The internationalisation and firm performance of engineering services in Japan

Zhang, Yufeng; Usui, Hayato ; Yang, Zhibo

The Internationalisation and Firm Performance of Engineering Services in Japan: A Comparative Study with Manufacturing

Yufeng Zhang[1], Hayato Usui[1] and Zhibo Yang[2]

1- Department of Management, Birmingham Business School, University of Birmingham, Edgbaston B15 2TT, UK

2- Henan Academy of Social Science, Zhengzhou, Henan, P.R. China

Abstract:

Japan has the world's second largest spending on engineering services. But surprisingly little is known about the internationalisation strategies of Japanese engineering service firms (ESFs). These firms heavily rely on theoretical insights developed from a manufacturing focused context to guide their international expansion, which is either inappropriate or risky as we have explored in this paper. Recognising that ESFs have business models that are fundamentally different from those of their manufacturing counterparts, we examine the internationalisation-firm performance (I-FP) relationship based on empirical data drawn from ESFs and manufacturing firms headquartered in Japan. Our analysis illustrates significant differences in the cycles and patterns of an S-shaped I-FP relationship between Japanese ESFs and manufacturing firms, specifically in light of ESFs' non-sequential international evolvement path and their project-following behaviours. This grounding work supports our further investigations to theorise decision boundaries for the international growth of ESFs and a broader range of service operations.

Keywords:

Engineering service firms (ESFs); Japan; Internationalisation; Firm performance

1. Introduction

Engineering service operations where engineering technologies, skills and expertise are applied in the creation of high value-adding products and solutions have expanded substantially in the contemporary global economy (Stark et al., 2010; US Census Bureau, 2014; METI, 2017). Offshored spending on engineering services is expected to increase from $100 billion in 2012 to $560 billion by 2020 (Booz & Company, 2010; Krull et al., 2012). The global market of engineering services outsourcing will probably reach $1.49 trillion by 2025 (RM, 2017). Japan currently positions itself as the world's second largest spender on engineering services (including design, research and development services predominantly contributed by multinational companies from various sectors), representing 14% of the global market (Booz & Company, 2010; ISG, 2013).

Global operations are apparently critical to the success of Japanese engineering service firms (ESFs), and the key is to understand how to make strategic decisions to effectively support their international growth (METI, 2017; Zhang et al., 2017). Japanese ESFs heavily rely on theoretical insights developed from a manufacturing focused context to guide their international expansion due to the fact that prior empirical studies on internationalisation are mostly drawn from manufacturing firms (Contractor et al., 2003; Greenwood et al., 2005; Ruigrok et al., 2007; Wu et al., 2012; Asakawa et al., 2013). However, ESFs have business models that are fundamentally different from those of manufacturing firms (Malhotra and Morris, 2009; Krull et al., 2012; Zhang et al., 2016). It is theoretically valuable and practically useful for us to examine the internationalisation and firm performance (I-FP) relationship of Japanese ESFs in a view to recognising key differences between ESFs and manufacturing firms. In doing so, we will be able to generate an in-depth view of global service operations, and identify research opportunities for further theoretical development (Contractor et al., 2007; Goerzen and Makino, 2007; Nordenflycht, 2010). At the same time, we can provide a solid empirical ground for managers to address the distinctive features of engineering service operations for developing effective international strategies (Ström, 2005; Abdelzaher, 2012; Zhang et al., 2016).

Another important reason for our choice of research focus is that Japanese firms have a traditional preference for a home-based model of internationalisation (Bartlett and Ghoshal, 1989). This has led to a high degree of operations embeddedness, i.e. an obvious tendency of high value-adding engineering activities remaining in Japan (Asakawa et al., 2013). Nevertheless, it has been observed that strategic decisions in Japanese multinational companies have evolved gradually from the traditional home-based model to a home-augmenting model (Song et al., 2011). Dispersed engineering capabilities are acquired, accumulated, integrated and exploited in their global network operations (Zhang and Gregory, 2011). This trend represents critical challenges for Japanese ESFs (Booz & Company, 2010; Asakawa et al., 2013) because their operations are still embedded in the domestic base where the longstanding low economic growth and shrinking engineering workforce constrain their competitiveness in the global economy (METI, 2017). Japanese ESFs are urgently required to go through an archetypal transition towards global network operations (Abdelzaher, 2012; Zhang et al., 2016).

Having been convinced by the value, importance and timeliness of the research topic, we set out to investigate the theoretical relation between ESFs' degree of internationalisation and their ability to achieve expected financial gains from international expansion. In the following section we will form a conceptual ground with a set of propositions that may help us recognise the differences between ESFs and manufacturing firms along their process of internationalisation. We will then introduce the research approach and report key findings from our analysis to validate these conceptual propositions with indisputable evidence. After that we will more explicitly illustrate the key differences between ESFs and manufacturing firms with a diagram and suggest avenues for further research.

2. Conceptualising the Differences between ESFs and Manufacturing Firms' Internationalisation

The internationalisation-firm performance (I-FP) relationship of ESFs has drawn growing attention among academics and practitioners worldwide driven by the international growth of complex engineering activities (Booz & Company, 2010; Stark et al., 2010; Zhang et al., 2016). However, Japanese ESFs have not received sufficient research attention yet in contrast to their obvious significance (Krull et al., 2012; Moreira et al., 2013; Zhang et al., 2017). In this section we will develop a set of conceptual propositions to possibly articulate the differences between ESFs and manufacturing firms' internationalisation.

2.1. The three stages of internationalisation to begin with

The I-FP relationship rests on an analysis of interactions between incremental costs and benefits arisen as the degree of geographical diversification increases (Contractor et al., 2003; Ruigrok et al., 2007; Abdelzaher, 2012). Existing studies suggested several primary models to explain the I-FP relationship, including the horizontal-S curve model (Lu and Beamish, 2004; Vilas-Boas and Isabel, 2007), U-shaped curve model (Capar and Kotabe, 2003), Sinus-shaped curve model (Ruigrok et al., 2007), and M-shaped curve model (Almódovar, 2012; Lee, 2013). Particularly, Contractor et al. (2003) have introduced the three-stage model that plots an S-shaped curve relationship between the firm performance on the vertical axis and the degree of internationalisation (DOI) on the horizontal axis. In the first stage where DOI is still low, costs stemming from initial learning, insufficient economies of scale, and liabilities of foreignness overweigh the economic benefits gained from international expansion (Contractor et al., 2003; Zaheer, 1995). These costs are gradually recouped through adjusting organisational structures and operations processes for international operations (Ruigrok et al., 2007), thus leading to a gradual reap in performance as DOI reaches moderate levels in the second stage. At the end of this stage, the performance increases up to an upper-bound inflection point, so-called internationalisation threshold (Geringer et al., 1989), at which performance reaches the apex and starts decreasing (Contractor et al., 2003). After that, increasing governance, coordination and transaction costs inhibit the firm's ability to appropriate benefits from international expansion, depicting a downward slope during the third stage where DOI exceeds the optimum point. Hence, firms in the third stage are considered as over-internationalised (Hitt et al., 2006). Notably, it has been suggested that knowledge-intensive service firms are able to digest the negative threshold effects at low DOI far better and faster than manufacturing firms (Contractor et al., 2003; Lu and Beamish, 2004). But, these firms often go beyond the optimum point and stray into the third stage in which operations become over-internationalised (Ruigrok et al., 2007; Almódovar, 2012; Wu et al., 2012).

