professional service firms (PSFs). We develop an integrative theoretical framework for the internationalisation of PSFs to better understand the dynamic process from nascent to mature phases of foreign expansion, and then empirically investigate the determinants the of international resource allocation decision through the analysis of an unbalanced panel of 265 engineering consultancies in the UK covering the 1989-2009 period. Controlling for potential endogeneity of explanatory variables, we estimate a fractional response model of internationalisation. We show that PSFs typically follow an evolutionary approach to internationalisation characterised by incremental investment in post-entry activities with strong experiential learning effects. In terms of the drivers of international expansion, our results suggest that the degree of internationalisation varies with industrial diversification and business age in a non-linear fashion. Human capital endowments, business size, home-market geographic diversifications, productivity levels, foreign ownership and ownership or managerial change also exert positive and significant effects on PSFs' internationalisation.

Keywords: Internationalisation, diversification, knowledge-intensive business services, professional service firms.

JEL codes: F14; L25; L84; M16

1 Introduction

Service firms from a wide range of industries such as accounting, law, advertising and consulting have expanded into global markets at an unprecedented pace in recent decades. This has occurred hand in hand with the integration of global product markets and the breakdown of trade barriers through deregulation and liberalisation[5]. With the service sector accounting for more than three quarters of the economic output in most highly developed economies, the considerable growth of services' share of foreign direct investments (FDIs) reflects their rising economic impact.

There is compelling evidence that an increasing proportion of the world's trade activities are taking place outside the manufacturing sector, altering the landscape of globalisation: many services enterprises, which some years ago were focused mainly on their home market, are now pursuing internationalization strategies involving ambitious investments in global markets (UNCTAD, 2010). Even amid the recent financial crisis, the UNCTAD's cross-border M&As statistics show that the service sector has continued to capture an increasing share of global FDIs: it accounted for around half of the world's M&A FDIs in 2009 compared with some 30% in the manufacturing and 20% in the primary sector. Moreover, with respect to job creation associated with FDI flows, manufacturing employment in foreign subsidiaries in industrialised countries declined steeply in the 1999-2007 period, whilst in services employment in foreign owned firms grew over time (OECD, 2010).

The rapid emergence and growth of service internationalisation has been facilitated by the declining costs of transportation and communications, and the remarkable development of information and communication technologies (ICTs). In particular, recent advances in ICTs have been playing a crucial role in the internationalisation process of service firms, especially those providing information-intensive 'soft' services, allowing them to diffuse intricate information on service design and delivery and disassemble their value chain, which leads to greater flexibility in their allocation of resources and general operations in host as well as domestic countries (Baark, 1999; Ball et al., 2008). This has also contributed to the 'hardening' of services through fostering their standardisation (Erramilli and Rao, 1990) and rendered traditionally untradeable service products more readily tradable across borders, thus expediting the pace of internationalisation.

[5] In a recent special issue of *Management International Review*, Kundu and Marchant (2008) and Merchant and Gaur (2008) provide useful reviews of trends in service internationalisation and surveys of the international business (IB) literature on service multinationals.

Despite the vital importance of service provision to aggregate national economies as a whole, especially in industrialised countries, and the growth of individual firms in particular, patterns of internationalisation in the service sector have only been explored to a limited extent so far, as existing evidence is mostly drawn from (large scale) manufacturing firms. Various scholars have lamented the imbalance between the ever-increasing economic impact of service producers and the academic negligence of the sector as a whole (e.g. Kundu and Merchant, 2008; Merchant and Gaur, 2008; Pla-Barber et al., 2010). For instance, based on a review of some 650 pieces of research published in four widely received outlets for International Business (IB) academics and practitioners alike[6], Merchant and Gaur (2008) find that in the past 20 journal-years, less than 7% of studies published in these leading journals focused solely on the non-manufacturing sector; and excluding the conceptual research published in *Thunderbird International Business Review*, that proportion falls to just 4%. This observation has led the authors to conclude that the landscape of recent academic work pertaining to the service sector (and non-manufacturing in general) is "largely barren" and describe IB scholars as "standing on very thin ice" in terms of our collective understanding of the mechanisms and/or processes through which service firms operate in an increasingly global context [7].

In the emerging body of literature on service internationalisation, the thematic issues that have been examined theoretically and/or empirically can be broadly grouped into three categories: the drivers of service internationalisation (Li and Guisinger, 1992; Dunning, 1993; Clark et al., 1997); the selection of appropriate entry modes (Erramilli, 1991; Erramilli and Rao, 1990, 1993; Agarwal and Ramaswami, 1992; Anand and Delios, 1997; Contractor and Kundu, 1998; Coviello and Martin, 1999; and more recently, Bouquet et al., 2004; Peinado and Barber, 2006; Pla-Barber et al., 2010); and lastly, the performance impact of such international expansion (Capar and Kotabe, 2002; Contractor et al., 2003; Brock et al., 2006; Hitt et al., 2006). In this paper we focus on the first theme, where evidence appears to be relatively scarcer (Lu and Beamish, 2004; Goerzen and Makino, 2007; Javalgi and Martin, 2007; Shukla and Dow, 2010).

[6] Namely, *Journal of International Business Studies* (*JIBS*), *Journal of World Business* (*JWB*), *Management International Review* (*MIR*), and *Thunderbird International Business Review* (*TIBR*).

[7] The paucity of studies on service internationalisation is corroborated in another similar survey of the literature by Kundu and Merchant (2008) based on a slightly different combination of IB journals, viz. *JIBS*, *MIR*, *JWB* and *International Business Review* (*IBR*). Their review suggests that there were just 1.35 studies published per year on services firms and merely 0.34 article per journal each year between 1971-2007.

The more specific concerns of this paper are the patterns and predictors of service internationalisation by knowledge-intensive professional services. As Kundu and Marchant (2008) point out, most existing empirical evidence for the service sector comes from more capital-intensive industries (e.g. finance, real estate, transport, hotels and telecommunication). Due to the 'heterogeneity' intrinsic in services, however, several scholars have called for more research into the distinct patterns of internationalisation in various types of service firms (Hipp, 1999; Merchant and Gaur, 2008), especially given the rising importance of knowledge-intensive services both within national economies and in world trade.

The distinction between knowledge-intensive and capital-intensive services has important implications for the growth strategy of globalised service firms. Several scholars have asserted that compared with capital-intensive service industries, the knowledge or information intensive sector is characterised by various, frequently advantageous features in the process of internationalisation, including the lower burden of 'irreversible' investment in tangible assets (Petersen and Pedersen, 1998), more flexibility in internationalisation decisions (Ball et al., 2008), greater global standardisation and better established overseas client base (Contractor et al., 2003), and lastly a preference for higher-involvement entry modes (Erramilli, 1990; Peinado and Barber, 2006).

Following the taxonomy of business services developed by von Nordenflycht (2010, Table 2), we set our sectoral focus on regulated professional service firms (PSFs) characterised by high knowledge intensity, low capital intensity and a professionalised workforce[8]. By analysing patterns emerging from the engineering consulting industry, we can derive insights into other PSFs with analogous trajectories of growth and foreign expansion such as law, accounting, architectural and other technical consultancies.

This paper is organised as follows. Section 2 draws insights from extant theories of internationalisation to build a framework and develop testable hypotheses for a quantitative analysis of the international expansion of knowledge-intensive service firms. In Section 3 we introduce our data and empirical methodology. Section 4 presents the evidence from the econometric estimation and develops interpretations of the impact exerted by the key determinants of the firms' internationalisation decision and intensity. The concluding section (5) draws from our evidence the relevant managerial and policy implications.

[8] As von Nordenflycht (2010) notes there is a shift of emphasis in the PSF literature from professionalism to knowledge intensity.

2 Theory and Hypotheses Development

Internationalisation allows firms to benefit from economies of scale and (geographic) scope: firms have incentives to expand into new markets so as to earn higher returns from their investments in production, as the product market widens when the firm's appropriability regime improves (Teece, 1986) and its market power increases over its suppliers, distributors, and customers (Kogut, 1985). Meanwhile multinationality can not only reduce fluctuations in business revenues by spreading investment risks and holding globally diversified portfolios (Kim et al., 1993), but also allows risk reduction in the manager's less diversified personal portfolio whilst power, reputation and remuneration accrue with managing an expanding transnational corporation (Jensen and Murphy, 1990).

A number of propositions have been put forward to systematically explain the rationales for firms' internationalisation. As Rugman (1981) noted, "the creation of an internal market by the MNE permits it to transform an intangible piece of research into a valuable property specific to the firm. The MNE will exploit its advantage in all available markets and will keep the use of information internal to the firm in order to recoup its initial expenditures on research and knowledge generation". According to Rugman's prevailing formulation of the 'internalisation theory', the primary motive for going abroad is to exploit (technological) advantages created in the home country by assisting production in foreign affiliates and adapting products/services to hosting markets. Extending the traditional transaction-costs economic theory (Coase, 1937) to an international context, such an 'internalisation' view provides an alternative organisational strategy which entails bringing cross-border transactions or new foreign operations within the boundary of the firm. Put differently, firms can internally exploit their valuable firm-specific (intangible) assets and transaction-based ownership advantages by operating from overseas markets, whereby they are able to effectively combat market imperfections and moral hazards, avoid stagnation in the domestic market and overcome trade barriers (Vernon, 1966; Caves, 1971; Hymer, 1976; Buckley, 1988; Dunning, 1993; Hitt et al., 1997).

Another competing but not mutually exclusive view on drivers of internationalisation stems from the exploration benefits of FDIs, in accordance with the theories on capabilities and organizational learning (Penrose, 1959; Kogut and Chang, 1991). This view on location-specific advantages posits that FDIs (especially technology-seeking ones) are motivated by the firm's desire to enhance its capabilities and knowledge base by tapping into locations

with distinct advantages (e.g. skilled human capital, technologies, resource endowments etc.) that are unavailable in home markets, which in turn confers the firm unique competitive advantages over indigenous competitors through experiential learning (Cantwell and Piscitello, 2000; Delios and Henisz, 2000; Zahra et al., 2000).

Although aforementioned motives of costs reduction and efficiency augmentation are salient in the context of internationalising firms in all market-based sectors, firms in services and especially knowledge-intensive services have been postulated to be driven by a disparate set of factors in their decisions to globalise. The thrust of the argument begins with the seminal work by Boddewyn et al. (1986) that attempts to provide a systematic reconceptualization of service MNEs driven by the remarkable distinction between manufacturing and service goods. In essence, services are generally described as being characterised by inseparability and simultaneity (of the production, delivery and use of services, which requires close relationships between service providers and their customers), intangibility (of service products), heterogeneity (in service outputs that requires a high level of customization and specialization), perishability (or non-storability of surplus services). These features of service industries have been frequently argued to predominantly account for the distinction in the internationalisation process between manufacturing and service sectors (Erramilli, 1990; Javalgi et al., 2003; Hitt et al., 2006; Goerzen and Makino, 2007).

Moreover, unlike production-related advantages in manufacturing firms, a primary source of competitive advantages in internationalised PSFs stems from their capabilities of circumventing market failures, responding to highly customised demands with high-quality performance, maintaining close contact with clients and lowering their transaction costs (Ochel, 2002). For instance, examining the internationalisation strategies of law firms in London, Beaverstock et al. (1999) point out that professional service providers are motivated to expand into foreign markets so as to gain access to a larger client base, combat competitive pressure from rival firms, establish strategic alliances through mergers and joint ventures and so on.

Aside the contingent financial rewards and the need for highly specialised services from global customers, one of the most widespread incentives for service internationalisation is the 'follow the client' strategy (Aharoni, 1996; Roberts, 1999) where service producers are pulled into overseas markets to expand strategic relations with global partners and serve new or existing clients more effectively. This is especially the case in knowledge-intensive firms (Rose, 1998; Contractor et al., 2003; Di Gregorio et al., 2009) or professional service firms

(Greenwood and Empson, 2003).[9] Løwendahl (1997) has further classified such client demand-side pull facing professional services as coming from the following categories: existing domestic clients with business in global markets, foreign clients with demand for globally standardized service products and those opting for world-class professional services from field leaders.

The international entrepreneurship literature adds substantial insights into the internationalisation behaviour exhibited in the PSFs. Above all, Dunning's eclectic paradigm has integrated several theories into a unified OLI-framework (Dunning, 1977, 2000), where MNEs are conceived as being able to exploit firm-specific assets based on a combination of advantages in ownership (O), location (L) and internalisation (I). The equally influential Uppsala approach, also developed in accordance with the Penrosian theory of firm growth (Penrose, 1959) and arguments of path-dependency in firm evolution (David, 1985; Teece, 1996), describes the internationalisation process as series of stages entailing gradual intensification of operations, incremental increases in commitment to foreign expansion and accumulation of experiential knowledge (Johanson and Vahlne, 1977, 1990).

