Capturing Value from Innovation in Knowledge-Intensive Business Service Firms: The Role of Competitive Strategy

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Building on a problem-solving perspective to value creation and capture, and on the business strategy literature, we argue that the actions that knowledge-intensive business service (KIBS) firms take to identify, select and solve client problems will affect their approach to capturing value from innovation. We apply regression analysis to data from an original survey involving a sample of 230 innovations introduced by 150 publicly traded UK and US KIBS firms. Distinguishing between cost- and differentiation-oriented KIBS firms, we find that cost-oriented firms tend to place more importance on all appropriability mechanisms than do differentiation-oriented firms. Furthermore, the perceived importance of formal appropriability mechanisms, relative to that of all appropriability mechanisms, tends to be higher for cost-oriented than for differentiation-oriented firms. This association is stronger for the case of the introduction of process (rather than product) innovation. These findings contribute to the strategy and service innovation literatures, by showing that KIBS firms' competitive strategies influence value capture, over and above the role of the innovation-, industry- and institutional-level factors examined in earlier studies.

Introduction

The question of how firms create and capture value from developing new processes, products or services is central to the strategy and innovation literatures (Bowman and Ambrosini, 2000;

Ceccagnoli, 2009; Cohen, Nelson and Walsh, 2000; Teece, 1986, 2006). Innovating firms employ various formal (patents, trademarks, copyrights, design rights) and informal (secrecy, lead-time advantages, complexity, complementary assets) appropriability mechanisms to capture value from innovation. The choice and perceived importance of these mechanisms has been shown to depend on such factors as: the nature of the innovation (product versus process), the type of sector, the capacity of firms to afford the cost of obtaining legal intellectual property (IP) rights, the ability of competitors to 'invent around' the innovation and the efficacy of legal IP protection (e.g. Cohen, Nelson and Walsh, 2000; Mansfield, 1986; Teece, 1986, 2006).

Most previous research focuses on the choice and perceived importance of appropriability

mechanisms of manufacturing firms concerning their technological innovations (Hall *et al.*, 2014; James, Leiblein and Lu, 2013). Much less attention has been paid to the question of how service firms capture value from innovation. This can be attributed to the historically dominant role of manufacturing sectors in the global economy, and to a 'supplier-driven view' of service firms, suggesting that their innovation is limited to adopting externally developed technologies that enable the offering of new or improved services (Pavitt, 1984). These perceptions, however, ignore recent trends. First, the structure of most developed economies has shifted away from manufacturing and towards service industries (BEA, 2016; BIS, 2016). Second, surveys have repeatedly shown certain types of service firms to be among the most innovative firms of the economy (Miles, 2005).

In this respect, knowledge-intensive business service (KIBS) firms are of special interest. These are firms '*whose primary value-added activities consist of the accumulation, creation, or dissemination of knowledge for the purpose of developing a customized service or product solution to satisfy the client's needs*' (Bettencourt *et al.*, 2002, pp. 100–101). KIBS firms include such activities as accountancy and legal services, architecture and advertising, software, computer services and engineering, testing and R&D services (Miles, 2011). The competitive advantage of these firms depends on their knowledge, creativity and innovation (den Hertog, 2000; Grant, 1996; Kogut and Zander, 1992).

It may be expected that KIBS firms are less concerned about the protection of their IP from imitation (than manufacturing firms) because of their focus on working closely with customers to produce services addressing their specific problems (Bettencourt *et al.*, 2002; den Hertog, 2000; Miles, 2008; Oliveira and von Hippel, 2011). In practice, however, the use of appropriability mechanisms by KIBS firms in the same sector differs widely. For instance, in management consulting, while there is no evidence of McKinsey's aggressive pursuit of IP rights, the case of Accenture is different. Accenture has sued a competitor management consultancy company for copying the 'look and feel' of their slogans (trademarks) (Lawson, 2013) and a competitor software company for patent infringement and misappropriation of trade secrets over their insurance claims management software (Hals, 2009).

This study set out to examine how KIBS firms capture value from innovation, by focusing on the role of competitive strategy. Indeed, the specific processes that firms have in place to identify and select customers and solve their problems depend on their established routines and ultimately on their broader competitive strategy (see Porter, 1980, 1985; Skivington and Daft, 1991; Treacy and Wiersma, 1995). Cost-oriented firms (COFs) try to gain high market share so as to improve their bargaining power and exploit efficiency gains arising from economies of scale and scope. In contrast, differentiation-oriented firms (DOFs) compete by offering unique or leading-edge service products, or by tailoring their service offerings to meet the demands and secure the loyalty of a few highly valuable customers. As a result, cost-oriented KIBS firms, which compete on the basis of scale and efficiency, can be assumed to be more concerned about how to best protect their IP than DOFs, whose services might be less systematized, codified and imitable.

Our theoretical model proposes that firms adopting different competitive strategies treat their IP differently and emphasize different appropriability mechanisms. Taking a problem-solving perspective on value creation and capture (Nickerson and Zenger, 2004; Nickerson, Silverman and Zenger, 2007), we argue that the specific actions by COFs and DOFs to select and solve client problems affect their approach to capturing value. A further crucial mediating factor of the competitive strategy–value appropriation relationship is derived from Barras' (1986) 'reverse product cycle' analysis of service innovation. This suggests that service providers move from process innovation, through improving the quantity and quality of services, to new or improved service products. We predict that, since COFs systematize processes to gain market share and expand to new markets, they will have stronger incentives to protect their IP early in this 'cycle'.