2.2. The initial stage is shorter for ESFs

Conceptual work generally describes international expansion as a sequence of strategic decisions (Johanson and Vahlne, 1977; Roberts, 1999). The Uppsala model, which was developed from observations on Scandinavian manufacturing firms by Johanson and Vahlne (1977), still remains as a dominant perspective in the internationalisation domain in spite of challenges made by the born-global theory (Robelts et al., 1999; Autio et al., 2000; Lee, 2013). However, ESFs may follow a non-sequential international evolvement path because of their project-following behaviours (Nordenflycht, 2010; Abdelzaher, 2012), i.e. ESFs often operate on a project-to-project basis so as to quickly respond to ad-hoc demand that arises in foreign markets (Malhotra and Hinings, 2010; Krull et al., 2012). Such behaviours draw a clear distinction between ESFs and manufacturing firms (see Figure 1) whose international operations are mainly composed of permanent facilities serving foreign markets for a long-term horizon (Malhotra and Hinings, 2010; Nordenflycht, 2010).

(Insert Figure 1 here)

To be specific- ESFs generally deploy temporary project offices and teams that are able to quickly reconfigure their operations processes and organisational structures in accordance with the scale and location of a particular project (Malhotra and Morris, 2009). This allows ESFs to capture market opportunities with minimal financial burden. For example, Krull et al. (2012) observed that an ESF in New Zealand had entered into new markets with project-based teams, and evolved to representative offices or subsidiaries only when subsequent activities were expected to continue after the projects complete. Conversely, the firm would withdraw from a market when insufficient (or fluctuated) demand for their services was predicted to avoid excessive expenses.

This non-sequential international evolvement path enables ESFs to observe demand changes at a proximate location. Therefore, they, unlike manufacturing firms, will be able to quickly improve international operations from their initial stage of internationalisation. In conjunction with their high flexibility of adjusting operations processes and organisational structures achieved through project-based operations (Malhotra and Hinings, 2010), ESFs can tailor their resource commitment to precisely observed demand changes in foreign markets. They have a better chance to avoid the financial burden associated with international operations. We therefore assume that ESFs are able to shorten the initial stage of international expansion.

<u>Proposition 1a:</u> The I-FP relationship of ESFs depicts a shorter curve than that of manufacturing firms in the initial stage of internalisation.

2.3. The falling curve is steeper for ESFs

The psychic distance between foreign markets and the domestic market has been highlighted as a key determinant for manufacturing firms' international expansion. The Uppsala model (Johanson and Vahlne, 1997) describes internationalisation as a gradual and linear process starting from cognitively proximate markets to distant markets through incremental learning (Ietto-Gillies, 2012). However, more recent studies (Roberts, 1999; Ball et al., 2008; Krull et al., 2012) argue that the less resource commitment of service operations provides broader options in selecting a foreign market regardless of its psychic distance. Compounded by ESFs' project-following behaviours, we can assume that ESFs have a tendency of expanding to cognitively or geographically distant markets in which certain need for their services exists.

However, ESFs rely heavily on tacit knowledge embodied in their professions (Vinding and Drejer, 2006; Moreira et al., 2013). The process of transforming engineering expertise into marketable outputs will require ESFs to simultaneously interact with clients and partners in various phases of a project (Malhotra and Morris, 2009). Although this can be attained with little financial burden when their operations are simple (Abdelzaher 2012), ESFs will become vulnerable to high coordination, transportation and transaction costs as their operations spread into various markets (Fenton and Pettigrew, 2000). Hence, alike the augments presented by Abdelzaher (2012) and Doh et al. (2009) that entering markets of high psychic distance may turn ESFs' ability to capture benefits from international expansion into short-term gains or even losses, ESFs at a high level of international expansion may experience a steeper decline in their performance. The following proposition can articulate the preceding augment:

<u>Proposition 1b:</u> The I-FP relationship of ESFs depicts a steeper falling curve than that of manufacturing firms at a high degree of internationalisation.

2.4. The influence of firm age

We will continue to progress the conceptual development by analysing the effect of three influencing factors, i.e. firm age, resource availability and firm size, on the I-FP relationship. Building upon the above argument that Japanese ESFs' high operations embeddedness is a key impediment to their international expansion, together with their non-sequential international evolvement path (see Figure 1), they become vulnerable to initial disadvantages arisen from the liabilities of newness (Asakawa et al., 2011). These liabilities assume that firms with insufficient time-based experience are likely to be at a disadvantage arising from the lack of recognition and legitimacy in internalising intangible processes and relationships with various agents in a foreign market (Zahra, 2008). This is echoed with arguments presented by Johanson and Vahlne (1997) that adequate capabilities and knowledge base to deal with unfamiliar business environments in a foreign market are gradually developed in proportion to the accumulation of time-based experience in international operations. In response, Sapienza et al. (2006) and Carr et al. (2010) indicate that firms with a longer history of operations (even they are lack of direct international experience) are more capable than firms with a shorter history to deal with the liabilities of newness by leveraging previously established brand recognition, distribution channels, supply chain relations and reputation. Likewise, Krull et al. (2012), as an extension of Roberts' (1999) argument to engineering services, suggest that experiences from the domestic market offer a useful guide for ESFs to mitigate negative shocks when they expand to a foreign market. Being different from ESFs, the majority of Japanese manufacturing firms spend a substantial period of time on exporting activities before they evolve to subsequent phases of internationalisation (see Figure 1). They have already accumulated sufficient resources and experience to deal with the liabilities of newness when they establish a physical presence in a foreign market (Kojima, 1978; Ahn, 2005; Coplan et al., 2012).

However, a long history of operations unavoidably involves potential risks of being exposed to the liabilities of aging (Barron et al., 1994). Older firms in general show a high tendency of falling into strategic inertia that may hamper their responsiveness to changes in foreign markets, since they are prone to persist in previously valuable practices (Sapienza et al., 2006; Carr et al., 2010). Considering Japanese manufacturers' achievement in the 1980's and 1990's represented by their prominent lean production practices, they are likely to be at risk of clinging to their past practices (Stark et al., 2010). Furthermore, the internationalisation of manufacturing firms generally premises that their production sites serve a particular market for a long-term horizon (Xue et al., 2013; Nordenflycht, 2010), which is opposed to ESFs whose internationalisation is less-constrained by such investments. Accordingly, we can see a clear implication that Japanese manufacturing firms are vulnerable to the liabilities of aging that may reduce their ability to reconfigure their international operations. The following proposition has been formulated to progress this line of argumentation.

<u>Proposition 2:</u> Firm age has a positive effect on the I-FP relationship of Japanese ESFs but a negative effect on that of Japanese manufacturing firms.