The OLI paradigm and the process/Uppsala approach are compatible with prior arguments and lead us to the formulation of our first hypothesis. Conditional on successful entry into foreign markets, PSFs internationalise through incremental resource commitments coupled with gradual learning and adaptation to local markets we therefore posit:

> Hypothesis 1: PSFs follow a gradual approach to internationalisation with incremental resource commitment after foreign-market entry

The product-life-cycle theory (Vernon, 1966; Krugman, 1979) and more recent neo-technology models (Greenhalgh, 1990; Greenhalgh and Taylor, 1994) laid the foundation of an extensive stream of literature on product or industrial diversification, which indicate that products move from industrialized economies to less industrialized ones as growth of the products in industrialized economies declines after it reaches maturity. Indeed, for many decades now, product diversification has been a widely used business strategy among growing industrial firms, especially in developed economies (Ansoff, 1958; Grant et al., 1988). From a business strategy perspective, various studies have suggested motives for such expansion into new product markets as being risk spreading, having excess resources or cash,

[9] Løwendahl (1997) has further classified such client demand-side pull facing professional services as coming from the following categories: existing domestic clients with business in global markets, foreign clients with demand for globally standardized service products and those opting for world-class professional services from field leaders.

responding to external opportunities, achieving conglomerate power and so on (Mueller, 1972; Datta et al., 1991; Tall man and Li, 1996; Hitt et al, 1997). Combining the theories of internationalisation in PSFs outlined above and the Penrosian capabilities view, we posit that the economies of scope gained through diversification both at home and abroad and the firm's dynamic capabilities enable entry into international markets. In particular, there is a substantial amount of learning taking place through diversification over time, which generates valuable experiential knowledge about competition, technologies, clients and local market conditions; such experiential knowledge in turn enhances the firm's capabilities to exploit its core resources in a dynamic pattern. It follows that the PSF's ability to appropriate its resources and accumulate experiential knowledge varies with its degree of industrial diversification.

However, diversification especially when it proceeds in an unrelated fashion is also perceived as being associated with increased levels of costs, for instance transaction costs in terms of distortion or loss of information as it passes through layers of hierarchy within multidivisional firms (Williamson, 1975) and governance or control costs in terms of managing internal capital markets and coordination across different segments (Hoskisson and Turk, 1990; Tallman and Li, 1996; Hitt et al., 1997). Such rising costs associated with higher levels of (unrelated) product diversification might in turn constrain the resources available to the firm's international expansion. Therefore, the combination of dynamic capacities view and transaction cost theory leads to the following hypothesis regarding the nexus between diversification and internationalisation in the PSFs:

> Hypothesis 2: The degree of internationalisation varies with industrial diversification and its direction in a non-linear fashion: diversification positively affects internationalisation with diminishing marginal effects.

According to the resource-based view (RBV) of the firm, what a firm possesses determines what it can accomplish (Rumelt, 1984; Wernerfelt, 1984; Barney, 1991). The thrust of the argument is based on the well-received assumption that 'better' firms possess intangible productive assets (e.g. skills and capabilities) that they are able to exploit to derive competitive advantages; at the same time, the sustainability of such competitive advantages will require the resources to be non-replicable and non-substitutable so as to deter competition from rival firms. Here a firm is defined as bundles of assets, essentially technology, capital and labour (c.f. Penrose, 1959) and the emphasis is placed on internal characteristics rather than the external environment (Barney, 1991; Kogut and Zander, 1996).

Among these assets human capital has been identified as a crucial aspect of organisational learning and the generation and sustainment of competitive advantage in individual firms. This is of relevance for both the knowledge-based view of internationalisation (Rialp et al., 2005; Sapienza et al., 2006; Tuppura et al., 2008) and the organisational-learning perspective (Autio et al., 2000; Di Gregorio et al., 2009), where human capital is the locus of knowledge accumulation and experiential learning.

As Hitt et al. (2006) suggest, professional services generally create value in the form of information and advice through the selection, development and use of human capital. The emphasis on human or intellectual as opposed to physical capital is one of PSFs defining characteristics (Shukla and Dow, 2010; von Nordenflitch, 2010) and constitutes a major distinction not only between PSFs and manufacturing firms but also between PSFs and other (capital-intensive) service firms (Erramilli and Rao, 1993). Hence we can expect that firms with greater human capital are more likely to enter global markets and subsequently have higher internationalisation degree.[10] These arguments lead to the following hypothesis:

> Hypothesis 3: Human capital stock has a positive impact on the level of internationalisation activities in PSFs.

In order to examine the effect of experience and knowledge accumulation over time, which, as we have argued, should also favour internationalisation we also test the following hypothesis:

> Hypothesis 4: Age has a positive impact on the level of PSFs' internationalisation activities.

The path-dependent nature of firms' internationalisation patterns may also have more local geographical roots or depend on exogenous determinants of firms' ownership and management structure. Following the learning argument, we can expect that the degree of international diversification is correlated with prior development of the firms' home market (Hitt et al., 2006). We could also hypothesise that the main home-based locus of operation might provide firms some degree of strategic advantage. Professional service firms appear to be sensitive to regional clustering, especially in urban areas, due to easier access to potential customers and complementary resources, including human capital (Martinez-Argüelles and

[10] There is a second reason for taking this into account: stage models of internationalisation often overlook important modes of internationalisation which are entrepreneurially motivated, proactive and rooted on strategic organisational behaviour (c.f. Autio et al., 2000; and especially in the context of knowledge intensive services, Erramilli, 1990; Westhead et al., 2001).

Rubiera-Morollón, 2006; Drejer and Vinding, 2005), which can facilitate the decision to internationalise and its implementation.

> Hypothesis 5a: Regional home-market diversification has a positive impact on international diversification.
>
> Hypothesis 5b: Home-location effects influence internationalisation.

Finally, if a firm operating in the UK is ultimately owned by a foreign company (i.e. a greenfield or brownfiled foreign subsidiary), such prior international exposure of the parent firm can be expected to boost the UK subsidiary's propensity to internationalise. Moreover, 'critical incidents' such as ownership or management changes can exert a powerful influence on the propensity of firms to internationalize. Bell et al. (2001) note these factors among those that most frequently lead the firm to embrace more rapid and committed internationalization. We therefore test the following and final hypotheses:

> Hypothesis 6a: Foreign ownership has a positive impact on the firm's internationalisation activity.
>
> Hypothesis 6b: Changes in the firm's ownership or governance structure positively influence internationalisation.

3 Data and Methodology

In order to investigate the drivers of PSFs' internationalization, this study employs a novel dataset of UK engineering consulting firms, a sector that has recently shown exceptionally high growth rates and strong orientation to global markets.[11] The data used in this study has been drawn from New Civil Engineer's (NCE) 'Consultants File'. Established in 1972 and (since 1995) published by EMAP, New Civil Engineer is the weekly magazine of the Institute of Civil Engineers (ICE), the UK's chartered body that oversees the practice of civil engineering in the UK. NCE has a circulation of around 57,000, including the 55,000 members of the ICE. Since 1979 NCE has been gathering and publishing data on individual

[11] The Annual Business Inquiry (ABI) data from the UK Office for National Statistics (ONS) shows that, the architectural and engineering consultancies (i.e. SIC74.2) taken together have achieved a growth rate of 38% between 1995 and 2007, expanding more substantially than various other business services such as R&D, legal activities and advertising. Moreover, gross value added (GVA) in real terms in this sector also increased by 94% over the same period, as opposed to a less than 1.4% rise in the UK manufacturing sector. In addition, the sector saw some 23% of its total turnover going to international markets – the second most internationalised in the EU – and displayed a strong orientation towards serving more distant destinations outside the EU (for instance, its dominant portion of sales to extra-EU markets was nearly 3 times of that to intra-EU markets in 2004), reflecting this UK sector's strong international competitiveness.

civil engineering consulting firms operating in the UK, as well as providing more general insights into the general health of the sector and trends within it. In particular, the annually published NCE Consultants File provides information on various firm-level characteristics, including the total number of staff employed in the UK and abroad, the proportion of civil/structural engineering staff, the proportion of technical staff working in the UK and abroad; total sales and the value of work in hand; and areas of work both in geographical terms (UK and world regions), as well as areas of expertise in the UK and overseas. Although selection into the Consultants File may be biased towards large engineering consultancies, we believe that this is not likely to be problematic in our empirical analysis given that, based on our calculations using Eurostat data for the whole sector (i.e. the architectural and engineering consultancies sector - SIC74.2), some 94% of all sector's output was concentrated in those with 250+ employees, and another 4% in those with 50-240 employees.

To compile a panel dataset, we took each year's Consultants File and linked the firms reported therein. According to our records, the NCE Consultants File provides at least one year of information on 847 firms (with a total of 6,915 firm-year records) for the period 1979-2009. However, as financial information such as turnover and fees was only collected from 1989 onwards, we restrict our analysis to 1989-2009 inclusive, a 21 year period. After discarding cases with missing turnover information, the sample used for the analysis of industry landscape (in this section) is constrained to the most recent 5,656 observations (801 firms). In order to construct a valid panel for our main empirical analysis (Section 4), another 2,268 records with an insufficient time run of observations were further excluded, leaving 3,388 valid firm-year observations (for 257 firms) in our final unbalanced panel dataset.

Additional firm level information was also gathered from the Internet and data sources such as *Financial Analysis Made Easy* (FAME) and *Zephyr* (available from Bbureau van Dijk) to enhance the dataset, including the location of the firms' headquarters, information on ownership status (e.g. limited, PLC), ownership changes (e.g. M&As, management buyouts), and other firm-life events (e.g. year of establishment, year of incorporation into limited, LLP and PLC forms, and closure). See Table 1 for detailed definitions of variables used in subsequent analysis and Table 2 for some descriptive statistics and correlation matrix.

TABLE 1: DEFINITIONS AND SOURCES OF VARIABLES

Variable	Definitions	Source
Internationalisation	Composite index based on % of overseas staff and no. of foreign markets involved in year t	NCE
Industrial Diversification	Diversification index based on number of segments in which a firm operates and average relatedness between these segments in year t	NCE
Business Age	Age of business in years since its original establishment	NCE
GO regions	Dummy variable =1 if registration office located in particular region	FAME
Size	Total number of staff employed in the UK in year t	NCE
Human capital	% of UK technical staff	NCE
Turnover	Real turnover deflated using Producer Price Index (PPIs), normalised to 2005 prices	NCE
Labour productivity	Turnover per employee in UK in year t	NCE
Geographic Diversification	No. of UK regions involved in divided by total no. of UK regions in year t	NCE
Foreign Ownership	Dummy variable =1 if the ultimate global owner is a non-UK company in year t	FAME
Acquisition & Merger	Dummy variable =1 if company acquiring/merging other businesses in year t	Zephyr
Acquired	Dummy variable =1 if company being acquired in year t	Zephyr
Governance structure change	Change of ownership status (e.g. private limited, LLP, PLC)	FAME
Closure	Firm closure due to dissolution or M&As	FAME

TABLE 2: DESCRIPTIVE STATISTICS AND CORRELATIONS

Variables		mean	median	s.d.	1	2	3	4	5	6	7	8	9	10	11
Internationalisation	1	0.18	0.10	0.21											
Industrial diversification	2	0.77	0.73	0.37	0.647*										
UK regional diversity	3	0.72	0.80	0.26	0.405*	0.368*									
Business age	4	44.6	30.0	53.6	0.271*	0.274*	0.202*								
Labour productivity	5	0.05	0.05	0.04	0.334*	0.171*	0.040	0.039							
UK staff	6	401	84	1,077	0.451*	0.419*	0.295*	0.192*	0.084*						
Foreign staff	7	117	1	439	0.547*	0.376*	0.238*	0.136*	0.216*	0.665*					
Human capital	8	0.75	0.80	0.17	-0.602*	-0.253*	-0.165*	-0.084*	-0.363*	-0.182*	-0.435*				
Foreign ownership	9	0.07	0	0.26	0.279*	0.223*	0.131*	0.077*	0.135*	0.147*	0.104*	-0.141*			
M&A	10	0	0	0	0.175*	0.222*	0.171*	0.086*	0.041	0.304*	0.201*	-0.023	0.234*		
MBO	11	0	0	0	0.018	0.018	0.028	0.017	0.013	0.001	0.001	-0.001	-0.015	-0.015	
Closure	12	0	0	0	0.009	0.023	0.012	-0.012	0.002	-0.010	-0.011	0.017	0.130*	0.348*	0.030

Notes: Pearson correlation coefficients (Bonferroni-adjusted); * significant at the 1% level

Traditional measures of internationalisation generally suffer from uni-dimensionality (Hitt et al., 1997; Lu and Beamish, 2004) in that they often account for only either the degree (e.g. foreign sales as a proportion of total sales)[12] or the scope of firms' overseas activities (e.g. number of international markets involved in)[13] but not both. We employ a multi-dimensional approach to constructing a combined measure of internationalisation based on these two components of internationalisation, viz. the depth (commitments to foreign markets) and the breadth (scope of international expansion) of a firm's internationalisation activities[14]. We measure the depth of internationalisation using information on the proportion of staff based in foreign countries[15] and the breadth using the ratio between the number of foreign markets a firm is already operating in and the maximum number of global markets potentially available for international expansion in a given year. The depth and breadth aspects are moderately correlated (correlation coefficient 53.4%), with a satisfactory internal consistency score (Cronbach's alpha=0.59, which is acceptable, given that only two components are combined). Our final measure of internationalisation integrates these two elements by taking the average of these two percentage figures, ranging between 0 and 1 with 1 indicating the highest degree of internationalisation. Similar composite index has been deployed by Sanders and Carpenter (1998), Lu and Beamish (2004) and Qian et al. (2008).