To test our predictions, we apply regression analysis to data from an original survey, conducted for the purpose of this study. This provides a sample of 230 product and process innovations that were introduced by 150 publicly traded UK and US KIBS firms. Three findings emerge from the analysis. First, COFs tend to place more importance on all appropriability mechanisms as a means of capturing value from innovation than DOFs. Second, the perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms tends to be

higher for cost-oriented than for differentiation-oriented firms. Third, the positive association between adopting a cost-oriented strategy and the relative importance of formal appropriability mechanisms within all appropriability mechanisms tends to be greater when the innovations that firms are introducing concern their service processes.

The contributions to the literature are twofold. First, we contribute to the literature exploring how firms profit from innovation (Arundel, 2001; Hall *et al.*, 2014; James, Leiblein and Lu, 2013; Leiponen and Byma, 2009). We study the challenge of capturing value from innovation in the KIBS sector of the economy, a significant empirical context overlooked by previous studies. Our results demonstrate the existence of important linkages between competitive strategy and the perceived importance of different appropriability mechanisms, over and above the influence of innovation-, industry- and institutional-level factors that studies of manufacturing firms have examined. Second, we contribute to the literature on competitive strategy (Bowman and Ambrosini, 2000; Porter, 1980, 1985; Treacy and Wiersma, 1995). We find evidence supporting the argument that firms' approaches to 'value capture' are closely associated with their broader competitive strategies. The differences in value appropriation between cost- and differentiation-oriented KIBS firms are consistent with the view that competitive advantage comes from the way that firms align the full set of their activities.

The next section of this paper describes the theoretical background of our research. Subsequently, we outline the methods used, the empirical results and the implications for research and management practice.

Theoretical background

Determinants of value capture from innovation and KIBS firms

Innovating firms choose among different avenues to create value from novel ideas giving rise to improved processes and products. They can either exploit these ideas directly in the market for products, or indirectly by selling them through the market for ideas (Gans and Stern, 2003). No matter which avenue is selected, the innovator's share of the new value created tends to be smaller when appropriability is weak due to imitation by competitors (Teece, 1986, 2006).

Several studies have explored firms' choices among formal and informal appropriability mechanisms to capture value from innovation (see Hall *et al.* (2014) and James, Leiblein and Lu (2013) for reviews). Formal appropriability mechanisms include patents, design rights, trademarks and copyrights. Informal appropriability mechanisms include the strategic exploitation of lead time, complexity in product design, the use of complementary production capabilities and secrecy (Cohen, Nelson and Walsh, 2000; Teece, 1986, 2006). The literature has highlighted the role of institutional-, industry- and innovation-level factors as determinants of IP protection decisions. We examine these in turn below.

In relation to institutional factors, differences in the strength of legal protection for IP rights across geographic regions imply some variance in the propensity to capture returns from innovation using formal appropriability mechanisms. In strong IP rights regimes, innovators with IP rights can resort to legal action in order to protect their interests against unlawful diminution of these rights (Hall and MacGarvie, 2006; Hall *et al.*, 2014). Such strong regimes offer innovators incentives to employ formal appropriability mechanisms for exploiting their novel ideas by establishing licensing agreements or by translating them into valuable propositions for customers (Gans and Stern, 2003).

Concerning industry characteristics, there is agreement across innovation survey-based studies that patents confer rather weak IP protection in most industries. The exceptions are industries like pharmaceuticals, where a patented innovation tends to map into a commercializable product (Ceccagnoli, 2009; Cohen, Nelson and Walsh, 2000; Levin *et al.*, 1987; Mansfield, 1986). In such discrete product industries, innovations have fewer patentable elements and it is easier for innovators to identify and defend against infringements. In complex product industries (e.g. computer equipment), in contrast, innovations are characterized by a large number of patentable elements. Innovators may find it difficult to develop a broad claim of novelty in a patent application, and to identify infringements. Other industry factors affecting the propensity to obtain formal IP protection include the ability of firms to 'invent around' their

competitors' innovations (James, Leiblein and Lu, 2013).

The characteristics of the innovation in question also affect the importance of appropriability mechanisms. When the new knowledge related to an innovation cannot easily be articulated and codified (i.e. reduced to information by means of drawings, formulae, numbers or words), formal IP protection is impractical (Amara, Landry and Traoré, 2008; Arora, 1997; Grant, 1996). The degree to which an innovation can be observed by individuals outside the innovating firm also matters. Unlike product innovation, which leads to the marketing of new or improved products, process innovations may involve proprietary elements of the value chain and be relatively less transparent to outsiders (Cohen, Nelson and Walsh, 2000; Levin *et al.*, 1987). Often, formal appropriability mechanisms are more relevant to the protection of product innovation, whereas informal appropriability mechanisms (especially secrecy) are more relevant to the protection of process innovation (Arundel, 2001; Harabi, 1995).

Fewer studies have examined the role of the innovator's own characteristics. There is some agreement that the propensity to patent rises with firm size and R&D intensity (Arundel, 2001; Hall *et al.*, 2014; Leiponen and Byma, 2009). The explanation usually given is that smaller firms generally have fewer resources for obtaining and defending patents; for example, they are less likely to have in-house patent attorneys to help with the process of obtaining and enforcing formal IP rights (Graham *et al.*, 2009; Somaya, Williamson and Zhang, 2007).

Most previous empirical work focuses on manufacturing firms and their technological innovations (Cohen, Nelson and Walsh, 2000; Hall *et al.*, 2014; James, Leiblein and Lu, 2013), with less attention paid to capturing value from innovation specifically by service firms (e.g. Amara, Landry and Traoré, 2008). The considerable heterogeneity of operations across services complicates the study of how service firms innovate and capture the resultant value. We focus on a particular set of service firms, KIBS, which span professional and technology-related services. Professional services include management consultancy, accountancy and legal services, banking and such services as architecture and advertising (von Nordenflycht, 2010). They typically have multiple touchpoints with clients, with relatively long contact time and with much value-added in the 'front office', where considerable judgement is applied concerning customer needs. Technology-related services are similar to professional services, but they are characterized by high use of scientific and technological knowledge and include such activities as software, computer services and engineering, testing and R&D services, where there is usually much technical back-office work to accomplish (Miles, 2011).