2.5. The influence of resource availability

Engineering service operations are highly knowledge-based (Molhorta and Morris, 2009; Krull et al., 2012). ESFs, as technology developers identified by Nordenflycht (2010), inevitably require substantial resources to support knowledge creation and facilitate knowledge reuse in foreign markets (Erramilli, 1990; Lee, 2011). The internationalisation of manufacturing firms also requires a large resource endowment not only for achieving sufficient economies of scale but also for supporting their foreign affiliates (Johanson and Vahlne, 1977; Xue et al., 2013). Thus, the ability of both ESFs and manufacturing firms to really benefit from internationalisation is subjective to their resource availability for international expansion. Especially, Japanese ESFs may call for a continuing resource commitment before they achieve the expected economic return on their up-front investments due to their high operations embeddedness. Japanese manufacturing firms may also require a high level of resource availability to continuously support their prolonged internationalisation process. In summary, having a necessary pool of available resources to support international operations is assumed to be vital for both Japanese ESFs and manufacturing firms.

<u>Proposition 3:</u> Resource availability positively affects the I-FP relationship of both Japanese ESFs and manufacturing firms.

2.6. The influence of firm size

Firm size can be considered as an indication of resource availability. Relevant studies such as Carr et al. (2010), Almódovar (2012) and Lee (2013) suggest a positive correlation between firm size and the international performance of manufacturing firms. For example, larger firms often have greater reliability to facilitate relationship-building with external partners, particularly with those (e.g. banks or investors) who provide financial resources (Contractor et al., 2007). Firm size is also positively associated with the ability to secure intangible assets such as human capital and customer relationship. Bloodgood et al. (1996) and Lawler (2008) suggest that larger firms in general have better accessibility to competent talents (specifically middle-class managers with rich international experiences) in either domestic or foreign talent pools. Malhotra and Morris (2009) and Moreira et al. (2013) reveal that ESFs tend to assign experienced engineers as project managers and rely on them for developing a comprehensive network of relations with clients, suppliers and locally recruited employees in foreign markets. Accordingly, we assume that sufficient firm size enables Japanese firms to access appropriate talents and necessary financial resources to enhance their international performance.

<u>Proposition 4:</u> Firm size positively affects the I-FP relationship of both ESFs and manufacturing firms.

3. Research Approach

The I-FP relationship has been studied by comparing internationalised and domestic firms or amongst internationalised firms based on the extent of internationalisation and financial performance (Contractor et al., 2003; 2007). The latter is better aligned to the primary aims of this paper- i) to examine heterogeneous shapes of the I-FP relationship between Japanese ESFs and manufacturing firms; and ii) to analyse factors influencing the I-FP relationship of Japanese ESFs. Such a research approach can improve the validity of estimates by exploring differences or commonalities existing amongst cross-sectional units as well as longitudinal variants of individual units over time (Contractor et al., 2003; Ruigrok et al., 2007).

3.1. The dataset

The assumed conceptual propositions are examined through a dataset obtained from Osiris, which is an integrated database including financial and operational (through additional data collection from company websites) data for publicly quoted firms from over 120 countries (Bureau Van Dijik, 2014). The dataset also corporates annual reports over an 11-year period from 2003 to 2013. Such panel data-based analysis ensures comparability with other longitudinal and cross-sectional studies conducted on the I-FP relationship in various research settings, e.g., Contractor et al. (2003; 2007), Lu and Beamish (2001; 2004), Ruigrok et al. (2007), Vilas-Boas and Isabel (2007), Almódovar (2012) and Lee (2013). This study is executed on a final sample encompassing 54 ESFs and 308 manufacturing firms headquartered in Japan (we extended the sample size of manufacturing firms to possibly examine the variance across manufacturing sectors) selected by using classifications from Osiris and the Engineering Advancement Association of Japan (ENNA, 2014). Although SIC codes '191' and '415' listed firms are primarily drawn from Osiris for Japanese ESFs (including general contractors and specialist contractors) and manufacturing firms respectively, those that exhibit no foreign sales over the 11-year period are excluded from the final sample. The sample firms include: 54 ESFs, 73 transportation equipment manufacturers, 68 electronic appliances manufacturers, 130 machinery and equipment manufacturers, and 37 manufacturers producing chemical, metal, rubbers and other products. This distribution actually reflects the smaller number of Japanese ESFs in comparison with manufacturing firms in Japan.

3.2. Variables and measures

3.2.1. Dependent variable

Dependent variables used in the I-FP relationship consist of three types of accounting-based performance measures: return on assets (ROA), return on sales (ROS) and return on equity (ROE). Although previous studies have used some or all of these measures collectively in regression analysis, Contractor et al. (2003; 2007) and Lee (2013) have reached the same conclusion that there is a high level of consistency across these measures and casted a doubt over the necessity of measuring firm performance by using alternative dependent variables. Therefore, we use ROS as a measure for firm performance considering its popularity in widely cited I-FP studies (Lu and Beamish, 2001; Capar and Kotabe, 2003; Contractor et al., 2007).

$$ROS\ (Return\ on\ Sales) = \frac{Net\ Income\ (Before\ Interest\ and\ Tax)}{Total\ Sales}$$

3.2.2 Independent variable

Lu and Beamish' (2004) study on the I-FP relationship of Japanese firms focuses on a firm's FDI (foreign direct investment) activities to indicate its degree of internationalisation (DOI). However, in the contemporary international operations of Japanese firms, they simultaneously conduct exporting and FDI activities or combine them over various segments of their value chains (Ahn et al., 2005). The traditional distinction between FDI and exporting as alternative internationalisation options seems not valid any more (Contractor et al., 2007). As argued earlier in our conceptual development, the international evolvement of ESFs follows a different path from that of manufacturing firms. Measuring a firm's DOI purely based on its FDI activities does not necessarily capture the actual scope and process of the firm's international operations. Unlike FDI measures, the ratio of foreign sales to total sales (FSTS) can satisfactorily indicate DOI regardless of whether foreign sales are generated from pure exporting activities, exports supplemented by foreign affiliates' inputs, or pure FDI affiliate activities (Contractor et al., 2003). For this reason we consider FSTS as an appropriate proxy for DOI- a variable that has been widely used to measure firms' DOI in similar studies (Ruigrok and Wanger, 2003; Contractor et al., 2007; Ruigrok et al., 2007).

$$DOI\ (FSTS)\ =\frac{Foreign\ Sales}{Total\ Sales}$$

3.2.3. Control variables

Control variables introduced in this paper are firm age, resource availability and firm size. Based on our conceptual development, these three variables are postulated to affect a firm's ability to capture financial gains from its international expansion. Firm age is measured by the number of years that a firm has been in operations since its foundation (Autio et al., 2000; Contractor et al., 2007; Carr et al., 2010; Almódovar, 2012; Xue et al., 2013). Current ratio, calculated as current assets divided by current liabilities of a firm, is used to indicate the amount of resources available to support its international expansion (Daniel et al., 2004; Lee, 2011). The value of total sales, measured by the natural logarithm of annual sales, is used as a proxy for firm size (Contractor et al., 2007; Vilas-Boas and Isabel, 2007).