Turning next to the measurement of industrial diversification, the entropy- and Herfindahl-type indices have been traditionally employed in the strategic management literature, which takes into account both the number of segments in which a firm operates and the proportion of total sales each segment represents.[16] Although the recent Herfindahl-type measure is methodologically superior to the entropy measure in that it considers the inter-relatedness between market segments, based on an arbitrarily defined system of Standard Industry Classification (SIC) codes, such measure of relatedness is nonetheless subject to classification errors. Moreover, its discrete nature also fails to capture the degree of industry relatedness (Fan and Lang, 2001). This deficiency in SIC-oriented relatedness measure gave rise to the

[12] Examples of using the ratio of foreign to total sales can be found in Geringer et al. (1989) and Di Gregorio et al. (2008); some scholars also opted for the entropy-type measure using weighted foreign sales, e.g. Hitt et al. (1997). However, as Tallman and Li (1996) pointed out such sales-based measures do not account for intermediate goods exported by the firm and then resold by its subsidiaries.

[13] See Tallman & Li (1996) for an example.

[14] Such a composite index was initially introduced in UNCTAD (1995) to measure multinationality, taking the form of an average of three ratios, viz. foreign employment per total employment, overseas sales per total sales and overseas assets per total assets of the firm.

[15] Kim et al. (1989) also used foreign staff ratio to proxy for internationalisation. We believe this measure provides a more intensive and persistent form of internationalisation compared with direct exports and foreign sales, since setting up foreign operations with a significant amount of personnel implies a higher level of commitment to these overseas markets.

[16] Refer to Palepu (1985), Hitt et al. (1997) and Hoskisson et al. (1994) for examples of entropy-type measures; and Grant et al. (1988), Tallman and Li (1996), Robins and Wiersema (1995) for examples of Herfindahl-type measures.

development of a new generation of indices based on Input-Output tables (McGuckin et al., 1992; Fan and Lang, 2000). For instance, employing commodity flow data from Input-Output (IO) tables, Fan and Lang (2000) have derived measures of inter-industry and inter-segment vertical relatedness and complementarity. They are able to show that firms increase their degree of vertical relatedness and complementarity over time.

Based on the co-occurrence method, above all, we follow Bryce and Winter (2009)'s procedure to develop a relatedness measure for each year. The methodological issues are discussed in detail in the Appendix 1. Our diversification measure is derived using the average distances between each pair of business activities in a firm's portfolio, accounting for both the number of segments in which a firm operates as well as the relatedness within them. The higher the diversification index the more *unrelated* such diversification is.[17]

We measure domestic geographical diversification using the ratio between the number of UK regional markets a firm was involved and the maximum number of regions (i.e. 10), which yields a percentage measure ranging between 0.1 and 1.[18] To proxy for the level of human capital in the parent firm in the UK, we use the information on the firm's accumulated stock of technical knowledge or the technical manpower, taken as the fraction of technical staff over total staff in the UK (c.f. Wolf, 1977).[19] To account for potential nonlinear effects of business age, we include its quadratic. To control for business size effects, we use the natural log of the number of employees based in the UK (c.f. Zahra et al., 2003). Lastly, we control for the impact of the firm's past internationalisation activities (mirroring the persistence in its internationalisation strategy as well as experiential learning) by including the lagged internationalisation index (Hitt et al., 2006).

Since our independent variable (internationalisation) consists of proportional values bounded between zero to unity, following Papke and Wooldridge (1996), we use the quasi-maximum likelihood estimation (QMLE) with a logistic mean function to estimate a pooled fractional

[17] This measure of related/unrelated diversification is conceptually analogous to the popular measure widely adopted in the literature based on Rumelt's (1974) subjective categorisation (into single, dominant, related and unrelated businesses). Nonetheless, we are not able to verify this due to the lack of information to quantify the distribution of segments (c.f. Tallman and Li, 1996).

[18] A more sophisticated index should take into account both the geographical scope (i.e. number of regional markets) and the relative importance of each market (i.e. sales derived from a market over total sales); however, such an entropy type of measure (based on the number of segments and the percentage distribution) as employed in Qian et al. (2008) is not available here for lack of information on the weight given to each regional market (i.e. how firms distribute resources amongst these regional markets).

[19] Note that in order to capture reputational and experiential assets, age here is not based on the initial inception date of business in its current form (as that documented in the accounting data in *FAME*) but the firm's self-reported history since its earliest establishment.

response model of internationalisation[20]. This approach has already been adopted in the modelling of export intensity, for example, by Wagner (2001) and Hanley (2004). Contrary to OLS-based methods, this strategy can take into account non-liner effects. It is also preferable over a two-stage model, including a sample selection model (Heckman, 1979), because it can accommodate the characteristic simultaneity and inseparability of the production and use of services as well as the fact that decisions on whether to internationalise and how much resources to commit are also not separable and therefore less amenable to estimation through two-stage techniques.

We estimate the following equation:

$$E[\text{INTLSTN}_{it} \mid x_{it}] = G(\beta_0 + \beta_1 \text{INTLSTN}_{it-1} + \beta_2 ln\text{Inddiv}_{it-1} + \beta_3 ln(\text{Inddiv}_{it-1})^2 + \beta_4 ln\text{Regdiv}_{it-1} + \beta_5 ln\text{Age}_{it-1} + \beta_6 ln(\text{Age}_{it-1})^2 + \beta_7 ln\text{Prod}_{it-1} + \beta_8 ln\text{Size}_{it-1} + \beta_9 ln\text{Humcap}_{it-1} + \beta_{10}\text{Foreign}_{it-1} + \beta_{11}\text{M \& A}_{it-1} + \beta_{12}\text{MBO}_{it-1} + \beta_{13}\text{Closure}_{it} + \beta_{14}\text{Region}_i + \beta_{15}\text{Time}_t), \qquad i = 1,..., N$$

where 'INTLSTN' is our dependent variable internationalisation, ranging from 0-1; INTLSTN_{it-1} denotes its previous value at time *t*-1; several other variables are included in natural log forms viz., Inddiv for industrial diversification, Regdiv for geographic diversification, Age for age, Prod for labour productivity, Size for number of UK staff, Humcap for human capital, Foreign for foreign ownership; other control variables are also included, such as M&A, MBO, firm closure as well as regional and time dummies to control for location and time effects. To control for potential endogeneity of explanatory variables, we estimate INTLSTN on the lagged values of these variables. The full model and further details of our chosen estimation method are presented in Appendix 2.

4 Results and Discussion

The results of the fractional logit model are presented in Table 3 where all continuous explanatory variables are in natural logs and all explanatory variables are entered in lagged form (except closure, region and time dummies) to combat potential endogeneity of determinants of internationalisation, and to allow inferences on causal relationships to be drawn. Both the estimated raw coefficients and marginal effects are reported along with robust standard errors. Marginal effects refer to the *ceteris paribus* change in the firm's degree of internationalisation with respect to a change in each determining explanatory

[20] In a more recent development, Papke and Wooldridge (2008) have proposed a panel data version of this estimator and tested this using a balanced panel dataset. However, as they point out in the paper, this estimator is currently difficult to extend to unbalanced panel data as in our case.

variable, which are either evaluated at mean values in the case of continuous variables or measured as discrete changes of dichotomous variables switching from 0 to 1.

Given the gradual decline in the proportion of foreign personnel (especially in the mid 1990's), as revealed in Figure A2, it is reasonable to expect that such internationalisation patterns might be conditioned by productivity gains (and other unobserved influences) amongst these engineering consultancies. Therefore, we also split our sample into 2 subgroups of similar size comprising of high- and low-productivity firms respectively, to estimate our models for these 2 sub-samples separately; those results based on split samples are reported in Models 2 and 3.

Overall, based on Model 1, a firm's past internationalisation experience is as expected highly significant in determining its current degree of internationalisation. The lagged dependent variable itself stands out as the most important predictor of its current level of international involvement and thus internationalisation of PSFs is highly persistent. Although PSFs might follow their customers into global markets with relatively lower entry barriers[21], once they are established in global markets, the process of further committing resources (in terms of setting up subsidiaries and recruiting foreign personnel etc.) follows an evolutionary approach, as it takes time to accumulate knowledge about local market and establish local business contacts alongside overcoming other cultural, environmental and/or linguistic barriers in host countries. This corroborates Hypothesis 1 that PSFs do follow an incremental approach to committing resources and the bulk of internationalisation activities are concentrated in the firms that have already gained experience on the international stage.

This is consistent with recent findings by Shukla and Dow (2010), who show that knowledge intensive service firms bring about successive but small changes so as to maintain their niche in foreign markets - they do not necessarily change their operational mode over time, but usually intensify their international expansion by diversifying geographically (e.g. opening more offices in different regions) or diversifying into new service products to cater to the host market. It is relatively less consistent with theories on 'born-global' firms which emphasise instead a mode of internationalisation based on the establishment of new ventures operating (almost) from inception on global markets (Oviatt and McDougall, 1994; Moen and Servais, 2002; Autio et al., 2000; Bell et al., 2003; Sharma and Blomstermo, 2003).

[21] This hypothesis cannot be directly tested in our study as we do not have information on overseas projects or external networks of these engineering consultancies to measure the client demand-side pull in the PSF's internationalisation activities.

TABLE 3: FRACTIONAL RESPONSE MODEL OF INTERNATIONALISATION OF UK ENGINEERING CONSULTING FIRMS, FULL SAMPLE

Dependent variable: Internationalisation / Independent variable	Baseline model (1)			
	$\hat{\beta}$	Robust SE	$\partial y / \partial x$	Robust SE
Internationalisation $_{(t-1)}$	5.350***	0.144	0.563***	0.016
ln industrial diversity $_{(t-1)}$	2.035***	0.502	0.214***	0.052
ln industrial diversity squared $_{(t-1)}$	-1.276***	0.399	-0.134***	0.042
ln UK regional diversity $_{(t-1)}$	0.296***	0.056	0.031***	0.006
ln age $_{(t-1)}$	0.248**	0.119	0.026**	0.013
ln age squared $_{(t-1)}$	-0.033**	0.016	-0.003**	0.002
ln labour productivity $_{(t-1)}$	0.078**	0.039	0.008**	0.004
ln size $_{(t-1)}$	0.064***	0.018	0.007***	0.002
ln human capital $_{(t-1)}$	0.761***	0.190	0.080***	0.020
Foreign ownership $_{(t-1)}$	0.119**	0.051	0.013**	0.006
Mergers & Acquisitions $_{(t-1)}$	0.048	0.051	0.005	0.006
Management Buyout $_{(t-1)}$	0.454***	0.155	0.056**	0.022
Closure	-0.293***	0.112	-0.028***	0.009
Region effect				
London	0.186***	0.033	0.020***	0.004
Northern Ireland	0.323***	0.108	0.038***	0.014
Year effect				
1990	0.497***	0.101	0.062***	0.015
1991	0.331***	0.092	0.039***	0.012
1992	0.348***	0.091	0.041***	0.012
1993	0.292***	0.094	0.034***	0.012
1994	0.030	0.105	0.003	0.011
1995	0.261***	0.092	0.030***	0.011
1996	0.268***	0.090	0.031***	0.011
1997	0.231***	0.085	0.026**	0.010
1998	0.165*	0.093	0.018*	0.011
1999	0.220**	0.086	0.025**	0.010
2000	0.148	0.090	0.016	0.010
2001	0.057	0.092	0.006	0.010
2002	0.028	0.093	0.003	0.010
2003	-0.066	0.092	-0.007	0.009
2004	-0.027	0.096	-0.003	0.010
2005	0.068	0.096	0.007	0.011
2006	-0.111	0.088	-0.011	0.009
2007	-0.118	0.095	-0.012	0.009
2008	-0.005	0.101	-0.000	0.011
2009	– [a]	–	–	–
Constant	-4.661***	0.278	–	–
Observations	2,896			
Log pseudo-likelihood	-722.9			

Notes: A 'fractional logit' model is estimated, based on the pooled quasi-maximum likelihood estimation (QMLE) with a logistic mean function. ***Significant at 1%, ** significant at 5%, *significant at 10% level.

For variable definitions, see Table 1. $\hat{\beta}$ - raw coefficients; $\partial y / \partial x$ - Marginal effect, which is for discrete change of dummy variable from 0 to 1. [a]dropped due to estimability.

Next, in testing the impact of industrial diversification, the highly significant and positive estimated parameter and marginal effect indicate that diversification exerts a substantial impact on the firm's degree of internationalisation. In order to test if a non-linear relationship exists between these two strategies, we also include diversification in its quadratic form and this turns out to be highly significant but negative in the results reported in Table 3.[22]

Therefore, as Figure 1 illustrates, on the one hand, a highly positive marginal effect of diversification on internationalisation suggests that a PSF's diversification into unrelated business markets provided an important impetus for its going into global markets, and to subsequently considerably intensify its globalisation activity. According to Chandler (1962), product diversification often leads to the adoption of a multidivisional structure that facilitates transactions across business units and thereby reducing costs. In the highly diversified but non-related firms, individual business units may achieve unique and inimitable synergies that resemble the benefits from internationalisation in foreign markets; such 'unrelatedness of activities' is likely to reduce bureaucratic governance costs and foster complementarities with internationalisation (Geringer et al., 2000).