In this study, we seek to improve our understanding of how firms capture value from innovation by considering the role of the characteristics of innovating KIBS firms. Taking a problem-solving perspective, we focus on the role of firms' competitive strategy.

Competition through a problem-solving perspective

The problem-solving perspective on how firms organize their activities provides a useful basis for a systematic examination of the links between strategy and value capture (Nickerson and Zenger, 2004; Nickerson, Silverman and Zenger, 2007). This perspective takes the problem identification process as the unit of analysis for exploring value creation, and uncovers the 'strategic problems' that firms solve, whether embedded with clients, suppliers or their own organization. This perspective is appropriate for studying innovation by KIBS firms, which are knowledge-intensive organizations and whose innovation is often co-created with clients (Bettencourt *et al.*, 2002; den Hertog, 2000; Miles, 2008; Oliveira and von Hippel, 2011). Although such firms are engaged in trying to solve numerous problems over their lifecycle, they tend to choose problems related to their existing knowledge assets (Nickerson and Zenger, 2004).

This perspective sees the roles of managers as: (a) identifying clients' problems – which, if solved, can yield new knowledge and improve their own organization's performance; (b) organizing ways of optimizing the likelihood, speed and cost with which valuable solutions are discovered; and (c) ensuring the appropriation of a sufficient portion of the solution's value. As Nickerson and Zenger argue, '*valuable solutions deliver value to the firm, either through enhancement or development of a product or service or by reducing the cost of production delivery*' (p. 619). Thus, the capacity of firms to identify and solve problems and capture (part of) the resultant value depends on their broader competitive strategy.

The competitive strategy literature has devoted considerable attention to the development of generic strategy types. Three of the most cited typologies emphasize different strategic components. Miles and Snow (1978) identify four patterns of organizational behaviour in adjusting to changing environments, classifying firms into defenders, prospectors, analysers and reactors. Porter (1980), emphasizing how firms create value for their customers, classifies firms depending on whether they pursue product/service differentiation, cost leadership or market focus. Treacy and Wiersema (1995) identify three 'value disciplines' determining how firms achieve leadership by delivering superior customer value: operational excellence, product/service leadership and customer intimacy. These strategy typologies, each with its own strengths and limitations (e.g. Hambrick, 1983), all contrast competitive strategies focusing on minimizing costs (and maximizing efficiency) with those focusing on offering differentiated products or services (Conner, 1991). They also all see strategy implementation as requiring consistency across the full system of value-creating activities (e.g. González-Benito and Suárez-González, 2010).

COFs aim to exploit sources of cost advantage such as effective supply chain management for sourcing and utilizing low-cost inputs, improving efficiency of operations and standardizing offerings (Porter, 1980, 1985; Treacy and Wiersma, 1995). Critical success factors for these firms include gaining high market shares so as to improve bargaining power and gaining efficiency through economies of scale and scope (Porter, 1980; Skivington and Daft, 1991). When it comes to KIBS, the evidence suggests that many COFs emphasize operational competences, with the objective of leading the industry in terms of price and convenience. For example, this is the case for many integrated solution providers, whose organization and learning processes are often project-based (Brady and Davies, 2004). Among such integrated solution providers are large IT service firms, which tend to rely on transferring industry-specific knowledge of staff across multiple clients (Miozzo and Grimshaw, 2005, 2011). These IT service providers aim to establish a large and diversified client base, developing and maintaining cost-effective management information systems and adopting a lean supply chain. They are further likely to outsource activities to suppliers located in low-cost countries, and to make frequent changes of preferred suppliers (Massini and Miozzo, 2012; Mol, 2007).

In relation to problem-solving, COFs are likely to emphasize relatively more analytical problem-solving processes (Nickerson, Silverman and Zenger, 2007). Such processes involve a set of structured steps to identify problems that, if solved, tend to reduce cost (or enhance quality) incrementally through reduction of variance or waste in particular steps of the value chain. Thus, these firms focus on well-defined metrics – for example, lower costs or fewer defects – as they are oriented to satisfying clients whose needs are familiar and clearly defined.

In contrast, DOFs emphasize output quality and must find ways to provide an offering that customers perceive to have unique features, worth paying a premium price for (Porter, 1980, 1985; Treacy and Wiersema, 1995). Differentiation by service firms may involve offering leading-edge service products to customers, but can also take other forms. Some firms focus on tailoring their service offerings to meet the demands of a few highly valuable customers, thus securing long-term loyalty. These firms tend to collaborate closely with high-end clients and to invest critical resources in idiosyncratic projects and relationships (Hansen, Nohria and Tierney, 1999; Suddaby, Greenwood and Wilderom, 2008).

In relation to problem-solving, DOFs tend to focus on synthetic problem-solving processes (Nickerson, Silverman and Zenger, 2007). These processes generate inductive, exploratory syntheses in identifying novel client problems and solving them through novel resource combinations and integration. These firms thrive on ambiguity or less structured environments to develop innovation.

Strategy as a determinant of value capture from innovation

The aforementioned differences between COFs and DOFs can be further reflected in the way they manage their IP assets (Bowman and Ambrosini, 2000). Since COFs tend to compete on the basis of efficiency and scale, they need to develop routines to transfer knowledge and replicate their best practices internally across time, space and business unit boundaries (Szulanski, 1996; Winter and Szulanski, 2001). Replication of best practices requires that the firms recreate complex (and partly

tacit) routines and processes, which are embedded in individuals and in intra-organizational arrangements (Kogut and Zander, 1992; Nelson and Winter, 1982).