3.3. The model and analysis

Since panel data pooling longitudinal and cross-sectional data is used in this study, the Hausman test is performed to contrast fits of the fixed-effect model and the random-effect model to the data by using the latest version of Stata (Hausman, 1978; Hitt et al., 2006). The fixed-effect model is confirmed as the preferred model for both ESFs and manufacturing firms (see Table 1).

(Insert Table 1 here)

As suggested by previous studies on the three-stage process of internationalisation (Contractor et al., 2003; Lu and Beamish, 2004; Ruigrok et al., 2007), we use three different econometric models (namely linear, quadratic and cubic models) to respectively test and identify the best model to describe the relationship between DOI and ROS. These models are expected to observe the I-FP relationship of Japanese ESFs with two infection points: a lower-bound point in the first stage and an upper-bound point between the second and final stages. The equations for these models are as follows:

Liner Model (using only single term of DOI):

$$ROS_i = \beta_0 + \beta_1 \cdot DOI_i + \sum \beta_c \cdot Control\ Variables_{ci} + \varepsilon_i$$

Quadratic model (using single and squared terms of DOI):

$$ROS_i = \beta_0 + \beta_1 \cdot DOI_i + \beta_2 \cdot DOI_i^2 + \sum \beta_c \cdot Control\,Variables_{ci} + \varepsilon_i$$

Cubic Model (using single, squared and cubic terms of DOI):

$$ROS_i = \beta_0 + \beta_1 \cdot DOI_i + \beta_2 \cdot DOI_i^2 + \beta_3 \cdot DOI_i^3 + \sum \beta_c \cdot Control\,Variables_{ci} + \varepsilon_i$$

4. Results

The descriptive statistics and correlation matrixes of the variables are presented in Tables 2 and 3 for ESFs and manufacturing firms respectively to initially check whether the results involve problems of multicollinearity (Contractor et al., 2003; Wu et al., 2012).

(Insert Table 2 and Table 3 here)

Except for the squared and cubic terms of DOI that are transformed from DOI, the results exhibit minimal possibility of including unstable and low efficient coefficients in the regression analysis, as it shows acceptably low values of inter-correlations amongst the variables (the largest values other than DOI^2 and DOI^3 are -0.41 and 0.28 respectively). The correlations between DOI and ROS (for both ESFs and manufacturing firms) show very low values (0.04 for ESFs and 0.07 for manufacturing firms). However, the significance level of these correlations differentiates the results. Table 2 shows a lower level of significance for ESFs ($p > 0.1$); and Table 3 shows a higher level of significance for manufacturing firms (***$p<0.01$). These results suggest that the I-FP relationship of ESFs, if it does exist, is more complicated than a linear relationship and that of manufacturing firms.

(Insert Table 4 here)

The results of estimated fixed effects drawn from the three models are presented in Table 4. As shown in the last two columns of Table 4, F and adjusted R values of the cubic model exhibit improved model fits between ROS and DOI as well as ROS and the other variables when the squared and cubic terms (DOI^2 and DOI^3) are added to the analysis. This suggests that the cubic model represents not only the best fit between firm performance (ROS) and internationalisation (DOI) but also improves the overall level of significance. Hence, the cubic model represents the highest explanatory power amongst the models.

Results from the cubic model exhibit negative and significant effects on DOI and DOI^3 for ESFs (-0.585* and -0.981** respectively). This confirms that firm performance (ROS) declines at the initial and final stages of internationalisation when the degree of internationalisation is still low or overly high. Conversely, the effect of coefficient on DOI^2 is positive and significant (1.583**), which indicates that firm performance (ROS) increases at the moderate degree of internationalisation. These results confirm that the three-degree polynomial best describes the I-FP relationship of Japanese ESFs. In addition, these results simultaneously confirm that the cubic model represents the best fit for the I-FP relationship of Japanese manufacturing firms, as it similarly shows negative and significant effects on DOI and DOI^3 (-0.230* and -0.484** respectively) and a positive effect on DOI^2 at a high level of significance (0.733**).

5. Visualising Key Differences between ESFs and Manufacturing Firms' Internationalisation

Figure 2 illustrates these two sets of results. In the first stage of internationalisation, ESFs' performance shows a steeply falling curve until it reaches the lower-bound inflection point (DOI = 1.05) at which their performance (ROS) exhibits the lowest score (-0.84). After that, the slope turns positive as ESFs increase the degree of internationalisation. Similarly, the I-FP relationship of manufacturing firms plotted by the dotted curve also shows a negative slope in the first stage. Yet, it depicts a much shallower descending shape than that of ESFs as the lowest ROS is -0.42. Moreover, the first stage for manufacturing firms exhibits a wider interval than that for ESFs as the curve continues to depict a descending shape until DOI reaches 1.20. These results suggest that ESFs are able to deal with their disadvantages and move on to enjoy internationalisation benefits sooner than their manufacturing counterparts. Proposition 1a is therefore supported.

(Insert Figure 2 here)

Firm performance rises up to the apex in the second stage. The curve of ESFs draws a rapid ascendance after the performance nadir at DOI = 0.105, which finally reaches the internationalisation threshold at DOI = 0.405 as firm performance comes to the apex (ROS = 0.90). However, firm performance deteriorates significantly after that point onward, drawing an inverted U-shaped curve with steep slopes between the second and third stages. This implies that ESFs are able to reap performance faster than their manufacturing counterparts during the second stage. However, their non-sequential international evolvement path and project-following behaviours incur significant costs in the third stage. This shortens the interval in which internationalisation benefits outweigh incremental costs from the expansion, and depicts a steeper falling curve in the third stage. Proposition 1b is therefore supported.

The larger performance deterioration plotted in the third stage of ESFs' I-FP relationship highlights their vulnerability to disadvantages emerged after the internationalisation threshold. Although the performance of manufacturing firms is slowly recovered after the first stage and reaches to a lower performance apex (ROS = 0.81), the I-FP relationship shows a gently-descending curve after that performance apex onward. This implies that the internationalisation of manufacturing firms, symbolised by their gradual and sequential international evolvement path, reduces potential risks of vulnerable performance from coordinating complex geographically and cognitively dispersed operations. Hence, the dotted curve represents a higher possibility to enjoy positive performance (ROS > 0) until DOI reaches 0.665.

These results can be explained through the three influencing factors. Firm age exhibits contradicting effects on ESFs and manufacturing firms. Specifically, the coefficient of firm age exhibits a positive effect (0.733) for ESFs but a negative effect (-0.785 in the cubic model) for manufacturing firms. These results support Proposition 2. The last two columns of Table 4 show significant and positive effects of resource availability on the performance of both ESFs (0.381**) and manufacturing firms (0.199***). Proposition 3 is therefore supported. Firm size does not have a significant effect on ESFs' performance as its p-value exhibits above 0.1, whilst the coefficient of firm size represents its positive effect (0.220) on manufacturing firms' performance at an acceptable level of significance (*p < 0.1). These results suggest that firm size more significantly affects manufacturing firms' performance. Proposition 4 can only be partially supported.