This finding also echoes the widely-received view in the strategy literature in that product diversification and internationalisation have been deployed as complementary growth strategies (which is especially prevalent amongst manufacturing firms and gradually becoming more so in services) (Cantwell, 1992, 1995; Zander, 1997 and Granstrand, 1998), and firms usually pursue a growth pattern of product diversification followed by internationalisation as the latter is more costly and complex to manage (Hymer, 1979). For instance, Hitt et al. (1997) argue that prior product diversification gives firms experience with managing complex multiple product markets which can be effectively exploited in international markets.

The highly negative second-order effect of (unrelated) industrial diversification (i.e. *ln* industrial diversity squared) is particularly interesting. The estimated parameters suggest that in accordance with the non-linearity predicted in Hypothesis 2, at a more mature stage of internationalisation the marginal impact of such unrelated diversification diminishes; in other words, more importantly, it is the industrial diversification in related business services (i.e. corporate coherence) that continues to enhance the firm's international expansion once it

[22] It is worthwhile emphasizing that given the way diversification is measured in our data using information on the average relatedness between a firm's market segments, our diversification index does not effectively capture the total level of industrial diversification but more the direction of such diversification strategy (more specifically the degree of unrelatedness). In this sense, our index of industrial diversification is analogous to a corporate coherence measure, and thus a high value indicates higher degree of unrelated diversification whilst a low value implying higher degree of related diversification (i.e. corporate coherence).

becomes a well-established global player (see Bengtsson, 2000 and Gabrielsson and Gabrielsson, 2004, for similar evidence). The more recent growing body of evidence (mostly from the manufacturing sector) offers compatible additional insights into the dynamics behind the firm's globalisation pattern where the term 'globalfocusing' is used to describe the shift in its strategy from being a domestic conglomerate to global specialist (e.g. Meyer, 2006). Finally, it is important to notice that although industrial diversification may precede internationalisation, they are also likely to complement each other and evolve together instead of being simple alternatives (Cantwell and Piscitello, 2000)[23].

In support of Hypothesis 3, another factor that plays a remarkable role in determining PSFs internationalisation intensity is the level of human capital, proxied here by the fraction of technical personnel[24]. This is in line with Hipp's (1999) argument concerning the knowledge-intensive business services in general that they create new services by synthesizing and transforming tacit and explicit information/knowledge that is obtained from distinct sources and partners. Here the internal knowledge is embodied in highly skilled and qualified personnel or disembodied in internal codified knowledge.

PSFs endowed with higher levels of skilled human capital are better positioned to readily respond to clients' needs for specialisation and customization and more readily adopt innovations and new technologies. Also given that highly skilled staff renders firms the access and leveraging of capabilities that are often unique and inimitable, this is more likely to lead to higher levels of international competitiveness (Di Gregorio et al., 2009). For instance, in a recent study of US law firms, Hitt et al. (2006) show that human capital had a significant and positive effect on internationalization, and corporate client relational capital could only be positive when teamed with strong human capital. Thus they conclude that firms that are effective at leveraging their human capital are expected to be effective at leveraging other capabilities, which allows them to enter and sustain operations in international markets with greater ease.

The age of a PSF is also found to be important in determining its commitment of resources in foreign markets, which provides support for Hypothesis 4. This finding emphasizes the importance of reputational assets as well as substantiates our argument that traditional process/stage model of internationalisation needs to be extended to incorporate theories of the

[23] We have also empirically modelled the firm's industrial diversification activity as a function of its internationalisation strategy (alongside other factors), and our results provide clear evidence of this reverse causality running from previous increases in internationalisation intensity to greater industrial diversification in the current period. These results are not reported here but available upon request.

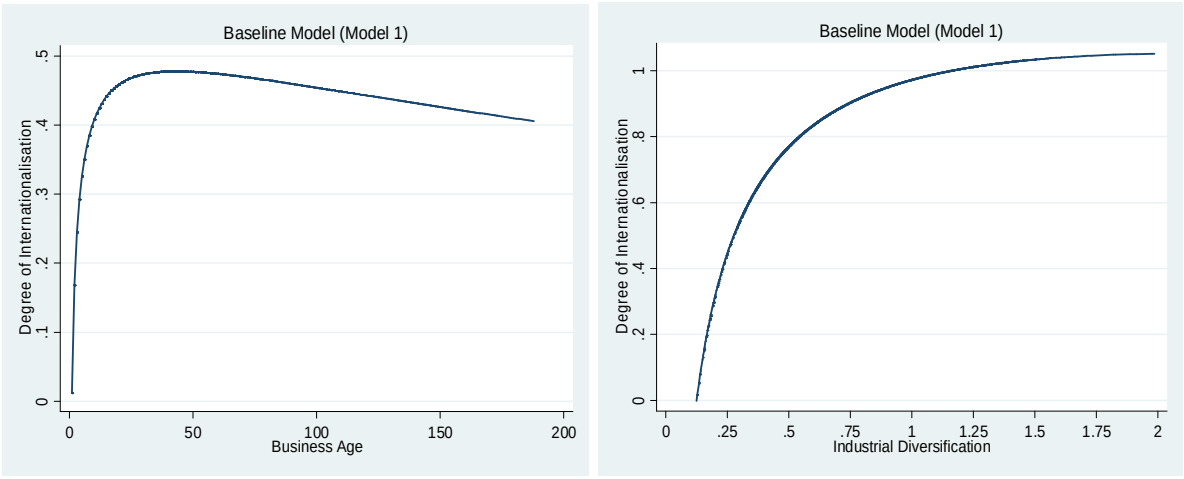
[24] We have also tested whether the relationship between human capital and internationalisation is non-linear by introducing a quadratic variable. Nevertheless, the squared term of human capital is not statistically significant and thus excluded from the model.

RBV and organisational learning (Autio *et al.*, 2000; Zahra *et al.*, 2003). It also complements our discussion of the role of human capital in that intellectual capital, which is key to professional service firms, accumulates over time in a path-dependent fashion with significant consequences for firms' internationalisation activities. Nevertheless, when age is introduced in quadratic form in the model to test for a non-linear effect, this term turns out to be negative and significant. The summary statistics in Table 2 indicate that the engineering consulting firms are on average nearly 46 years old [25] with a median of 30. This implies that our sample is slightly skewed towards older firms, perhaps reflecting the higher likelihood of these older (and thus more reputable) engineering consultancies being selected into the sample. Based on results in Model 1, as illustrated in Figure 1, the positive effect of business age on internationalisation tends to diminish beyond a threshold age of 43 year old, holding other things constant. If the first-order positive impact of age on internationalisation is a direct outcome of experiential learning and/or reputational assets, this diminishing marginal effect of age then highlights the notion of 'myopia of learning' (Levinthal and March, 1993) in international expansion – older firms tend to concentrate on knowledge merely related to their own experience due to inertia, complacency, or resistance to change, and therefore become more inward-looking and short-sighted of more distant opportunities.

Put differently, our finding of the inverted-U shaped relationship between age and international expansion is in line with the concept of learning advantages of newness (LAN) at the centre of the international entrepreneurship literature (Autio *et al.*, 2000). More specifically, the firm's age at first entry into export markets will affect how quickly it will gain new foreign knowledge (and how likely it will be to favour continued international expansion as a growth strategy). That is, firms that internationalise at a later age are likely to have developed competencies constraining what they see and how they see it. Autio *et al.* (*op. cit.*) find strong evidence that the age of a high-tech firm at international entry is negatively related to its subsequent growth in international sales, and that the knowledge intensity of such firms is positively related to their growth in international sales. Such evidence of entrepreneurial dynamics of learning was also demonstrated in earlier work of Brush and Vanderwerf (1992) who find that early internationalising firms hold more positive attitudes towards foreign markets than those that internationalise late.

[25] Note as discussed earlier, age is measured here to reflect the company's history instead of age since incorporation into a private limited company, LLP or PLC.

FIGURE 1: EFFECTS OF AGE AND INDUSTRIAL DIVERSIFICATION ON INTERNATIONALISATION IN UK ENGINEERING CONSULTING FIRMS, 1989-2009



Notes: based on Model 1 results

Turning next to the impact of our remaining explanatory variables, we find support that prior experience of geographic diversification in their domestic market favours PSFs international expansion (Hypothesis 5a). We also find significant location effects for PSFs located in London and Northern Ireland, which are far more internationalised than those based in other UK regions (Hypothesis 5b). The former result corroborates the intuition that London provides advantages as a hub for global trade in services; whereas the latter can be explained by the substantial trade and investment flows between Northern Ireland and the Republic of Ireland.

With respect to the impact of foreign ownership, in support of Hypothesis 6a, our results suggest that foreign subsidiaries in the UK have significantly higher levels of internationalisation which might be explained by the global orientation of the foreign parent firms. Furthermore, as to the effect of ownership change (Hypothesis 6b) instead, whilst there is no significant effect of mergers and acquisitions, prior management buyouts seem to be influential in boosting the PSF's international expansion and – unsurprisingly – firm closure had a detrimental impact on its internationalisation strategy. As a consequence our findings provide mixed evidence in relation to Bell et al. (2001)'s observation that such 'critical incidents' lead the firm to embrace more rapid and committed internationalization, as the nature of such 'incidents' also seems to matter.

Taking into account the control variables 'size' and 'productivity', it appears that PSFs displayed a higher degree of internationalisation if they were larger and more productive. Finally, given the expected structural differences, Models 2 and 3 (Table 4) are estimated for

the low- and high-productivity firms separately so as to relax the assumption of same parameterisation for these two distinct sub-groups.

TABLE 4: FRACTIONAL RESPONSE MODEL OF INTERNATIONALISATION OF UK ENGINEERING CONSULTING FIRMS, SAMPLE SPLIT BY PRODUCTIVITY

Dependent variable: Internationalisation / Independent variable	Low Productivity Firms (2)				High Productivity Firms (3)			
	$\hat{\beta}$	Robust SE	$\partial y / \partial x$	Robust SE	$\hat{\beta}$	Robust SE	$\partial y / \partial x$	Robust SE
Internationalisation $_{(t-1)}$	6.014***	0.265	0.412***	0.019	4.998***	0.180	0.734***	0.028
ln industrial diversity $_{(t-1)}$	0.092	0.728	0.006	0.050	2.544***	0.761	0.374***	0.109
ln industrial diversity squared $_{(t-1)}$	0.186	0.647	0.013	0.044	-1.538***	0.562	-0.226***	0.081
ln UK regional diversity $_{(t-1)}$	0.403***	0.080	0.028***	0.005	0.153**	0.077	0.023**	0.011
ln age $_{(t-1)}$	0.390**	0.198	0.027**	0.014	0.246	0.177	0.036	0.026
ln age squared $_{(t-1)}$	-0.053*	0.028	-0.004*	0.002	-0.030	0.022	-0.004	0.003
ln labour productivity $_{(t-1)}$	0.040	0.056	0.003	0.004	0.100	0.069	0.015	0.010
ln size $_{(t-1)}$	0.120***	0.031	0.008***	0.002	0.048**	0.022	0.007**	0.003
ln human capital $_{(t-1)}$	0.834**	0.390	0.057**	0.026	0.509**	0.222	0.075**	0.033
Foreign ownership $_{(t-1)}$	-0.177	0.138	-0.011	0.008	0.171***	0.054	0.026***	0.009
Mergers & Acquisitions $_{(t-1)}$	-0.091	0.153	-0.006	0.010	0.113**	0.053	0.017**	0.008
Management Buyout $_{(t-1)}$	0.783***	0.230	0.075***	0.029	0.222	0.163	0.035	0.027
Closure	-0.287*	0.162	-0.018**	0.009	-0.333**	0.150	-0.044**	0.018
Region effect								
London	0.137**	0.062	0.010**	0.005	0.184***	0.037	0.027***	0.006
Northern Ireland	0.463***	0.121	0.038***	0.012	–	–	–	–
Year effect								
1990	0.747***	0.208	0.069***	0.024	0.372***	0.116	0.061***	0.021
1991	0.409**	0.192	0.033*	0.018	0.302***	0.107	0.048***	0.019
1992	0.493**	0.201	0.041**	0.020	0.265***	0.095	0.042***	0.016
1993	0.436**	0.196	0.035*	0.018	0.226**	0.105	0.035**	0.018
1994	0.174	0.212	0.013	0.017	-0.018	0.116	-0.003	0.017
1995	0.572***	0.192	0.049**	0.020	0.095	0.098	0.014	0.015
1996	0.372*	0.192	0.029*	0.017	0.240**	0.101	0.038**	0.017
1997	0.437**	0.190	0.035**	0.018	0.133	0.091	0.020	0.014
1998	0.320*	0.190	0.025	0.016	0.096	0.103	0.014	0.016
1999	0.424**	0.188	0.034*	0.017	0.111	0.092	0.017	0.014
2000	0.359*	0.198	0.028	0.018	0.039	0.091	0.006	0.014
2001	0.092	0.200	0.007	0.015	0.043	0.098	0.006	0.015
2002	0.223	0.207	0.017	0.017	-0.043	0.094	-0.006	0.013
2003	0.085	0.195	0.006	0.014	-0.109	0.100	-0.015	0.014
2004	0.015	0.216	0.001	0.015	-0.020	0.102	-0.003	0.015
2005	0.224	0.206	0.017	0.017	0.035	0.102	0.005	0.015
2006	0.078	0.207	0.005	0.015	-0.179**	0.088	-0.025**	0.012
2007	-0.122	0.240	-0.008	0.015	-0.132	0.095	-0.019	0.013
2008	0.115	0.225	0.008	0.017	-0.061	0.105	-0.009	0.015
2009	–	–	–	–	–	–	–	–
Constant	-4.978***	0.483			-4.482***	0.387		
Observations	1,439				1,457			
Log pseudo-likelihood	-298.9				-421.1			

See Table 3 for notes.