Thus, we can expect that, compared with DOFs, COFs (when they are largely engaged in replication of internal practices) will be more actively pursuing concerted action to protect their IP. One reason for this is that, in replicating their organizational practices, they may become more aware of sources of novelty, and put in place mechanisms to capture value from these and render them more easily protectable by formal means. Furthermore, as they systematize and replicate their practices (Leiponen, 2006), imitation by competitors (which may be a result of staff leaving the firms and being employed by competitors) could become easier, so they will take measures to protect their IP rights (Roy and Sivakumar, 2011).

In contrast, the knowledge generated by DOFs is likely to be more client-specific, with limited opportunities for cross-fertilization across clients and projects. When client problems are highly complex or unusual, KIBS firms often craft solutions based on clients' problems by establishing a multifunctional team combining multiple individual experiences, knowledge and competencies (Love, Roper and Bryson, 2011). This client-specific knowledge tends to be largely embedded in individuals or in collaborative social arrangements (Kogut and Zander, 1992). Some of these firms may put in place formal organizational processes for addressing client needs in their projects (Miozzo *et al.*, 2012). But because they are harder to learn, systematize or for others to replicate, these organizational features tend to be difficult to copy (Zander and Kogut, 1995). The resultant sources of competitive advantage will be better protected through resource scarcity, immobility and causal ambiguity (Ambrosini and Bowman, 2010; Barney, 1991; Peteraf, 1993).

In addition, COFs will have stronger economic incentives to prevent unintentional knowledge leakages and imitation by competitors, in order to protect anticipated returns from innovation. As a result of placing emphasis on analytical problem-solving processes, COFs will tend to produce new solutions generating positive, proximate and predictable returns (March, 1991). In contrast, DOFs, emphasizing synthetic problem-solving processes to explore new alternatives, are likely to generate knowledge which is still at a

'pre-paradigmatic' stage (Teece, 1986, 2006). Solving novel and complex problems often involves long trial-and-error processes and complex patterns of interactions with clients (Perks, Gruber and Edvardsson, 2012). During this experimentation phase, failure occurs more frequently than success (Thomke, 2013). This process generates returns which tend to be uncertain, distant and often even negative (March, 1991), making value capture more challenging. Therefore we hypothesize that:

> *H1:* The perceived importance of all appropriability mechanisms as a means of capturing value from innovation will be higher for cost-oriented firms than for differentiation-oriented firms.

Our second prediction has to do with the perceived importance of formal mechanisms relative to that of all of the appropriability mechanisms that may be employed. As noted, COFs, which rely on the exploitation of sources of cost advantages and emphasize analytic problem-solving processes, are more likely to generate new knowledge which can be relatively easily codified for formal protection (Fey and Birkinshaw, 2005; Hall *et al.*, 2014). Furthermore, the need to share knowledge within organizational boundaries, as COFs grow, suggests that they will tend to increasingly formalize and systematize organizational knowledge (Winter, 1987; Zollo and Winter, 2002). Even when these firms offer their customers what appear to be bespoke solutions, these services tend to be largely standardized and only partially customized (Love, Roper and Bryson, 2011). They are more likely to generate incremental innovations within established paradigms. Finally, COFs may not be able to maintain or raise barriers to imitation by relying, for example, on secrecy. Having large supplier and client bases is liable to raise costs for drafting, monitoring and enforcing IP-related contractual agreements (Williamson, 1981).

In contrast, DOFs face greater challenges in formalizing and systematizing new knowledge which is still at a 'pre-paradigmatic' stage. Furthermore, since these service providers tend to be engaged in a close and often exploratory relationship with client firms, the ownership and division of IP rights can be unclear or subject to dispute (den Hertog, 2000; Hagedoorn and Hesen, 2007). With the organizational knowledge and skills that are critical to solution generation being socially embedded and closely intertwined with individual

expertise (Jonsson and Foss, 2011), innovation taking place in DOFs may be better protected using informal mechanisms. Finally, when successful in innovation, DOFs, emphasizing synthetic problem-solving processes, will tend to generate more significant innovations by combining diverse sets of resources. Anton and Yao (2004) show that radical (cf. incremental) innovations are less likely to be protected through formal mechanisms, because the costs of information disclosure are very high. We summarize the hypothesized higher relative salience of formal mechanisms in the set of appropriability mechanisms as follows:

> H2: The perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms will be higher for cost-oriented firms than for differentiation-oriented firms.

We further argue that the perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms for COFs will depend on the type of innovation. Previous studies of manufacturing firms suggest that patents are most important for capturing value from product innovation, whereas secrecy is most important for process innovations (Arundel, 2001; Hall *et al.*, 2014; Harabi, 1995). However, fuller understanding of the challenge of capturing value from innovation in KIBS requires a service-oriented approach which emphasizes the specificities of innovation in services (Tether, 2005; von Nordenflycht, 2010).

Barras (1986, 1990), building on the traditional product lifecycle model used in manufacturing (Abernathy and Utterback, 1978), proposed a 're-verse product cycle' model for services innovation. His model was originally based on examination of information-intensive industries such as financial services and real estate, but he generalized it to cases of service industries being transformed through the use of new information technology (IT). Thus, the model has applicability to services that are first adopting IT to support their own processes, and ultimately learn that this can be the basis for offering improved service quality and new services (Gallouj, 1998, 2002). Specifically, Barras argues that service providers start with back-office process improvements to increase the efficiency of existing services (e.g. computerization of bank transaction records). Later, process

innovation is intended to improve the quantity and quality of services (e.g. extended access to bank services by use of ATMs, more frequent bank statements). Finally, new or improved service products (e.g. on-line and home banking, new types of bank account and related services) are introduced, aiming to open up service provision to new markets. Barras' account has been criticized as mainly describing developments in the era in which service industries were first being transformed through new IT (Uchupalanan, 2000). However, the likelihood that some KIBS firms will move from adopting new processes to save costs, gain efficiency and improve quality to realizing new products enabled by these processes makes this approach relevant and worth considering (Gallouj, 1998; Gallouj and Savona, 2009; Nightingale, 2003).