6. Further Discussions

6.1. Key research issues

Our findings indicate that the distinctive features of ESFs alter the shape of the I-FP relationship differently from that of manufacturing firms. Specifically, ESFs' non-sequential international evolvement path and their project-following behaviours significantly boost their performance between the first and second stages of internationalisation. Yet, they simultaneously enlarge the performance variance across the stages and shorten the interval in which incremental internationalisation benefits exceed incremental costs. Despite their high potential to quickly digest the negative shocks and to reach high performance at moderate DOI, there are risks associated with their business models (Hansen et al., 2011). These distinctive features may turn their internationalisation strategies into highly speculative and unsustainable as the solid curve exhibits fluctuated performance over different DOIs. Such observations provide an empirical ground to recognise the differences between the I-FP relationship of ESFs and manufacturing firms in the specific context of Japan. With this grounding work supported by indisputable evidence, we can start developing theoretical explanations and testing them in the future. For example, we can provide real options reasoning for various patterns of internationalisation strategic choices (McGrath, 1999), or examine the influence of network structures on the performance of global service operations (Zhang et al., 2016).

Specific research issues can also be identified. For example, by revisiting Japanese ESFs' mean DOI (0.15) that is much lower than manufacturing firms' mean DOI (0.28), we can recognise that ESFs are still regarded as relatively inexperienced in international operations and adhered to their business practices in the domestic operations context. It is therefore important for them to deal with associated disadvantages (especially liabilities of newness) as the solid curve in Figure 2 plots a steeply descending curve in the early stage of internationalisation. Similarly, the positive effect of firm age implies that ESFs' longevity is positively related to their ability to mitigate operations embeddedness. Indeed, experience and knowledge accumulated during the process of internationalisation can accelerate the performance reaped during the second stage and slacken the rapidly falling performance after the internationalisation threshold. In contrast, the liabilities of aging are considered as a key explanatory factor for manufacturing firms' slower and smaller performance increase during the second stage of internationalisation. We can therefore propose that ESFs with a longer history of international operations are able to benefit more from their international expansion. In other words, operations embeddedness would be effectively mitigated by ample time-based experience. In addition, even though Japanese ESFs are able to reach the first inflection point (DOI = 0.105) earlier than manufacturing firms and their performance is recovered faster during the following interval, having sufficient resources to endure the deep performance drops in this interval is vital to support and accelerate their internationalisation leading up to the stage in which incremental costs can be offset by incremental benefits. On the contrary, the dotted curve exhibits shallower drops in manufacturing firms' performance during the early stages. This indicates that they are able to deal with high entrance costs and expand to foreign markets more smoothly than ESFs. However, the curve illustrates a prolonged interval in which their performance is negative, which indicates a long time gap between exporting and FDI phases in their internationalisation as well as their vulnerability to the liabilities of aging. These research issues suggest promising avenues for our theoretical development in the future (Nordenflycht, 2010; Zhang et al., 2017).

6.2. Managerial implications

By recognising the positive effects of firm age and resource availability on internationalisation, our findings will offer useful guidance for Japanese ESFs to make effective strategic decisions. Since there are in general considerable costs and disadvantages resulted from high operations embeddedness when ESFs expand to foreign markets, their internationalisation strategy should be carefully designed to minimise or endure a deep performance drop in the early stage of internationalisation. To do so, their managers need a proper grasp of the positive driving forces for firm performance embodied by time-based experience and available resources. These factors would lead to organisational flexibility and financial strength to deal with unfamiliar foreign business environments and initial internationalisation disadvantages. That is to say- sufficiently accumulated experience and available resources can be used to enhance strategic operations capabilities to cope with increasing coordination, governance and transaction costs occurred in the later internationalisation stages. In addition, on the ground that firm size does not exhibit a significant effect on the I-FP relationship in our analysis, we are reluctant to recommend Japanese ESFs to over aggressively increase their scale of international operations as major global ESFs tend to do that recently through ambitious mergers and acquisitions.

7. Conclusion

We empirically illustrate the notion that the relationship between internationalisation and firm performance is heterogeneous and dynamic in nature. In particular, our analysis demonstrates that the ESFs' non-sequential international evolvement path and their project-following behaviours play a central role in destabilising and shortening the cycle of their international expansion. We also recognise a critical impediment to the international growth of Japanese ESFs, namely operations embeddedness, and recommend firm age and resource availability as key factors alleviating this impediment.

Whilst this paper explores the I-FP relationship in an important industrial setting, the findings should be interpreted in light of a few limitations. Above all, we can only investigate 54 ESFs due to the small number of Japanese ESFs operating in foreign markets, whereas 308 firms are drawn from manufacturing sectors. This limits the stability and generalisability of our findings, and most importantly the comparability of our results drawn from the dataset. Notably, we attempted to identify the variance across manufacturing sectors in the dataset but our analysis hardly suggested any significant result. Future research should include additional firms or sub-sectors conducting engineering service related activities so that the sample size of both ESFs and manufacturing firms can be adequately balanced. In addition, new variables especially those that can precisely measure a firm's international experience such as years of international involvement (Xue et al., 2013) and FETE (Contractor, 2012) can be included to provide a robust mitigating effect on the I-FP relationship. Furthermore, Proposition 4, which is not fully supported in this paper, can be further studied by using these international experience variables or redefined firm size parameters that may specifically indicate a firm's international operations. This will hopefully lead to valuable insights for Japanese ESFs to cope with negative shocks stemming from their operations embeddedness. Last but not least, future research should be targeted at theoretical explanations extending to other contextual factors, such as country distance, institutional structures, economic cycles and operational characters, for the continuing growth this important knowledge area.

Reference:

Abdelzaher, D.M. (2012). The impact of professional service firms' expansion challenges on internationalisation process and performance. *The Service Industries Journal*, 32(10): 1721-1738.

Ahn, S., Fukao, K. and Kwon, H.U. (2005). The Internationalisation and Performance of Korean and Japanese Firms: An Empirical Analysis Based on Micro-data. *RIETI Discussion paper*, 05-E-008: 1-46.

Almódovar, P. (2012). The international performance of standardizing and customizing Spanish firms: The M curve relationship. *Multinational Business Review*, 20(4): 306-330.

Asakawa, K. and Ito, K. (2013). Internationalisation in Japan's service industries. *Asia Pacific Journal Management,* 30(4): 1115-1168.

Autio, E., Sapienza, H.J. and Almeida, J.G. (2000). Effects of Age at Entry, Knowledge Intensity, and Imitability on international growth. *Academy of Management Journal*, 43(5): 909-924.

Ball, D., Lindsay, V. and Rose, E. (2008). Rethinking the paradigm of service internationalisation: Less resource-intensive market entry modes for information-intensive soft services. *Management International Review*, 48(4): 413-431.

Barron, D.N, West, E. and Hannan, M.T. (1994). A time to grow and a time to die: growth and mortality of credit unions in New York City, 1914–1990. *American Journal of Sociology,* 100(2): 381–42.

Bartlett, C.A. and Ghoshal, S. (1989). *Managing across borders: the transnational solution*. London: Hutchinson Business Books.