Interestingly, industrial diversification in the less productive PSFs appeared to no longer have any influence on their international expansion. In marked contrast, amongst more productive firms such diversification in unrelated business segments was not only highly conducive to internationalisation, but even more so than average firms, comparing the marginal effects from estimating Models 1 and 3. We interpret such results as suggesting that firms with higher productivity are in a more advantageous position to leverage the scope or scale economies brought about by product diversification to penetrate global markets. In a similar vein, the non-linearity associated with this diversification-internationalisation relationship (i.e. the benefits to internationalisation shifting from diversification in unrelated to related segments as internationalisation reaches maturity) is also considerably more pronounced amongst the more productive PSFs.

Estimation results in Table 4 also note some disparity between the low- and high-productivity PSFs in terms of how various other factors determine internationalisation. In particular, although internationalisation experience was found to be highly persistent in both groups, prior internationalisation intensity had an even more substantial effect in the more productive firms (in terms of marginal effects). Business age was an important determinant of internationalisation only in the low-productivity firms, taking an inverted-U shape as seen in Model 1. In addition, mergers and acquisitions were important for international expansion in more productive firms; whereas only management buyouts were significant in enhancing internationalisation in the less productive PSFs. The estimated coefficients for other variables (viz. geographical diversification, size, human capital, firm closure and regional effect) are broadly comparable with results in Model 1 discussed earlier.

5 Conclusion

As the balance of many (industrialised) economies shifts from traditional manufacturing to services-oriented firms, it is generally acknowledged that to a large extent the received IB theory on international expansion (which was developed largely in the context of manufacturing) needs to address thoroughly and explicitly the internationalisation of service providers, including the very important class of professional services. Alongside the emerging body of research on entry mode and performance impact of service multinationals, the literature on service internationalisation has to date largely neglected the fundamental

questions of what factors lead firms to become international and how this phenomenon might progress along an evolutionary path.

Our study attempts to provide a fuller understanding of the underlying factors and mechanisms that drive international expansion of service firms paying special attention to the heterogeneity within the service sector (e.g. capital intensive vs. knowledge intensive services). Using data from engineering consulting firms in the UK, we set our focus on PSFs. More specifically, this study investigates the empirical questions of determination of commitment of resources in PSFs' internationalising activities and examines an unbalanced panel of 265 engineering consulting firms in the UK over the two-decade period from 1989 to 2009.

Controlling for potential endogeneity of explanatory variables, a fractional response model of internationalisation has been estimated and our results show that PSFs typically follow an evolutionary approach with incremental resource commitment in post-entry internationalisation activities coupled with significant experiential learning. In terms of the important drivers of international expansion of PSFs, we have found that the degree of internationalisation varies with industrial diversification in a non-linear fashion: increasing as unrelated product diversification enhances scope economies but decreasing as such diversification surpasses the range of rent-yielding resources with excessive transaction costs.

Likewise, business age is also found to have a curvilinear relationship with the degree of internationalisation. Moreover, our findings also suggest that, as expected, human capital stock has a substantial and positive impact on the level of internationalisation in PSFs. Other factors boosting the extent of internationalisation include business size, geographic diversification of business activities within the UK, foreign ownership and ownership change such as management-buyouts. Our findings further reveal that a number of determinants also influence the firm's internationalisation degree in a different fashion depending on the firm's productivity levels.

Our analysis is novel and provides a number of unique contributions to the literature. Above all, much of the existing evidence on internationalisation (and its interplay with diversification etc.) comes from US manufacturing data (e.g. studies like Cantwell and Piscitello (2000) employ patent data which is generally unavailable to measure service activities). Drawing on a unique dataset of PSFs, our research helps to address the imbalance between importance of the service sector and the paucity of scholarly work in this area.

In addition, following Bryce and Winter (2009)'s recent work in developing a general relatedness index for US manufacturing sector, we have adopted an analogous co-occurrence

method and derived a measure of relatedness for these engineering consulting firms using information on their service business activities. Our diversification index takes into account both the number of business segments a firm is involved in and the interrelatedness between these segments, instead of using a simple product count. Therefore, our diversification or coherence measure is both theoretically sound (capturing the PSFs' core to distant competences and technological diversification) as well as methodologically robust.

Whilst existing empirical studies are mostly of a cross-sectional nature (c.f. Cantwell and Piscitello, 2000), we also contribute to the literature by using a panel dataset spanning two decades, which allows us to explore the evolution of these service firms and the dynamic interactions between their growth strategies such as internationalisation and diversification. More importantly, by using the appropriate econometric methodology in estimating a fractional response variable and addressing potential endogeneity issues of explanatory variables, we are able to draw inferences on causal effects of various factors on the internationalisation activities of PSFs.

Furthermore, Hitt et al. (1997) emphasised the importance of understanding the combined evolutionary path of product and international diversification. In this sense, the non-linearity revealed in the internationalisation-diversification nexus provides strong support for our Hypothesis 2 that PSFs derive international competitiveness from diversifying or investing in unrelated business services although this also entails a dynamic business strategy to re-focus on more related niche markets as internationalisation matures in order to further boost their degree of internationalisation. This finding, we believe, is particularly important in advancing our understanding of the interaction between the PSFs' growth strategies of product diversification and globalisation in a dynamic and evolutionary fashion. As Geringer et al. (2000) contend, outside the historic perspective of Chandler (1962), most empirical studies of diversification neglect the temporal dimension – often based on cross-sectional or pooled data, extant literature views strategy as having evolved over time through an internal logic whilst failing to address the contextual change and investigate if such strategies and their consequences evolve with time.

Admittedly, from a conceptual point of view, given the lack of boundary conditions for the term PSFs (ranging from the industries typically investigated in the PSF literature such as law, accounting, to the less canonical industries like software development or staffing agencies), the analysis undertaken (and conclusions drawn) in this study may not be generalizable to all PSFs without a robust comparative study. We do, however, believe, that

the broader conclusions do apply to the knowledge-intensity feature of these firms (von Nordenflycht, 2010).

Lastly, as with all empirical analysis, there are several limitations to our study, due to data constraints. One potentially important factor that our study does not consider is the role of external relationship and/or relational assets in driving PSFs globalisation process. For instance, the network theory of internationalisation is becoming increasingly attractive in providing a contextual analysis of specific paths of internationalisation, emphasizing the role of external resources and relational capital (Coviello and Munro, 1997; Ball et al., 2008; Johanson and Vahlne, 2009) and its interaction with the firm's internal resources such as human capital (Hitt et al., 2006). As Johanson and Vahlne (2009) argue the problems and opportunities facing international businesses are becoming less country-specific and more relationship and network-specific.

Future work should extend the theory and evidence of services internationalisation to incorporate the impact of relational assets and their interplay with firms' internal resources, which will provide useful insights into the process whereby such inimitable firm-specific resources are exploited to confer competitive advantages in global markets, to inform the management and organisation of knowledge-intensive professional service firms (especially those project-based PSFs). Another limitation in our data is that there is no information available on foreign sales to allow a more comprehensive measure of internationalisation. Ideally, a multidimensional measure should take into account several aspects of the firm's internationalisation activities including overseas sales and employment, geographic expansion and so on.

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References

Agarwal, S. and Ramaswami, S.N. (1992) Choice of foreignmarket entry mode: impact of ownership, location andinternalization factors. *Journal of international business studies*, 23, 1-27.

Aharoni, Y. (1996) The organization of global service MNEs. *International Studies of Management and Organization*, 26, 6-23.

Akpinar, M. (2009) Internationalization vs. Diversification: A Study on the Drivers of Growth Strategies. *Journal of Global Business Issues*, 3(2), 1-7.

Anand, J. and Delios, A. (1997) Location specificity and thetransferability of downstream assets to foreign subsidiaries. *Journal of international business studies*, 28, 579-603.

Ansoff, H.I. (1958) A model for diversification. *Management Science*, 4, 392-414.

Argyres, N. (1996) Capabilities, Technological Diversification and Divisionalization. *Strategic Management Journal*, 17(5), 395-410.

Asmussen, C.G., Benito, G.R., and Petersen, B. (2009) Organizing foreign market activities: From entry mode choice to configuration decisions. *International business review*, 18, 145-155.

Autio, E., Sapienza, H., and Almeida, J. (2000) Effect of Age at Entry, Knowledge Intensity, and Imitability on International Growth. *Academy of Management Journal*, 43, 909-924.

Baark, E. (1999) Engineering Consultancy: An Assessment of IT-enabled International Delivery of Services. *Technology Analysis & Strategic Management*, 11(1), 55-74.

Ball, D.A., Lindsay, V.J., and Rose, E.L. (2008) Rethinking the paradigm of service internationalisation: Less resource-intensive market entry modes for Information- intensive Soft services. *Management international review*, 48, 413-431.

Bayraktar, E., Demirbag, M., Koh, L., Tatoglu, E., and Zaim, H. (2009) A Causal Analysis of the Impact of Information Systems and Supply Chain Management Practices on Operational Performance: Evidence from Manufacturing SMEs in Turkey. *International Journal of Production Economics*, 122(1), 133-149.

Beaverstock J.V., Smith, R., and Taylor, P.J. (2010) The long arm of the law: the globalization of London 's law firms. *Environment and Planning A*, 31, 1857-1876.

Bell, J., McNaughton, R., and Young, S. (2001) 'Born-Again Global' Firms: An Extension to The 'Born-Global' Phenomenon. *Journal of international management*, 7, 173-189.

Bell, J., McNaughton, R., Young, S., and Crick, D. (2003) Towards an Integrative Model of Small Firm Internationalisation. *Journal of International Entrepreneurship*, 1, 339-362.

Bengtsson, L. (2000) Corporate strategy in a small open economy: reducing product diversification while increasing international diversification. *European Management Journal*, 18(4), 444-453.

Bishop, P. (2009) Spatial spillovers and employment growth in the service sector. *Service Industries Journal*, 29(6), 791-803.

Blumenfeld, M. (2009) Branching Out: Diversification Strengthens Industry. *Credit Union Journal*, 13(39), 15-15.

Boddewyn, J., Halbrich, M., and Perry, A. (1986) Service multinationals: conceptualization, measurement and theory. *Journal of international business studies*, 17, 41-57.

Bouquet, C., Louis, H., and elios, A. (2004) Foreign expansion in service industries: Separability and human capital intensity. *Journal of Business Research*, 57(1), 35-46.

Brock, D.M., Yaffe, T., and Dembovsky, M. (2006) International diversification and performance: a study of global law firms. *Journal of international management*, 12(4), 473-489.

Cantwell, J. and Piscitello, L. (2000) Accumulating Technological Competence: Its Changing Impact on Corporate Diversification and Internationalization. *Industrial and Corporate Change*, 9(1), 21-51.

Capar, N. and Kotabe, M. (2003) The Relationship between International Diversification and Performance in Service Firms. *Journal of International Business Studies*, 34(4), 345-355.

Chang, H. (2009) IT Capital Accumulation and Productivity Growth in Public Accounting Firms. *IEEE Transactions on Engineering Management*, 56(4), 692-700.

Chatterjee, S. and Singh, J. (1999) Are Tradeoffs Inherent in Diversification Moves? A Simultaneous Model for Type of Diversification and Mode of Expansion Decisions. *Management Science*, 45(1), 25-41.

Chung, Y.Y. and Cheah, C.Y.J. (2006) Interactions between Business and Financial Strategies of Large Engineering and Construction Firms. *Journal of Management in Engineering*, 22(3), 148-155.

Cicic, M. and Patterson, P.G. (1999) A Conceptual Model of the Internationalization of Services Firms. *Journal of Global Marketing*, 12(3), 81-

Coase, R.H. (1937) The Nature of the Firm. *Economica*, 4, 386-405.

Contractor, F.J. and Kundu, S.K. (1998) Modal choice in aworld of alliances: analyzing organizational forms in theinternational hotel sector. *Journal of international business studies*, 29, 325-358.