Even if the three posited phases do not follow a rigid pattern, we suggest that, as COFs formalize and systematize processes to gain market share and expand to new markets, they will have incentives to obtain formal protection over their process innovation early in the 'cycle'. Failing to do so might mean that they will be unable to offer a new service later, when a competitor obtains formal protection of necessary process improvements (Ceccagnoli, 2009; Desyllas and Sako, 2013).

Finally, new services tend to emerge through crafting solutions based on clients' problems; some of these solutions may eventually lead to new service products whose core is a replicable service (Love, Roper and Bryson, 2011). Since the customer is a co-creator of value in services (e.g. Bettencourt *et al.*, 2002), secrecy about processes may not be a viable option to protect new knowledge.

Thus, the association anticipated in Hypothesis 2, that the perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms will be higher for COFs, can be predicted to apply more strongly for service process innovations (which may eventually underpin new service products) than for service product innovations themselves. Accordingly, we introduce our final hypothesis:

> H3: For cost-oriented firms the perceived importance of formal appropriability mechanisms, relative to that of all appropriability mechanisms, will be higher when process rather than product innovations are concerned.

Methods

Data sources and the model

The empirical analysis uses a sample of publicly traded KIBS firms which are incorporated in the UK and the USA. Data are derived by matching two databases. The first of these, from an original survey, contains information on firms' innovation activity, perceived importance of appropriability mechanisms, competitive strategy and other characteristics. The survey was administered through telephone interviews between September and December 2012. The second database is Thomson's Datastream, one of the most comprehensive data sources for economic and financial information for publicly traded firms.

The sampling frame for the survey is a list of all UK and US publicly traded KIBS firms in Datastream.[1] The initial list comprises 406 UK and 1892 US firms. The respondents were selected to ensure that they were top management team members and knowledgeable about their organization's competitive and IP strategy.[2] Respondents, on average, had about 7 years of experience in their organizations, had served the organization in two different posts and had spent about 5 years in their last position within their organization: a long enough period of time to build an in-depth understanding of their organization. All were given an overview of the survey so that they could judge whether they had adequate knowledge around the subject matter of the survey. The questionnaire was piloted on a small sample of subjects to establish that the questions were sufficiently clear and provided useful information for the dependent and explanatory variables of the study. The survey resulted in 223 responses (92 UK and 131 US firms), an overall response rate of about 10%, comparable to several previous studies (e.g. Mina, Bascavusoglu-Moreau and Hughes, 2014).

We tested for non-response bias by comparing the characteristics of the respondents and the whole sample in terms of firm size, industry and country of origin. The response rates are significantly different in the UK and the USA (23% and 7%, respectively), and biased in favor of UK firms (χ^2 test = 94.5, p < 0.001) and large firms (measured by number of employees) (t test = −4.4, p < 0.001). To adjust for non-response bias in firm size and country, we applied a weighting technique based on logistic regression modelling (David *et al.*, 1983; Kalton and Flores-Cervantes, 2003). We regress whether each of the firms in our sampling frame responded to our survey on firm size and country of origin, and we estimate each firm's propensity to respond to the survey. Then, we weight observations of the focal regressions by the reciprocal of each firm's estimated propensity to respond. We also tested early and late respondents, as the latter are often assumed to be more similar to non-respondents. We found no evidence suggesting that competitive strategy differs between 50 early and 50 late respondents (who had to be prompted several times to respond) (χ^2 test = 2.10, p = 0.15) (Armstrong and Overton, 1977).

We acknowledge the possibility of common method bias affecting our regression analysis, since our dependent and independent variables are based on responses to the same survey instrument. It has been argued, however, that models assuming a non-linear relation between the response and predictor variables (as in the case of our fractional logit regression) are less affected by common method bias (Chang, van Witteloostuijn and Eden, 2010; Siemsen, Roth and Oliveira, 2010). Nonetheless, we adopted a number of standard practices to minimize the risk that our results are subject to common method bias (Podsakoff *et al.*, 2003). First, the questions related to our dependent and independent variables were placed in different sections of the survey. Second, the questionnaire included different types of responses, including Likert scales, yes/no answers and questions requiring numbers. Third, we assured respondents that their identity and responses would remain anonymous and confidential. Fourth, our analysis combines variables constructed using subjective information from our survey with others constructed using information from Datastream. Finally, we formally tested whether the results suffer from common method bias by assessing the effect of a single unmeasured latent method factor (Podsakoff *et al.*, 2003). We found that the variance attributed to the single

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[1]These are firms operating in SIC 48 communications; 60 banks; 61 non-depository credit institutions; 62 security and commodity brokers; 63/64 insurance carriers and agents; 65 real estate; 67 investment offices; 73 business services; 87 engineering, accounting, research and management services; and 82 educational services.
[2]Respondents were in senior managerial positions, including CEO, CFO, president and vice president, head of marketing, head of communications and head of business development.

common method is less than 1%, suggesting that common method bias is not significant.