Bloodgood, J.M., Sapienza, H.J. and Almeida, J.G. (1996).The internationalisation of new high-potential U.S. ventures: Antecedents and outcomes. *Entrepreneurship Theory and Practice*, 20(4): 61–76.

Booz & Company (2010). *Globalization of Japanese Engineering Research and Development: Option or Imperative?*[Online] Available at http://www.strategyand.pwc.com/global/home/what-we-think/reports-white-papers/article-display/globalization-japanese-engineering-research-development[Accessed at 15th June 2014]

Bureau Van Dijik (2014). *Osiris: Information on listed companies across the globe.* [Online] Available at http://www.bvdinfo.com/en-gb/our-products/company-information/international/osiris [Accessed 20th July]

Carr, J.C., Haggard, K.S., Hmieleski, K.M. and Zahra, S.A. (2010). A study of the moderating effects of firm age at internationalisation on firm survival and short-term growth. *Strategic Entrepreneurship journal*, 4(2): 183-192.

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.

Contractor, F.J. (2012). Why Do Multinational Firms Exist? A Theory Note about the Effect of Multinational Expansion on Performance and Recent Methodological Critiques. *Global Strategy Journal,* 2 (4): 318-331.

Contractor, F.J., Kundu, S.K., and Hsu, C.A. (2003). Three-stage Theory of International Expansion: The Link between Multinationality and Performance in the Service Sector. *Journal of International Business Studies,* 34(1): 5-18.

Contractor, F.J., Kumar, V. and Kundu, S.K. (2007). Nature of the relationship between international expansion and performance: The case of emerging market firms. *Journal of World Business*, 42(4): 401-417.

Coplan, A.M., Delios, A. and Hikino, T. (2012). How does export commitment and product diversity affect the international scope-firm performance relationship? Evidence from Japan. *Asian Business and Management,* 12(1):142-172.

Daniel, F., Lohrke, F.T., Fornaciari, C.J. and Turner, J.R.A. (2004). Slack resources and firm performance: A meta-analysis. *Journal of Business Research*, 57(6): 565-574.

Doh, J., Bunyaratavej, K. and Hahn, E. (2009). Location determinants of services offshoring. *Journal of International Business Studies*, 40(6): 926 –943.

ENNA (2014). *Engineering Advancement Association of Japan*. [Online] Available at http://www.enaa.or.jp/EN/activities/index.html [Accessed 20th July 2014]

Erramilli, M. (1990).Entry mode choice in service industries. *International Marketing Review*, 7(5):50 –62.

Fenton, E. and Pettigrew, A. (2000). *The Innovating Organization*. London: SAGA.

Geringer, M.J., Beamish, P.W. and Costa, R.C. (1989). Diversification Strategy and Internationalisation: Implications for MNE Performance. *Strategic Management Journal,* 10(2): 109–119.

Goerzen, A. and Makino, S. (2007). Multinational corporation internationalisation in the service sector: a stud of Japanese trading companies. *Journal of international business studies,* 38(7): 1149-69.

Greenwood, R., Li, S., Prakash, B. and Deephouse, D.L. (2005). Reputation, Diversification, and Organizational Explanations of Performance in Professional Service Firms. *Organization Science*, 16(6): 661-673.

Hansen, Z., Zhang, Y. and Ahmed-Kristensen, S. (2011). Viewing engineering offshoring in a network perspective: addressing and managing risks. *Journal of Manufacturing Technology*, 24(2): 14-173.

Hausman, J.A. (1978). Specification Tests in Econometrics. Econometrica, 46(6): 1251–1271.

Hitt, M., Uhlenbruck, K. and Shimizu, K. (2006).The importance of resources in the internationalisation of professional service firms: the good, the bad, and the ugly. *Academy of Management Journal*, 49(6): 1137-1157.

Ietto-Gillies, G. (2012).*Transnational Corporation and International production: concepts, theories and effects.* London: Edward Elgar.

ISG (2013). *Robust Growth for Engineering Services Outsourcing*. [Online] Available at http://www.isg-one.com/knowledgecenter/whitepapers/private/papers/White_Paper_ESO_Market_Trends.pdf[Accessed on 15th June 2014]

Johanson, J. and Vahlne, J.E. (1977). The Internationalisation Process of the Firm: A Model of Knowledge Development and Increasing Foreign Market Commitment. *Journal of International Business Studies*, 8(1): 23–32.

Johanson, J. and Vahlne, J.E. (2009). The Uppsala internationalisation process model revisited: From liability of foreignness to liability of outsidership. *Journal of International Business Studies*, 40(9): 1411– 1431.

Kojima, K. (1978). *Direct Foreign Investment: A Japanese Model of Multinational Business Operations*. London: Croom Helm.

Krull, E., Smith, P. and Ge, L.G. (2012). The internationalisation of engineering consulting from a strategy tripod perspective. *the Service Industrial Journals*, 32(7): 1097-1119.

Lawler, E. (2008). *Talent: making people your competitive advantage.* San Francisco: Jossey-Bass.

Lee, I.H. (2013). The M-Curve and the multinationality-performance relationship of Korean INVs. *Multinational Business Review*, 21(3): 214-231.

Lee, S. (2011). How financial slack affects firm performance: Evidence from US industrial firms. *Journal of Economic Research*, 16(1): 1-27.

Lu, J.W. and Beamish, P.W. (2001). The internationalisation and performance of SMEs. *Strategic Management Journal*, 22(6/7): 565–586.

Lu, J.W. and Beamish, P.W. (2004). International Diversification and Firm Performance: The S-Curve Hypothesis. *Academy of Management Journal*, 27(4): 598–609.

Malhotra, N. and Hinings, C.R. (2010). An organizational model for understanding internationalisation processes. *Journal of International business Studies*, 41(2): 330-349.

Malhotra, N. and Morris, T. (2009). Heterogeneity in Professional Service Firms. *Journal of Management Studies*, 46(6): 895-923.

McGrath, R.G. (1999). Falling forward: Real options reasoning and entrepreneurial failure. *Academy of management review*, 24(1): 13-30.

METI 2017. *Industrial Structure Vision: The Way Forward for Japanese Industry*. Ministry of Economy, Trade and Industry, Tokyo. Available via http://www.meti.go.jp/press/2017/05/20170530007/20170530007-2.pdf. Accessed on 15th May 2017.

Moreira, M., Maia, M., Sousa, P. and Meneses, R. (2013). Factors Influencing the Internationalisation of Services Firms: The Case of Design, Engineering and Architecture Consulting Firms. *Business Information Proceeding*, 143: 246-262.

Nordenflycht, A.V. (2010). What is a professional service firm? Toward a theory and taxonomy of knowledge-intensive firms. *Academy of management review*, 35(1): 15-174.

RM (2017). *Reports on global engineering outsourcing market.* Research and Markets. [online] available via https://www.researchandmarkets.com/research/8d9hkl/engineering. Accessed on 27th Dec 2017.

Ruigrok, W. and Wangner, H. (2003). Internationalisation and Performance: An Organizational Learning Perspective. *Management International Reviews*, 43(1): 63-83.