Contractor, F.J., Kundu, S.K., and Hsu, C.C. (2003) A three-stage theory of international expansion: the link between multinationality and performance in the service sector. *Journal of international business studies*, 34, 5-18.
Cort, K.T., Griffith, D.A., and White, D.S. (2007) An attribution theory approach for understanding the internationalization of professional service firms. *International Marketing Review*, 24(1), 9-25.
Coviello, N.E. and Martin, K.A. (1999) Internationalization of service SME's: an integratedperspective from the engineering consulting sector. *Journal of International Marketing*, 7, 42-66.
David, P. A. (1985). Clio and the economics of QWERTY. *American Economic Review*, 75, 332–37.
Davis, R. and Duhaime, I.M. (1992) Diversification, Vertical Integration, and Industry Analysis: New Perspectives and Measurement. *Strategic Management Journal*, 13(7), 511-524.
Delios, A. and Beamish, P.W. (1999) Geographic scope,product diversification and the corporate performanceof Japanese firms. *Strategic ManagementJournal*, 20, 711-727.
Delios, A. and Henisz, W.J. (2000) Japanese firms' investmentstrategies in emerging economies. *Academy of Management Journal*, 43, 305-323.
Di Gregorio, D., Musteen, M., and Thomas, D.E. (2008) Offshore outsourcing as a source of international competitiveness for SMEs. *J Int Bus Stud*, 40(6), 969-988.
Drejer, I., Vinding, A. (2005) 'Location and Collaboration: Manufacturing Firms' Use of Knowledge Intensive Services in Product Innovation', European Planning Studies, 13(6): 879-898.
Dunning, J.H.(1981) *International Production and the Multinational Enterprise*, London: Allen & Unwin.
Dunning, J.H. (2000) The Impact of the Completion of the European Single Market on FDI. In: Dunning, J.H.(eds.) *Regions, Globalisation and the Knowledge-Based Economy*, Oxford: Oxford University Press.
Erramilli, M.K. and Rao, C.P. (1990) Choice of foreign market entry modes by service firms: Role of market knowledge. *Management international review*, 30, 135-150.
Erramilli, M.K. (1990) Entry Mode Choice in Service Industries. *International Marketing Review*, 7, 50-62.
Erramilli, M.K. (1991) The experience factor in foreign market entry behavior of service firm. *Journal of international business studies*, 22, 479-501.
Erramilli, M.K. and Rao, C.P. (1993) Service firms' international entry-mode choice: a modified transaction-cost analysis approach. *Journal of Marketing*, 57, 19-38.
Farjoun, M. (1994) Beyond Industry Boundaries: Human Expertise, Diversification and Resource-Related Industry Groups. *Organization Science*, 5(2), 185-199.
Farjoun, M. (1998) The Independent and Joint Effects of the Skill and Physical Bases of Relatedness in Diversification. *Strategic Management Journal*, 19(7), 611-630.
Gabrielsson, P. and Gabrielsson, M. (2004) Globalizing internationals: business portfolio and marketing strategies in the ICT field. *International business review*, 13(6), 661-684.
Garbe, J.N. and Richter, N.F. (2009) Causal analysis of the internationalization and performance relationship based on neural networks - advocating the transnational structure. *Journal of international management*, 15(4), 413-431.
Gardner, H.K., Anand, N., and Morris, T. (2008) Chartering new territory: diversification, legitimacy, and practice area creation in professional service firms. *Journal of Organizational Behavior*, 29(8), 1101-1121.
Gaur, A.S. and Kumar, V. (2009) International Diversification, Business Group Affiliation and Firm Performance: Empirical Evidence from India. *British Journal of Management*, 20(2), 172-186.
Geringer, J.M., Tallman, S., and Olsen, D.M. (2000) Product and International Diversification among Japanese Multinational Firms. *Strategic Management Journal*, 21(1), 51-80.
Geringer, J.M., Beamish, P.W., and da Costa, R.C. (1989) Diversification Strategy and Internationalization: Implications for MNE Performance. *Strategic Management Journal*, 10(2), 109-119.
Goerzen, A. and Makino, S. (2007) Multinational corporation internationalization in the service sector: a study of Japanese trading companies. *Journal of international business studies*, 38(7), 1149-1169.
Greenhalgh, C. (1990) Innovation and Trade Performance in the United Kingdom. *Economic Journal*, 100(400), 105-118.
Greenhalgh, C. and Taylor, P. (1994) Innovation and Export Volumes and Prices-A Disaggregated Study. *Oxford Economic Papers*, 46(1), 102-124.
Greenwood, R. and Empson, L. (2003) The professional partnership: Relic or exemplary form of governance? *Organization Studies*, 24, 909-933.
Greenwood, R., Li, S.X., Prakash, R., and Deephouse, D.L. (2005) Reputation, Diversification, and Organizational Explanations of Performance in Professional Service Firms. *Organization Science*, 16(6), 661-673.
GWEE, J. (2009) Innovation and the creative industries cluster: A case study of Singapore's creative industries. *Innovation: Management, Policy & Practice*, 11(2), 240-252.
Harris, S. and Wheeler, C. (2005) Entrepreneurs' Relationships for Internationalization: Functions, Origins and Strategies. *International business review*, 14, 187-207.

Hitt, M.A., Hoskisson, R.E., and Kim, H. (1997) International diversification: effects on innovation and firm performance in product-diversified firms. *Academy of Management Journal*, 40, 767-798.

Hitt, M.A., Bierman, L., Uhlenbruck, K.L.A.U., and Shimizu, K. (2006) The importance of resources in the internationalization of professional service firms: The good, the bad, and the ugly. *Academy of Management Journal*, 49, 1137-1157.

Hitt, M.A., Bierman, L.E.O.N., Uhlenbruck, K.L.A.U., and Shimizu, K.A.T.S. (2003) The Internationalization of Professional Service Firms: Effects of Human Capital and Social Capital. B1-B6. Academy of Management. available at http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=13792860&site=ehost-live

Hymer, S.H.(1976) *The International Operations of National Firms: a Study of Foreign Direct Investment*, Cambridge: MA.

Hymer, S.H. (1979) The Multinational Corporation: A Radical Approach. In: Cohen, R.B., Felton, N., Nkosi, M., and van Liere, J.(eds.) *Papers by Stephen Herbert Hymer*, Cambridge, Mass: Cambridge University Press.

Jensen, M.C. and Murphy, K.J. (1990) Performance pay and top management incentives. *Journal of Political Economy*, 98, 225-264.

Johanson, J. and Vahlne, J.E. (1977) The Internationalization Process of the Firm - A model of Knowledge Development and Increasing Foreign Market Commitment. *Journal of international business studies*, 8, 23-32.

Johanson, J. and Vahlne, J.E. (2009) The Uppsala Internationalization Process Model Revisited: From Liability of Foreignness to Liability of Outsidership, *Journal of International Business Studies*, 40, 1411-1431.

Jolly, V.K., Alahuta, M., and Jeannet, J. (1992) Challenging the incumbents: How high technology Start-ups compete globally. *Journal of Strategic Change*, 1, 71-82.

Kadlec, S.A. (1997) The Internationalization of the United States Chemical Industry. *Journal of international business studies*, 28(2), 429-429.

Kashlak, R.J. and Maheshkumar, P.J. (1994) Core Business Regulation and Dual Diversification Patterns in the Telecommunications Industry. *Strategic Management Journal*, 15(8), 603-611.

Kazanjian, R.K. and Drazin, R. (1987) Implementing Internal Diversification: Contingency Factors for Organization Design Choices. *The Academy of Management Review*, 12(2), 342-354.

Kim, C.W., Hwang, P., and Burgers, W.P. (1989) Global diversification strategy and corporate profit performance. *Strategic Management Journal*, 10, 45-57.

Kim, W.C., Hwang, P., and Burgers, W.P. (1993) Multinationals' diversification and the risk-return trade-off. *Strategic Management Journal*, 14, 275-286.

Kogut, B. (1985) Designing global strategies: Comparativeand competitive value added chains. *Sloan Management Review*, 27, 27-38.

Kogut, B. (1985) Designing global strategies: profiting from operating flexibility. *Sloan Management Review*, 27, 27-38.

Kogut, B. and Chang, S.J. (1991) Technological capabilities and Japanese foreign direct investment in the United States. *Review of Economics and Statistics*, 73, 401-413.

Kogut, B. and Zander, U. (1993) Knowledge of the firm and the evolutionary theory of the multinational corporation. *Journal of international business studies*, 24, 625-645.

Kogut, B., Walker, G., and Anand, J. (2002) Agency and Institutions: National Divergences in Diversification Behavior. *Organization Science*, 13(2), 162-178.

Krugman, P. (1979) A Model of Innovation, Technology Transfer, and the World Distribution of Income. *Journal of Political Economy*, 87(2), 253-266.

Kundu, S.K. and Merchant, H. (2008) Service Multinationals: Their Past, Present, and Future. *Management International Review (MIR)*, 48(4), 371-377.

Laanti, R., McDougall, F., and Baume, G. (2009) How well do traditional theories explain the internationalisation of service MNEs from small and open economies? - case: national telecommunication companies. *Management international review*, 49(1), 121-143.

Le Bas, C. and Patel, P. (2005) Does Internationalisation of Technology Determine Technological Diversification in Large Firms? An Empirical Study. *Revue d'Economie Industrielle*, (110), 157-174.

Li, J. and Guisinger, S. (1992) The globalization of service multinationals in the "triad" regions: Japan, Western Europeand North America. *Journal of international business studies*, 23, 675-696.

Li, X., Xin, J.L., and Zheng, G. (2009) A Strategic Performance Measurement System for Firms across Supply and Demand Chains on the Analogy of Ecological Succession. *Ecological Economics*, 68(12), 2918-2929.

Lu, J.W. and Beamish, P.W. (2004) International diversification and firm performance: The S-curve hypothesis. *Academy of Management Journal*, 47, 598-609.

Lubatkin, M., Merchant, H., and Srinivasan, N. (1993) Construct Validity of Some Unweighted Product-Count Diversification Measures. *Strategic Management Journal*, 14(6), 433-449.

Markides, C. and Williamson, P. (1994) Related Diversification, Core Competencies and Corporate Performance. *Strategic Management Journal*, 15, 149-165.
Markides, C. and Williamson, P. (1995) Diversification, Restructuring and Economic Performance. *Strategic Management Journal*, 16(2), 101-118.
Martínez-Argüelles, S.R., Rubiera-Morollón, F. (2006) Outsourcing of advanced business services in the Spanish economy: Explanation and estimation of the regional effects, The Service Industries Journal 26(3), pp. 267 – 285.
Mayer, M. and Whittington, R. (2003) Diversification in Context: A Cross-National and Cross-Temporal Extension. *Strategic Management Journal*, 24(8), 773-781.
Merchant, H. and Gaur, A. (2008) Opening the 'Non-Manufacturing' Envelope: The Next Big Enterprise for International Business Research. *Management International Review (MIR)*, 48(4), 379-396.
Miller, D. (2004) Firms' Technological Resources and the Performance Effects of Diversification: A Longitudinal Study. *Strategic Management Journal*, 25(11), 1097-1119.
Moen, O. and Servais, P. (2002) Born Global or Gradual Global? Examining the Export Behaviour of Small and Medium-Sized Enterprises. *Journal of International Marketing*, 10, 49-72.
Mort, G.S., Winzar, H., and Han, C.M. (2001) Country Image Effects in International Services: A Conceptual Model and Cross National Empirical Test. 12.43-available at http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=10561660&site=ehost-live
Mueller, D.C. (1972) A life cycle theory of the firm. *The Journal of Industrial Economics*, 20, 199-219.
Nayyar, P.R. (1992) On the Measurement of Corporate Diversification Strategy: Evidence from Large U.S. Service Firms. *Strategic Management Journal*, 13(3), 219-235.
Nunes, P.J., Serrasqueiro, Z.M., and Sequeira, T.N. (2009) Profitability in Portuguese service industries: a panel data approach. *Service Industries Journal*, 29(5), 693-707.
Ochel, W. (2002) The international competitiveness of businessservice firms: The case of Germany. *Service Industries Journal*, 22, 1-16.
OECD (2010) Promoting transparency and exchange of information for tax purposes. Background Information Brief, March 2010.
Opsahl, T.(2009) Structure and Evolution of Weighted Networks. University of London (Queen Mary College), London, UK, pp. 104-122. Available at http://opsahl.co.uk/tnet
Oviatt, B. and McDougall, P. (1994) Toward a Theory of International New Ventures. *Journal of international business studies* , 25, 45-64.
Palich, L.E., Cardinal, L.B., and Miller, C. (2000) Curvilinearity in the Diversification-Performance Linkage: An Examination of over Three Decades of Research. *Strategic Management Journal*, 21(2), 155-174.
Papke, L.E. and Wooldridge, J.M. (1996) Econometric Methods for Fractional Response Variables with an Application to 401(K) Plan Participation Rates. *Journal of Applied Econometrics*, 11, 619-632.
Papke, L.E. and Wooldridge, J.M. (2008). Panel Data Methods for Fractional Response Variables with an Application to Test Pass Rates. *Journal of Econometrics*, 145, 121-133.
Peinado, S.E. and Barber, J. (2006) A multidimensional concept ofuncertainty and its influence on the entry mode choice: Anempirical analysis in the service sector. *International BusinessReview*, 15, 215-232.
Penrose, E.(1959) *The Theory of the Growth of the Firm*, Oxford: OUP.
Petersen, T. and Pedersen, B. (1998) Explaining gradually increasing resource commitment to a foreign market. *International business review*, 7, 483-501.
Pla-Barber, J., Sanchez-Peinado, E., and Madhok, A. (2010) Investment and Control Decisions in Foreign Markets: Evidence from Service Industries. *British Journal of Management*, 21, 736-753.
Prahalad, C.K. and Hamel, G. (1990) The core competence of the corporation. *Harvard Business Review*, 68, 79-91.
Qian, G., Li, L., Li, J., and Qian, Z. (2008) Regional diversification and firm performance. *Journal of international business studies*, 39(2), 197-214.
Quintas, M.A., Vazquez, X.H., Garcia, J.M., and Caballero, G. (2008) Geographical amplitude in the international generation of technology: present situation and business determinants. *Research policy*, 37(8), 1371-1381.
Reihien, M. and Apel, B.A. (2007) Internationalization of professional service firms as learning Γ沤 a constructivist approach. *International Journal of Service Industry Management*, 18(2), 140-151.
Rialp, A., Rialp, J., and Knight, G. (2005) The Phenomenon of Early Internationalizing Firms: What Do We Know After A Decade (1993-2003) of Scientific Inquiry. *International business review*, 14, 147-166.
Robins, J.A. and Wiersema, M.F. (2003) The Measurement of Corporate Portfolio Strategy: Analysis of the Content Validity of Related Diversification Indexes. *Strategic Management Journal*, 24(1), 39-59.
Rugman, A.M.(1981) *Inside the multinationals : the economics of internal markets*, New York: Columbia University Press.