The empirical analysis is conducted using data from firms which introduced at least one innovation during the period 2009–2011. We adopted a two-stage cluster sampling design. The primary sampling units are firms, and the secondary sampling units are their portfolios of product or process innovations. The unit of analysis in the regressions is their portfolio of product or process innovations. To adjust for intra-firm correlation of observations within a firm, we use the Huber–White cluster-robust standard error estimator (Rogers, 1993; White, 1980; Williams, 2000).[3] Due to missing observations in some of the explanatory variables, the final sample in the analysis comprises 230 product and process innovations, derived from 150 innovating firms.

The dependent variables for hypothesis testing are measured on a self-reported 1–5 Likert scale (respondents were asked to score the significance of various appropriability mechanisms in capturing value from their innovation). As with other surveys, the quality of responses reflects the suitability of the informants and is subject to biases arising from personal perceptions. In order to minimize the impact of this possible source of bias, we focused our attention on whether respondents assigned low (scores 1–3) or high (scores 4–5) importance to each of the appropriability mechanisms (similar to Laursen and Salter, 2014). We then created a measure of the perceived importance of all eight appropriability mechanisms by adding up the transformed scores (as we explain later, our results are not sensitive to this transformation). Since this measure takes non-negative integer values (as they are counts of scores), Poisson or negative binomial regression models could be appropriate. However, because the dependent variable is restricted by an upper bound (8 is the maximum score), the assumption that the conditional distribution of the dependent variable comes from an exponential family is not fulfilled and such models are not appropriate. Following previous studies (Laursen and Salter, 2014), we use a fractional logit model (Papke and Wooldridge, 1996) to examine the relation between a firm's competitive strategy and the perceived importance

of appropriability mechanisms. This model is also particularly appealing for testing Hypotheses 2 and 3 regarding the relative importance of formal mechanisms (formality quotient). Furthermore, we carry out sensitivity analyses to check the robustness of our findings to the operationalization of our dependent variable and the estimation approach. In particular, we check the robustness of our findings regarding Hypothesis 1 using an alternative (untransformed) measure of our dependent variable and a negative binomial regression specification (see the 'sensitivity analysis' section).

Dependent variables

Hypothesis 1 concerns the perceived importance of all appropriability mechanisms. To design the survey questions concerning value appropriation (i.e. the wording of the questions for each mechanism and the options available to respondents), we drew on previous innovation surveys. We primarily followed the Community Innovation Survey (CIS), which has been used in a number of studies (Arundel, 2001; Brouwer and Kleinknecht, 1999; Hall *et al.*, 2014), and the Yale/Carnegie Mellon survey (Cohen, Nelson and Walsh, 2000; James, Leiblein and Lu, 2013). Accordingly, for each portfolio of innovations (i.e. product or process innovations), we asked respondents to score from 1 to 5 how significant each of the following mechanisms have been in capturing value from their innovation: (1) patents, (2) business method patents, (3) copyrights, (4) trademarks, (5) design rights, (6) secrecy, (7) complexity of the service or service process, (8) complementary service development and delivery capabilities. Responses to this question are likely to reflect the perceived effectiveness of a mechanism in value appropriation and the frequency with which a mechanism is employed (Cohen, Nelson and Walsh, 2000).[4]

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[3]This heteroscedasticity-consistent estimator also takes account of the presence of heteroscedasticity of unknown form.

[4]Since our measures are based on perceptual measures of the importance of appropriability mechanisms, we acknowledge that these measures might diverge from the extent to which sample firms actually rely on particular appropriability mechanisms. This can be particularly true since the importance of each appropriability mechanism is measured using a single item. In order to assess whether the 'perceived importance' of, and 'reliance' on, different appropriability measures are broadly consistent dimensions, we collected information from the Derwent patent database on the actual number of patents granted to our sample US firms and compared it with

The '*all appropriability mechanisms' importance*' measure is constructed as follows. First, each of the eight appropriability mechanisms is coded as a binary variable, to indicate the significance of this appropriability mechanism in capturing value from innovation. Here, 0 indicates no or low perceived significance (original scores 1–3) and 1 indicates high perceived significance (original scores 4–5). This transformation makes scales less sensitive to respondent-specific perspectives. Second, the significance of all appropriability mechanisms is added up, running from 0 to 8. The scale formed from these items, as a proxy for the perceived significance of a firm's overall appropriability mechanisms, has a high degree of internal consistency (Cronbach's $\alpha = 0.851$; see Table 1). Third, in order to apply fractional logit regression, we divide the sum by 8 (the highest possible number of appropriability mechanisms seen as significant). The resulting variable takes values between 0 and 1. The greater the value, the higher the level of the perceived importance of all appropriability mechanisms.[5]

Hypothesis 2 concerns the perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms. The sets of items that have been defined as formal (items 1–5) appropriability mechanisms in the literature (Cohen, Nelson and Walsh, 2000; Hall *et al.*, 2014; James, Leiblein and Lu, 2013) appear to have a good degree of internal consistency (Cronbach's $\alpha = 0.882$).

We proxy for the perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms using the

variable '*formality quotient*'. For this purpose, we construct the variable '*formal appropriability mechanisms' importance*'. Each of the five formal appropriability mechanisms is coded as a binary variable, as explained above. Then, the importance of the five formal appropriability mechanisms is summed (running from 0 to 5) and this score is divided by 5 (the highest possible number of formal appropriability mechanisms seen as important). Similarly, we calculate the variable '*informal appropriability mechanisms' importance*'. Each of the three informal appropriability mechanisms is coded as a binary variable. Then, the importance of the informal appropriability mechanisms is summed (running from 0 to 3) and this score is divided by 3 (the highest possible number of informal appropriability mechanisms seen as important). Finally, we construct the variable '*formality quotient*' by calculating the ratio between '*formal appropriability mechanisms' importance*' and the sum of '*formal appropriability mechanisms' importance*' and '*informal appropriability mechanisms' importance*'. The resulting variable can take values between 0 and 1. The greater the value of the variable, the higher the perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms.