Ruigrok, W., Wolfgang, A. and Wanger, H. (2007).The Internationalisation -Performance Relationship at Swiss Firms: A Test of the S-Shape and Extreme Degrees of Internationalisation. *Management International Reviews*, 47(3):349-368.

Roberts, J. (1999). The Internationalisation of Business Services Firms: A Stage Approach. *The Service Industries Journals*, 19(4):68-88.

Stark, K.F., Bamber, P. and Gereffi, G. (2010). *Engineering services in Americas*. [Online] Available at http://www.cggc.duke.edu/pdfs/CGGC-IDB_CORFO_Engineering_Services_in_the_Americas_July_1_2010.pdf [Accessed on 10th June 2014]

Ström, P. (2005). The Japanese service industry: An International Comparison, *Social Science Japan Journal*, 8(2): 253-266.

Song, J., Asakawa, K. and Chu, Y. (2011). What determines knowledge sourcing from host locations of overseas R&D operations? A study of global R&D activities of Japanese multinationals. *Research Policy*, 40(3): 380-390.

Sapienza, H.J., Autio, E., George, G. and Zahra, S. (2006). A capabilities perspective on the effects of early internationalisation on firm survival and growth. *Academy of Management Review*, 31(4): 914–933.

US Census Bureau (2014). North American Industry Classification System (NAICS). [Online] Available at http://www.census.gov/cgi-bin/sssd/naics/naicsrch [Accessed at 10th June 2014]

Vilas-Boas, R. and Isabel, S.G. (2007). Internationalisation and Firm Performance: The S-Curve Hypothesis under the Eurozone context. *Documentos de Trabajo Nuevas Tendencias en Dirección de Empresas, 15-07:* 1-34.

Vinding, A. and Drejer, I. (2006). The further the better? Knowledge intensive service firms collaboration on innovation. *DRUID Working Papers 06*-31: 1-15.

Wu, D., Wu, X. and Zhou, H. (2012).International Expansion and firm performance in emerging market: evidence from China. *Chinese Management Studies*, 6(3): 509-528.

Xue, Q., Zheng, Q. and, Lund, D.W. (2013). The Internationalisation of Service firms in China: A Comparative Analysis with Manufacturing firms. *Thunderbird International Business Review*, 55(2): 137-151.

Zaheer, S. (1995). Overcoming the Liability of Foreignness. *Academy of Management Journal*, 38(2): 341–363.

Zahra, S. (2008). The virtuous cycle of discovery and creation of entrepreneurial opportunities. *Strategic* Entrepreneurship Journal, 2(3): 243–257.

Zhang, Y. and Gregory, M. (2011). Managing global network operations along the engineering value chain. *International Journal of Operations and Production Management*, 31(7): 736-764.

Zhang, Y., Gregory, M. and Neely, A. (2016). Global Engineering Services: Shedding Light on Network Capabilities. *Journal of Operations Management*, 42(3): 80-94.

Zhang, Y., Yang, Z. and Zhang, T. (2017). Strategic Resource Decisions to Enhance the Performance of Global Engineering Services. *International Business Review*, in press, pp. 1-23. https://doi.org/10.1016/j.ibusrev.2017.11.004.

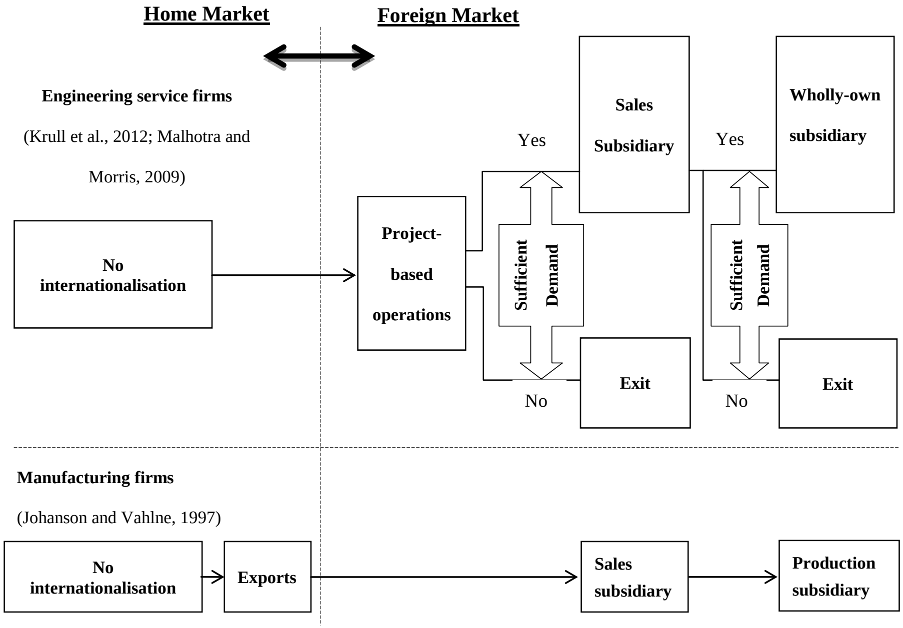

Figure 1: Non-sequential international evolvement path of ESFs

Table 1: Results of Hausman test

	Fixed-effect model (b_1)		Random-effect model (b_0)	
Variables	**Engineering service firms**	**Manufacturing firms**	**Engineering service firms**	**Manufacturing firms**
DOI	-0.585	-0.230	-0.056	-0.151
DOI^2	1.583	0.733	0.19	0.549
DOI^3	-0.981	-0.484	-0.084	-0.365
Firm Age	0.733	-0.035	0.079	-0.346
Resource Availability	0.381	0.263	0.098	0.263
Firm Size	0.029	0.277	-0.041	0.028
Chi-squared distribution	68.25	68.09		
Probability	0.0000	0.0000		

Chi-squared distribution is calculated by using the following function:

$$\mathbf{H} = (b_1 - b_0)'[(\mathbf{Var}(b_1) - \mathbf{V}\,(b_0)]\text{^}(-1)](b_1 - b_0)$$

Table 2: Description Statistics and Correlation Matrix (Engineering service firms)

	Variables	N	Min	Mean	Max	SD	1	2	3	4	5	6	7
1	**ROS**	515	-45.44	1.73	33.05	4.60	1						
2	**DOI**	500	0	0.15	0.69	0.16	0.04	1					
3	**DOI^2**	500	0	0.05	0.48	0.07	0.05	0.93***	1				
4	**DOI^3**	500	0	0.02	0.34	0.03	0.06	0.82***	0.97***	1			
5	**Firm Age**	593	0	63.34	124	24.09	0.01	-0.05	-0.06	-0.03	1		
6	**Resource Availability**	572	0.50	1.94	10.38	1.50	0.07	0.19***	0.21***	0.20***	-0.41***	1	
7	**Firm Size**	572	13.85	3121.64	34900	5363.53	-0.03	0.18***	0.08*	0.04	0.38***	-0.23***	1