Rugman, A.M. and Verbeke, A. (2008) A New Perspective on the Regional and Global Strategies of Multinational Services Firms. *Management International Review (MIR)*, 48(4), 397-411.

Saarenketo, S., Puumalainen, K., Kyl+鴎eiko, K., and Kuivalainen, O. (2008) Linking knowledge and internationalization in small and medium-sized enterprises in the ICT sector. *Technovation*, 28(9), 591-601.

Sharma, D.D. and Blomstermo, A. (2003) The Internationalisation Process of Born Globals: A Network View. *International business review*, 12, 739-753.

Shukla, A. and Dow, J.D. (2010) Post-entry advancement of international service firms in Australia: A longitudinal approach. *Scandinavian Journal of Management*, 26(3), 268-278.

Sirmon, D.G. and Hitt, M.A. (2009) Contingencies within Dynamic Managerial Capabilities: Interdependent Effects of Resource Investment and Deployment on Firm Performance. *Strategic Management Journal*, 30(13), 1375-1394.

Stimpert, J.L. and Duhaime, I.M. (1997) In the Eyes of the Beholder: Conceptualizations of Relatedness Held by the Managers of Large Diversified Firms. *Strategic Management Journal*, 18(2), 111-125.

Sueyoshi, T., Gotoc, M., and Shang, J. (2009) Core business concentration vs. corporate diversification in the US electric utility industry: Synergy and deregulation effects. *Energy Policy*, 37(11), 4583-4594.

Tallman, S. and Li, J. (1996) Effects of international diversity and product diversity on the performance of multinational firms. *Academy of Management Journal*, 39, 179-196.

Teece, D.J. (1986) Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy. *Ricerche Economiche*, 40(4), 607-643.

Teece, D.J. (1996) Firm Organization, Industrial Structure, and Technological Innovation. *Journal of Economic Behavior & Organization*, 31(2), 192-224.

Tether, B.S. and Tajar, A. (2008) The organisational-cooperation mode of innovation and its prominence amongst European service firms. *Research policy*, 37(4), 720-739.

Touzi, J., Benaben, F., Pingaud, H., and Lorre, J.P. (2009) A Model-Driven Approach for Collaborative Service-Oriented Architecture Design. *International Journal of Production Economics*, 121(1), 5-20.

Tuppura, A., Saarenketo, S., Puumalainen, K., Jantunen, A., and Kyläheiko, K. (2008) Linking knowledge, entry timing and internationalization strategy. *International business review*, 17(4), 473-487.

UNCTAD (2010) World Investment Report: Investing in a low-carbon economy. Geneva, Switzerland: UNCTAD.available at http://unctad.org/en/docs/wir2009_en.pdf

Vanchan, V. and MacPherson, A. (2008) The Recent Growth Performance of US Firms in the Industrial Design Sector: An Exploratory Study. *Industry and Innovation*, 15(1), 1-17.

Vernon, R. (1966) International investment and international trade in the product cycle. *Quarterly Journal of Economics*, 80, 190-207.

von Nordenflycht, A. (2010) What is a Professional Service Firm? Toward as Theory and Taxonomy of Knowledge-Intensive Firms. Academy of Management Review35(1), 155-174.

Ward, K. (2004) Going Global? Internationalization and Diversification in the Temporary Staffing Industry. *Journal of Economic Geography*, 4(3), 251-273.

Winch, G.M. (2008) Internationalisation strategies in business-to-business services: the case of architectural practice. *Service Industries Journal*, 28(1), 1-13.

Wolf, B.M. (1977) Industrial Diversification and Internationalisation: Some Empirical Evidence. *Journal of Industrial Economics*, 26(2), 177-191.

Zaheer, S. and Mosakowski, E. (1997) The dynamics of the liability of foreignness: a global study of survival in financial services. *Strategic Management Journal*, 18, 439-464.

Zahra, S.A., Ireland, R.D., and Hitt, M.A. (2000) International expansion by new venture firms: International diversity, mode of market entry, technological learning,and performance. *Academy ofManagement Journal*, 43, 925-950.

Zahra, S.A., Korri, J.S., and Yu, J. (2005) Cognition and International Entrepreneurship: Implications for Research on International Opportunity Recognition and Exploitation. *International business review* , 14, 129-146.

Williamson, O.E.(1975) *Markets and Hierarchies: Analysis and Antitrust Implications*, New York: Free Press.

Rumelt, R.P. (1984) Towards a Strategic Theory of the Firm. In: Lamb, R.B.(eds.) *Competitive Strategic Management*, 556-571. NJ.

Wernerfelt, B. (1984) A Resource-Based View of the Firm. *Strategic Management Journal*, 16, 171-180.

Barney, J. (1991) Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), 99-120.

Sapienza, H.J., Autio, E., George, G., and Zahra, S.A. (2006) A capabilities perspective on the effects of early internationalization on firm survival and growth. *Academy of Management Review*, 31, 914-933.

Appendix 1

Measurement of Relatedness and Diversification

Relatedness measures based on co-occurrence matrices were first introduced to quantify corporate coherence in the early 1990's and, since then, have been widely deployed in the strategy literature to capture the relatedness of firms' portfolios and the impact of this on corporate strategies between organic growth and expansion through M&As (e.g. Teece et al, 1994). This method is also increasingly used in social science research in general; for instance, co-citation analysis entails a similar exercise to map and visualise knowledge domains in the web of science by creating a large-scale map of science from a sample of documents across disciplines, thus developing measures of earlier journal-journal relatedness to more resource-intensive matrix of paper-paper relatedness (Klavans and Boyack, 2006).

Central to the application of the co-occurrence method in the business and management literature is the survivor principle, postulating that activities that are more related will be more frequently combined within the same portfolio. Therefore, if two activities are observed to nearly always appear together within the same business, such activities can be assumed to be highly related; on the contrary, those business activities rarely occurring together are assumed to be largely unrelated (c.f. Teece et al., 1994). Bryce and Winter (2009) recently adopted and revised the co-occurrence method to measure relatedness, combating various deficiencies associated with a simple co-occurrence matrix of raw frequencies.

Another recent attempt to measure relatedness was the 'revealed relatedness' approach initially put forward in Neffke and Henning (2008) and subsequently developed in Neffke et al. (2009) to map industry space using plant-level Swedish manufacturing data. In contrast to the focus on firm portfolios in Teece et al. (1994) and Bryce and Winter (2006), a distinctive feature of this revealed relatedness approach lies in its use of plant-level product portfolios data. Based on predicting co-occurrence using knowledge about class specific attributes, this measure of revealed relatedness compares such predicted co-occurrence with the actual raw counts of co-occurrence observed in data to derive the relatedness matrices (i.e. probability indices). These studies are usually based on large portfolio data covering a wide range of industries, taking into account the direction of links in a Bayesian framework. Given the special focus of engineering consultancies in our data, there is not sufficient variation in business disciplines to allow a comprehensive index of revealed relatedness to be

meaningfully developed, since any combination of the business activities provided by these engineering firms could, by definition, be perceived as being rather 'expected' and thus characterised by a high level of co-occurrence.

It follows that the relatedness index developed in this paper largely follows Bryce and Winter's procedure. Ideally, we would like to utilise the information on the joint co-occurrences of two disciplines across all firms throughout the whole 21-year period. However, in practice, our measure of relatedness is constructed for each year separately, given that information on business disciplines was collected in an inconsistent fashion over time (see Table A1 for more information on the appearance patterns of disciplines covered in the NCE data) [26].

To develop a generic index, a co-occurrence matrix was first constructed based on the frequencies of two disciplines both appearing within the same firm. Given that there might be situations where a combination of activities is appearing more (or less) often than by random chance, adjustments need to be made to control for the expected frequencies of any two activities being observed in the same firm, such raw counts were subsequently normalised to operationalize the random hypothesis, following the randomisation procedure initially put forward in Teece et al. (1994)[27]. This is implemented in R using the 'tnet' programme by Opsahl (2009).

Further biases may however arise in using an occurrence method, as smaller portfolios are reflective of stronger relationships between a pair of related activities than is the case with larger portfolios. This adjustment is operationalized using a Newman (2001) weighting procedure. In summary, weights have been applied to the co-occurrence matrices, based the following formula:

$$w_{ij} = \sum_p \frac{1}{N_p - 1}$$

where w_{ij} is the weight between node i and node j, p is the firms where two activities are observed to co-appear and N_p is the number of disciplines observed within the same firm.

[26] Notably, in studies using manufacturing data (e.g. Bryce and Winter, 2009), missing information on products in certain years has been inferred as long as such products were observed in previous years given the assumption that such production capacity still exists despite the lack of product information compiled. This is a reasonable assumption as far as manufacturing products are concerned especially in studies emphasizing the role of underlying firm-specific assets/resources in shaping relatedness and thus corporate strategies. However, in the context of service products (and professional services in particular), such missing data cannot be imputed as there is substantially higher level of variation in a firm's portfolio over time due to relatively low level of sunk costs associated with entry into new markets and high level of flexibility to exit from unprofitable markets.

[27] This is similar to another adjustment procedure widely adopted in the literature based on a modified cosine index for expected co-occurrence frequencies (Klavans and Boyack, 2006).

Notably, Bryce and Winter (2009) made an analogous point by arguing that some large firms may engage in relatively insignificant disciplines that may be only weakly linked to other activities in the same portfolio. Consequently they addressed this issue by weighting the frequency matrices by the extent to which the pair of activities were both significant to the overall economic output of the firm. As we do not have information on output attributable to each discipline (which was used in Bryce and Winter's adjustment, Step 2) to weight the importance of dyads, we believe the Newman weighting procedure is appropriate in allowing the size of portfolios to be adequately adjusted for (to reflect the economic importance of the dyads) [28].

TABLE A1: AN EXAMPLE OF INDEX SCORES - PAIRWISE DISTANCES BETWEEN AREAS OF WORK, 2009 DATA, SORTED BY MEANS

Discipline Code	Discipline	Frequency	Mean	Std. Dev.	Max
ceng	General civil design/consultancy	34	0.757	0.547	2.242
b	Building services	34	0.779	0.558	2.166
sseng	Structural works/engineering	34	0.824	0.567	2.321
f	Foundations	34	0.835	0.587	2.355
rd	Roads & bridges	34	0.872	0.578	2.376
si	Site investigation	34	0.892	0.573	2.106
wds	Water supply, drainage & sewerage	34	0.910	0.596	2.446
pm	Project management	34	0.915	0.560	2.402
ev	Environmental consultancy	34	0.936	0.576	2.335
gge	Geotechnical & ground engineering	34	0.972	0.595	2.388
fa	Flood alleviation	34	1.018	0.601	2.569
wl	Waste & land reclamation	34	1.023	0.601	2.476
qs	Quantity surveying	34	1.071	0.597	2.584
ra	Railways	34	1.118	0.580	2.652
tr	Transport planning & consultancy	34	1.126	0.590	2.724
hs	Health & safety consultancy	34	1.142	0.601	2.660

[28] Bryce and Winter (2009) also employed the shortest path method to fill in missing links and calculate potential co-occurrence of two products that are not linked in real data. In the context of diversification in services, we do not adopt such an approach as we set our focus on the revealed relatedness/diversity rather than the underlying resources in realising such potential linkage.

hd	Harbours, ports & docks	34	1.192	0.589	2.725
po	Power	34	1.261	0.597	2.811
df	Defence design & consulting	34	1.342	0.606	2.868
a	Airports	34	1.371	0.602	2.843
fm	Facilities/asset management	34	1.422	0.601	2.968
ln	Inspection, certification & investigation	34	1.441	0.608	2.973
m	Manufacturing, chemical & process plant facilities	34	1.507	0.632	3.024
tu	Tunnelling	34	1.517	0.614	2.992
t	Training	34	1.601	0.614	3.173
mc	Management consultancy	34	1.712	0.635	3.270
sw	Solid waste treatment	34	1.869	0.631	3.481
fe	Fire engineering	34	2.028	0.657	3.555
it	IT consultancy/software development	34	2.029	0.693	3.702
tel	Telecoms	34	2.059	0.652	3.656
eq	Earthquake engineering	34	2.151	0.674	3.703
mi	Mining, quarrying, metallurgy	34	2.197	0.677	3.565
oog	Offshore, oil & gas, pipelines	34	2.276	0.667	3.901
lw	Law, contracts, arbitration	34	2.765	0.701	3.901

From a transaction-cost theoretical perspective (Williamson 1979), each dyad between two business activities represents the transaction costs of a firm diversifying from one area into another; put another way, the distance between segments mirrors the costs of diversifying. Ideally a diversification measure should be a multidimensional construct that captures two fundamental components in managerial decisions of corporate diversification, namely, the total magnitude and direction/type of such diversification. Regarding the first dimension, given that the data structure of questions regarding disciplines varies over time (i.e. certain business areas only appear in some years whilst newly emerging areas are identified in more recent years), we are not able to construct a total diversification score based on the sum of all distances across disciplines to consider inter-temporal changes. Nevertheless, firms with very

different diversification profiles could have the same total diversification score; in this sense the second dimension in terms of the direction of diversification is most appropriate in characterizing the nature of such diversification as being related or unrelated. Hence our diversification measure is derived using the average distances between each pair of business activities in a firm's portfolio[29], accounting for both the number of segments in which a firm operates as well as the relatedness within them. More specifically, the higher the diversification index the more *unrelated* such diversification is.