Independent variables

Our hypotheses revolve around the fundamental distinction between COFs and DOFs. We adopt a dual approach to capture competitive strategy types through our survey by combining deductive and inductive approaches (Hinkin, 1995). A deductive approach was based on a review of the literature on strategy typologies. Given that the empirical context of the study is KIBS firms, our attempt was to design questions that would better enable respondents to identify and select the most appropriate competitive strategy type. Treacy and Wiersema's (1995) strategy typology, emphasizing three 'value disciplines' (operational excellence, service leadership and customer intimacy), has been found appropriate in previous studies focusing on service firms (e.g. Potgieter and Roodt, 2004). We complemented this approach by adopting an inductive method, examining annual reports of 50 UK KIBS firms in 2012 and interviewing managers of 6 UK KIBS companies. Table A1 (in the Appendix) provides example quotations from company annual reports,

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their recorded scores of perceived importance of patents as means of value appropriation. The average number of patent grants is actually monotonically increasing with the recorded score of perceived patent importance. We therefore feel that there is a good degree of agreement between perceived importance and actual reliance on the various mechanisms. Results are available upon request.

[5]We carried out several tests to check the sensitivity of our findings to the measurement of the dependent variables. For example, we found a highly positive and significant correlation coefficient between the 'all appropriability mechanisms' importance' variable when it is constructed using the dichotomized and the original scores of respondents' perceived importance (0.896, $p < 0.01$). In addition, our findings continued to hold when we replicated the regression analysis with the variable calculated using the original scores. Results are available upon request.

Table 1. Definition and descriptive statistics for variables

Variable	Type of variable	Description	Mean	Std. Dev.
Firm level				
Cost-oriented strategy	Categorical	Whether the respondents' competitive strategy is based on operational excellence (yes = 1 and no = 0).	0.112	0.316
R&D investments	Index: 4 items (Cronbach's $\alpha = 0.657$)	Whether respondents spent, for the year 2011, more than 1% of their turnover in support of innovation on each of the following activities (yes = 1 and no = 0): (1) conducting R&D internally; (2) acquisition of machinery, equipment and software; (3) training for innovative activities; (4) all forms of design. The average of these item scores is calculated.	0.539	0.334
Formalized organizational knowledge	Categorical	Respondents who answered that they have (yes = 1 and no = 0): developed an explicit manual or blueprint documenting organizational processes and operating practices, applied systematic ways of reviewing performance and learning from past experience and used information systems to map expertise and share knowledge.	0.612	0.488
Innovation collaboration	Index: 6 items (Cronbach's $\alpha = 0.607$)	Whether respondents collaborated with the following types of partners for their creation of innovation (yes = 1 and no = 0): (1) suppliers, (2) clients/customers, (3) competitors, (4) consultants and commercial laboratories, (5) universities, (6) government or public research institutes. The average of these item scores is calculated.	0.529	0.247
Number of employees	Continuous	Natural logarithm of number of employees, averaged during 2009–11 (Source: Datastream).	5.742	2.184
Cash holdings	Continuous	The ratio of total cash and equivalent to total assets, averaged during 2009–11 (Source: Datastream).	0.175	0.210
Manufacturing	Categorical	Whether the firm has some activity in manufacturing (SIC 20–39) (yes = 1 and no = 0) (Source: Datastream).	0.084	0.278
Growth rate	Continuous	The difference in total assets between 2011 and 2009, divided by the value of total assets in 2009 (Source: Datastream).	0.760	3.861
Tobin's Q	Continuous	The market value of common equity plus the book value of preferred stock plus the book value of total debt divided by the firm's total assets, averaged during 2009–11 (Source: Datastream).	3.094	8.822
Human capital	Continuous	The proportion of staff with university degrees or equivalent qualifications in sciences or engineering, business, economics or social sciences, law or education, culture or art.	0.678	0.334
USA	Categorical	Whether the firm is located in the USA (USA = 1, UK = 0) (Source: Datastream).	0.820	0.385
Portfolio of innovation level				
Formal appropriability mechanisms' importance	Index: 5 items (Cronbach's $\alpha = 0.882$)	Recoded scores of respondents' perception about how significant the following mechanisms have been in capturing value from their innovation (high level of significance = 1 and low level of significance = 0): (1) patents, (2) business method patents, (3) copyrights, (4) trademarks, (5) design rights. The sum of these item scores is divided by 5 (the highest possible number of appropriability mechanisms seen as significant).	0.324	0.375
Informal appropriability mechanisms' importance	Index: 3 items (Cronbach's $\alpha = 0.657$)	Recoded scores of respondents' perception about how significant the following mechanisms have been in capturing value from their innovation (high level of significance = 1 and low level of significance = 0): (1) secrecy, (2) complexity of the service or service process, (3) complementary service development and delivery capabilities. The sum of these item scores is divided by 3 (the highest possible number of appropriability mechanisms seen as significant).	0.473	0.384
All appropriability mechanisms' importance	Index: 8 items (Cronbach's $\alpha = 0.851$)	Recoded scores of respondents' perception about how significant the following mechanisms have been in capturing value from their innovation (high level of significance = 1 and low level of significance = 0): (1) patents, (2) business method patents, (3) copyrights, (4) trademarks, (5) design rights, (6) secrecy, (7) complexity of the service or service process, (8) complementary service development and delivery capabilities. The sum of these item scores is divided by 8 (the highest possible number of appropriability mechanisms seen as significant).	0.380	0.334
Formality quotient	Proportion; continuous	Formal appropriability mechanisms' importance/(formal appropriability mechanisms' importance + informal appropriability mechanisms' importance).	0.265	0.283
Process innovation	Categorical	Whether the innovation is a process innovation (yes = 1 and no = 0).	0.422	0.495
Number of innovations	Continuous	Natural logarithm of number of product and process innovations introduced between 2009 and 2011.	1.138	1.157
Radical innovation	Categorical	Whether the innovation is radical (i.e. innovation new to the market) (yes = 1 and no = 0).	0.439	0.497
Radical innovation not reported	Categorical	When respondents failed to report whether the innovation is radical (yes = 1 and no = 0).	0.159	0.367