Significance Levels: *p<0.1; **p<0.05; ***p<0.01

ROS = Return on Sales

DOI = Degree of Internationalisation (FSTS)

DOI^2 = Squared DOI

DOI^3 = Cubic DOI

Firm Age = Years since establishment

Resource Availability = Current Ratio (%)

Firm Size = Logarithm of total sales (USD million)

SD = Standard deviation

N = Number of observation

Table 3: Description Statistics and Correlation Matrix (Manufacturing firms)

	Variables	N	Min	Mean	Max	SD	1	2	3	4	5	6	7
1	ROS	3217	-52.25	2.73	35.63	6.10	1						
2	DOI	2969	-0.07	0.28	0.81	0.19	0.07***	1					
3	DOI^2	2969	0	0.11	0.66	0.11	0.07***	0.94***	1				
4	DOI^3	2969	0	0.05	0.54	0.07	0.06**	0.86***	0.98***	1			
5	Firm Age	3378	0	59.50	117	19.41	-0.04**	-0.01	0.03	0.04*	1		
6	Resource Availability	3217	0.43	2.09	13.9	1.46	0.27***	0.02	0.01	0.01	-0.13***	1	
7	Firm Size	3217	3.98	4221.07	263000	1.72	0.01	0.24***	0.28***	0.28***	0.15***	-0.10***	1

Significance Levels: *p<0.1; **p<0.05; ***p<0.01

ROS = Return on Sales

DOI = Degree of Internationalisation (FSTS)

DOI^2 = Squared DOI

DOI^3 = Cubic DOI

Firm Age = Years since establishment

Resource Availability = Current Ratio (%)

Firm Size = Logarithm of total sales (USD million)

SD = Standard deviation

N = Number of observation

Table 4: Results of Panel Data Analysis

Variables	Panel Data Analysis[a] Linear Model: Engineering service firms	Linear Model: Manufacturing firms	Quadratic Model: Engineering service firms	Quadratic Model: Manufacturing firms	Cubic Model: Engineering service firms	Cubic Model: Manufacturing firms
DOI	-0.011	0.030	0.070	0.032	-0.585*	-0.230*
DOI^2			-0.089	-0.028	1.583**	0.733**
DOI^3					-0.981**	-0.484**
Firm Age	0.730*	-0.787***	0.720*	-0.786***	0.733*	-0.785***
Resource Availability	0.350**	0.200***	0.348*	0.199***	0.381**	0.199***
Firm Size	0.079	0.195	0.085	0.195	0.029	0.220*
Observations, N	471	2766	471	2766	471	2766
F - Value	2.62***	3.25***	2.62***	3.25***	2.76***	3.26***
R-squared	0.258	0.324	0.259	0.324	0.270	0.325
Adjusted R-squared	0.156	0.245	0.154	0.245	0.165	0.246

Significance Levels: *p<0.1; **p<0.05; ***p<0.01
[a] = Standardized coefficients
ROS = Return on Sales
DOI = Degree of Internationalisation (FSTS)
DOI^2 = Squared DOI
DOI^3 = Cubic DOI

Firm Age = Years since establishment
Resource Availability = Current Ratio (%)
Firm Size = Logarithm of total sales (USD million)

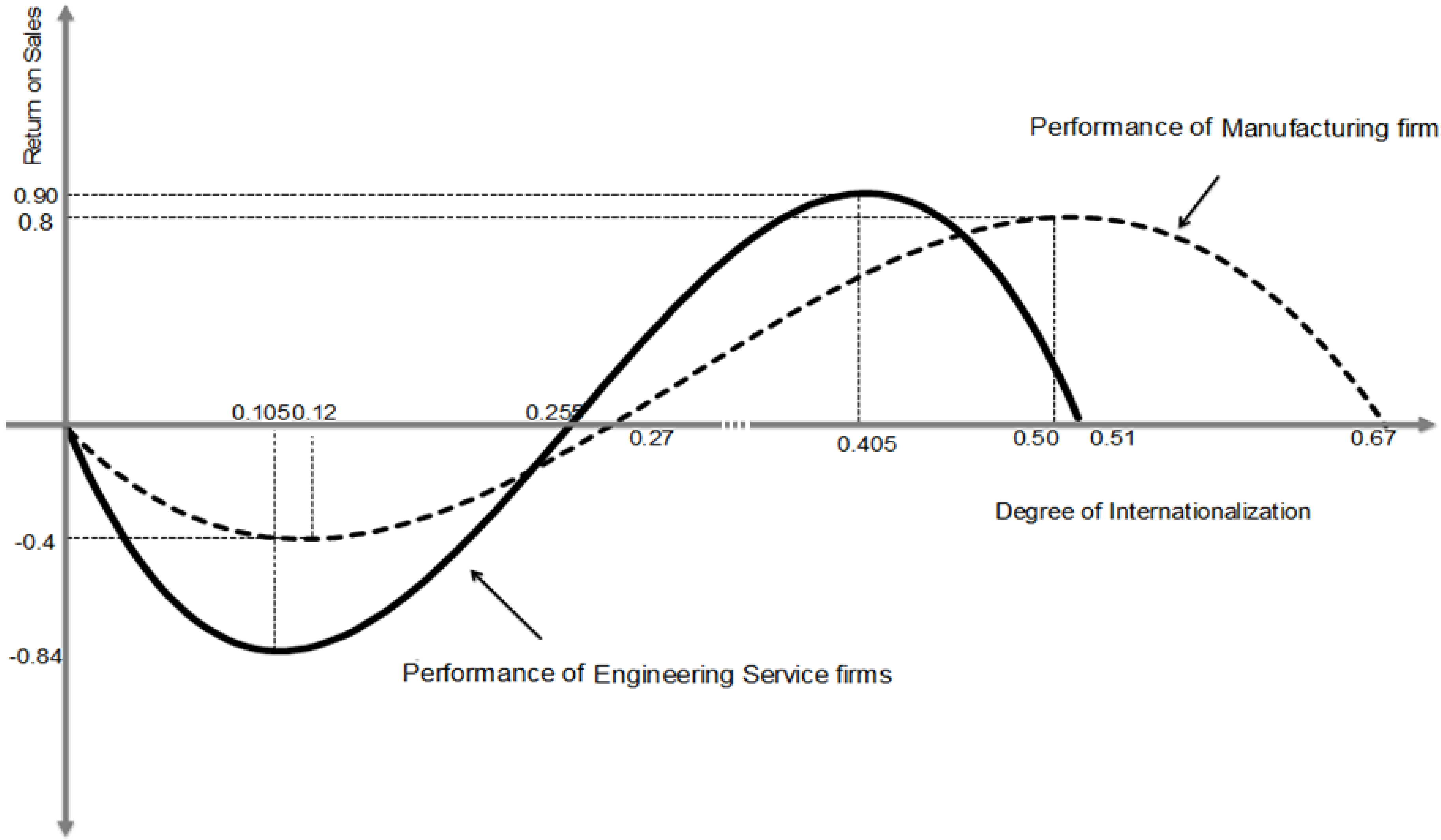

Figure 2: The S-curved shapes of ESFs and manufacturing firms