This is our preferred measure of diversity within a firm, which takes a rather different perspective from that in a number of commonly used measures that have been traditionally derived, such as the Herfindahl-type or the entropy measure. For instance, as Figure A1 illustrates, although the diversification index generally increases as the number of segments grows, the highest levels of diversification are observed in those firms engaged in a moderate number of segments that are usually less related; put differently, our index recognises firms involved in a large number of related segments as being less diversified than those firms that concentrate their resources in a few but rather distinct segments.

We contend that our measure based on relatedness is more consistent with the conceptualisation of technological diversification and the resource-based theory that have been increasingly effective in explaining internationalisation in services. In other words, a relatedness-based diversification measure is more appropriate for service firms given their rather distinct motives for diversification, compared with the market-volume-based measure in the case of goods production.

FIGURE A1: DIVERSIFICATION INDEX: DISCIPLINES COUNT VS. RELATEDNESS

[29] This is calculated as the ratio between the total sum of distances and the number of possible combinations.

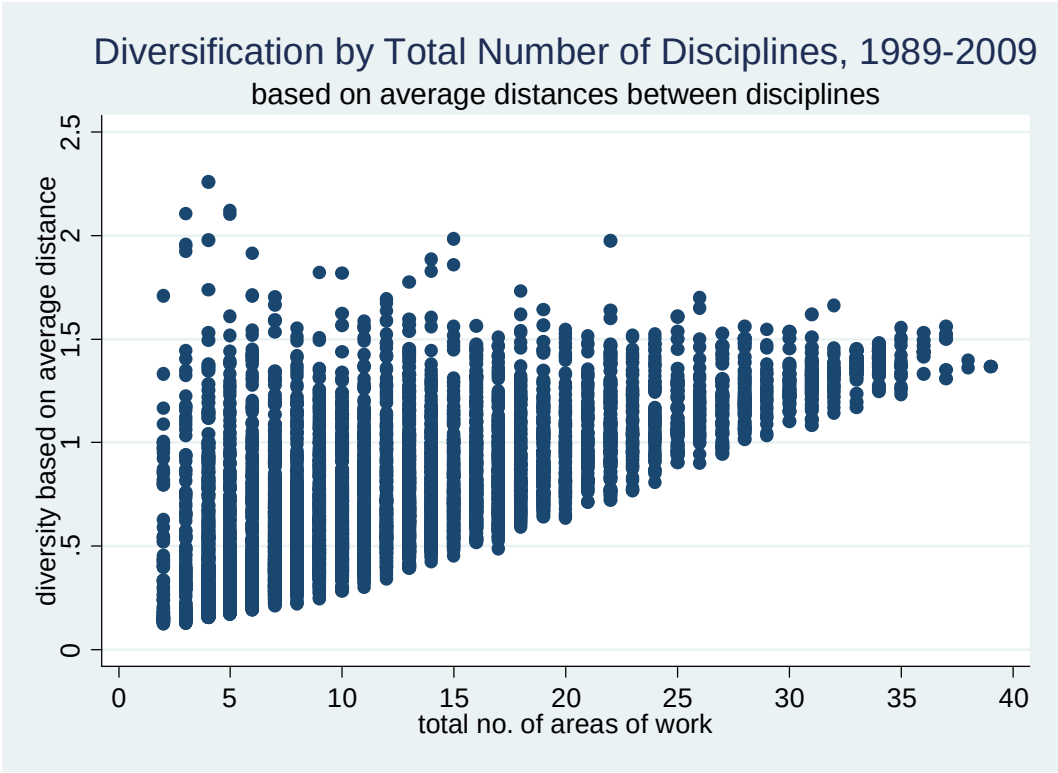
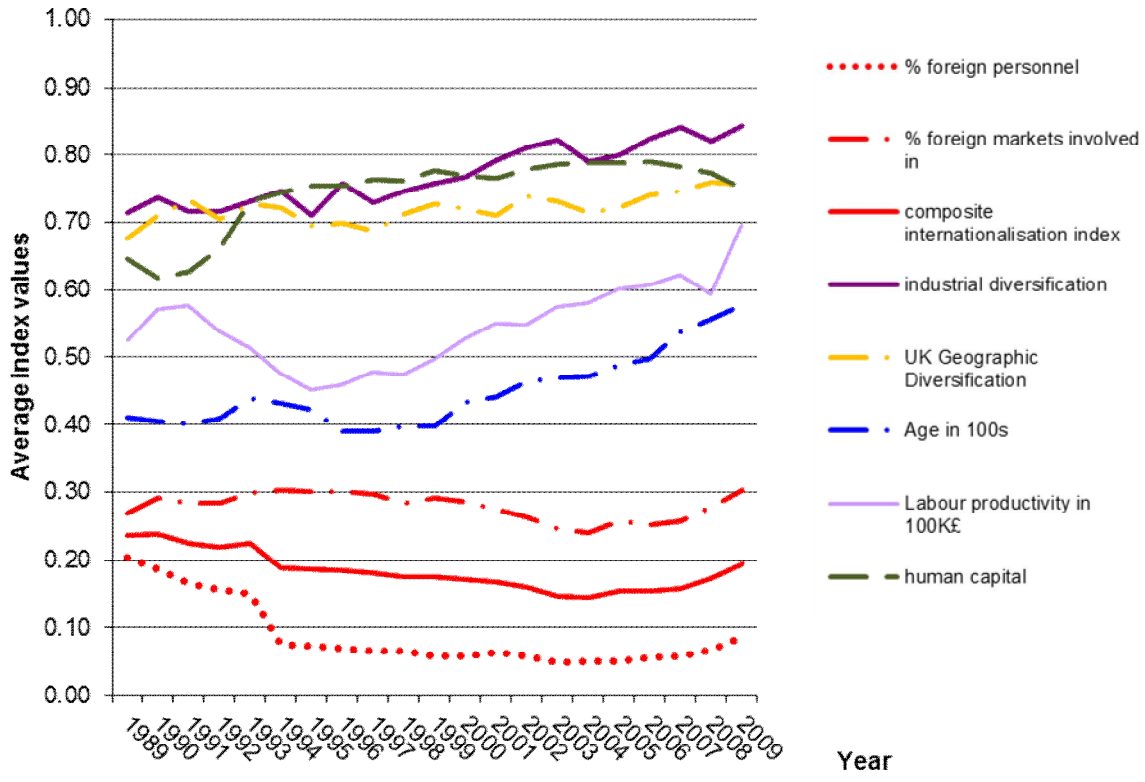


FIGURE A2: RECENT TRENDS IN UK ENGINEERING CONSULTING INDUSTRY, 1989-2009



Source: authors' own calculations using NCE data

Appendix 2

A logistic or probit model is usually employed in the simple modelling of international-market entry decision (i.e. whether a firm internationalise or not); alternatively, some studies have employed the standard OLS approach to consider the determinants of the intensity of internationalisation (often defined as foreign over total sales). In this case of estimating intensity, as the dependent variable is only observed if it is greater than zero, the analysis is often restricted to only those firms that are internationalised. For instance, in our case of engineering consultancies, around one third of all observations were not engaged in international activities; in other words, some 56% of all NCE firms in our data did not participate in global markets in at least one year over the 1989-2009 period.

Using a generalised Tobit approach, the expected value of the dependent variable with respect to each explanatory variable could be decomposed into two elements – the probability that an observation will be positive (i.e. the firm internationalises) as well as the conditional mean of dependent variable (i.e. the intensity). It follows that the Tobit method is generally favoured over the probit or OLS approach, as it allows the dependent variable to have a censored distribution (for instance, Kumar and Siddharthan, 1994). However, the Tobit procedure may be too restrictive in that it requires the propensity equation and the intensity equation to have the same parameterisation (i.e. all determinants having identical effects on both decisions), which may again result in misspecification of the model.

Therefore some scholars have opted for two-stage models such as the sample selection models (Heckman, 1979) to estimate two equations: in the first stage, a binary variable determines whether or not the outcome is observed; secondly, the expected value of the outcome is estimated, conditional on it having been observed. Both models are estimated simultaneously using maximum likelihood estimators (e.g. FIML estimator) to obtain both efficient and consistent coefficients (c.f. Barrios et al., 2003; Harris and Li, 2009).

To date, most of the studies adopting a two-stage approach differentiating the firm's entry decision from the magnitude of internationalisation are based on manufacturing firms. In the context of PSF internationalisation, given our prior discussion on the inseparability and simultaneity of the production and use of services, and the prevailing 'follow-the-client' approach of going global (c.f. Contractor et al., 2003), we believe that the decisions on whether to internationalise and how much resources to commit are not separable, and thus the two-stage process of internationalisation is not applicable to PSFs.

Given that our dependent variable of internationalisation consists of proportional values bounded between zero to unity, following Papke and Wooldridge (1996), it is appropriate to use the quasi-maximum likelihood estimation (QMLE) with a logistic mean function to estimate the fractional response model of internationalisation. This approach, for instance, has been adopted in the modelling of export intensity by Wagner (2001) and Hanley (2004). More specifically, we consider the following model for the conditional expectation of the fractional response variable 'INTLSTN':

$$E[\text{INTLSTN}_{it} \mid x_{it}] = G(\beta_0 + \beta_1 \text{INTLSTN}_{it-1} + \beta_2 ln\text{Inddiv}_{it} + \beta_3 ln(\text{Inddiv}_{it})^2 + \beta_4 ln\text{Regdiv}_{it} + \beta_5 ln\text{Age}_{it} + \beta_6 ln(\text{Age}_{it})^2 + \beta_7 ln\text{Prod}_{it} + \beta_8 ln\text{Size}_{it} + \beta_9 ln\text{Humcap}_{it} + \beta_{10}\text{Foreign}_{it} + \beta_{11}\text{M \& A}_{it} + \beta_{12}\text{MBO}_{it} + \beta_{13}\text{Closure}_{it} + \beta_{14}\text{Region}_i + \beta_{15}\text{Time}_t), \quad i = 1,..., N \qquad (1)$$

where 'INTLSTN' is our dependent variable internationalisation, ranging from 0-1; INTLSTN_{it-1} denotes its previous value at time *t*-1; several other variables are included in natural log forms viz., Inddiv for industrial diversification, Regdiv for geographic diversification, Age for age, Prod for labour productivity, Size for number of UK staff, Humcap for human capital; other control variables are also included, such as M&A, MBO, firm Closure as well as regional and time dummies to control for location and time effects.

And $G(\bullet)$ is the logistic function such that $G(z) = \dfrac{\exp(z)}{1-\exp(z)}$, which means z falls within the (0, 1) interval. Here, based on the formulation put forward by McCullagh and Nelder (1991), to obtain consistent estimates of β, Papke and Wooldridge propose the maximisation of log likelihood using the Bernoulli quasi-likelihood function given by:

$$l_i(b) = y_i \log[G(x_i\beta)] + (1 - y_i)\log[1 - G(x_i\beta)] \qquad (2)$$

To control for potential endogeneity of explanatory variables, we estimate INTLSTN on the previous values of these variables by lagging them by one year. Therefore, Equation (1) transforms into:

$$E[\text{INTLSTN}_{it} \mid x_{it}] = G(\beta_0 + \beta_1 \text{INTLSTN}_{it-1} + \beta_2 ln\text{Inddiv}_{it-1} + \beta_3 ln(\text{Inddiv}_{it-1})^2 + \beta_4 ln\text{Regdiv}_{it-1} + \beta_5 ln\text{Age}_{it-1} + \beta_6 ln(\text{Age}_{it-1})^2 + \beta_7 ln\text{Prod}_{it-1} + \beta_8 ln\text{Size}_{it-1} + \beta_9 ln\text{Humcap}_{it-1} + \beta_{10}\text{Foreign}_{it-1} + \beta_{11}\text{M \& A}_{it-1} + \beta_{12}\text{MBO}_{it-1} + \beta_{13}\text{Closure}_{it} + \beta_{14}\text{Region}_i + \beta_{15}\text{Time}_t), \quad i = 1,..., N \qquad (3)$$

The fractional logit modelling method brings about several major advantages. Above all, compared with traditional OLS method, this estimator can ensure the estimate of $E[y_i \mid x_i]$ and thus its predicted values are bounded between 0 and 1. This methodology also accommodates the non-linear relationship between explanatory variables and the dependent

‘internationalisation’ variable, which is a more reasonable assumption than linearity since the marginal effect of an explanatory variable is expected to diminish. Last but not the least, this procedure can be easily implemented using a statistical package (e.g. Stata) that estimates a generalized linear model with a binomial distributional family and logit link function and that does not treat the fractional dependent variable as a binary response.