N = 230. Weighted results to correct for non-response.

reflecting each strategy type. This approach revealed an additional way whereby KIBS firms differentiate their offerings, apart from 'service leadership' and 'customer intimacy'. These are cases where KIBS firms create value by offering a unique perspective on their clients' problems, and rely on a combination of unique professional knowledge and skills to address these client problems. In order to allow for this possible strategy approach in our survey instrument, we adopted a KIBS-specific extension of Treacy and Wiersema's strategy typology as developed by Miozzo *et al.* (2012).

Following previous studies (e.g. McDaniel and Kolari, 1987; Snow and Hambrick, 1980; Troilo, Luca and Atuahene-Gima, 2014), we adopted a (so-called) 'self-typing' approach to capture strategy types.[6] We asked respondents to select which competitive strategy best describes their company's competitive strategy: (1) operational excellence: the company's strategy emphasizes efficiency, low cost and competitive prices relative to competitors; (2) service leadership: the company's strategy emphasizes offering leading-edge services that enhance clients' businesses; (3) unique services: the company's strategy emphasizes delivering a unique service using a particular mix of skills and technology resources that transform clients' businesses; and (4) customer intimacy: the company's strategy emphasizes tailoring service offerings to match exactly the demands of key customers. Initial piloting of the questionnaire with nine companies confirmed that these questions were well understood by respondents, establishing face validity.

The four ideal strategy types can manifest themselves – to varying degrees – into multiple dimensions, including pricing, marketing communications, operating costs, resource utilization, innovation inputs and outputs, and management systems and controls. Since these dimensions often vary across different parts of multidivisional organizations (Bowman and Daniels, 1995), and

our sample consists of large and (often) multi-divisional companies, we chose to focus on the organizations' overarching strategy orientations (in a way similar to the group-level consolidated information presented in annual reports) (MacKenzie, Podsakoff and Podsakoff, 2011).

Using this information, the dummy variable '*cost-oriented strategy*' is constructed using item 1 (coded 1). The rest of the items (2–4) representing the reference category (coded 0) are seen as indicative of a differentiation-oriented strategy. In the sensitivity analysis which follows, we further explore the trends when DOFs are decomposed into three strategy sub-groups for service leadership, unique services and customer intimacy.

Any survey of this kind might be subject to problems arising from single respondent perceptions (Bowman and Ambrosini, 1997) and functional expertise biases (Bowman and Daniels, 1995). To assess the extent to which these problems apply, the literature recommends considering multiple sources of information when evaluating a firm's strategy (Bowman and Ambrosini, 1997; Hambrick, 1983; Snow and Hambrick, 1980). We thus compared firms classified as either cost- or differentiation-oriented on the basis of questionnaire responses against an objective indicator. Previous studies suggest that DOFs tend to exhibit higher general, selling and administrative (GS&A) expenses than COFs (Higgins, Omer and Phillips, 2015; McAlister *et al.*, 2016). Testing for corresponding trends for a sub-sample of 100 firms with data available from Datastream, we found that GS&A expenses per firm employee were economically and statistically significantly different between cost- and differentiation-oriented sample firms (mean $= 90.12$ vs 167.06; p-value $= 0.045$). This result increased our confidence in our strategy categorization and reduced concerns of possible common method bias arising from measures of the predictor and criterion variables from the same rater (Podsakoff *et al.*, 2003).

Process innovation. We asked respondents whether they introduced any new and significantly improved service processes or service products during 2009–11: the dummy variable '*process innovation*' is equal to 1 for process innovation and 0 otherwise. We adopt this variable, together with its interaction with the variable '*cost-oriented strategy*', to test Hypothesis 3.

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[6]Our study set out to explore associations between competitive strategy and capturing value from innovation. We are thus interested in capturing a firm's 'intended' strategy as a broad description of a firm's desired position in the marketplace. Top management team members should be knowledgeable about their firm's broad strategic orientation, as they should have been involved in strategy formulation and implementation (see Bowman and Ambrosini (1997) for a detailed discussion of the strengths and weaknesses of managerial perceptions).

Control variables

We include a number of control variables that have been shown to influence appropriability strategy (see Table 1 for details on measurement). We control for the '*number of innovations*' introduced by the firm (measured by the natural logarithm of product and process innovations). Introducing several innovations simultaneously might compromise a firm's capacity to manage them and capture the resultant value created (Van de Ven, 1986). The index '*R&D investments*' is created using the survey question about whether a firm spent in a number of activities to support innovation. Prior literature finds that R&D-performing firms are more likely to have patentable inventions (e.g. Hall *et al.*, 2014). Firm size is proxied by the variable '*number of employees*' (measured by the natural logarithm of the number of employees). Large firms tend to perceive patents as more important appropriability mechanisms (e.g. Arundel, 2001; Leiponen and Byma, 2009).

To further strengthen our analysis, we estimate an augmented specification with additional control variables. A dummy is employed to capture whether the firm has introduced a '*radical innovation*' (i.e. an innovation new to the market; to avoid a sample reduction due to a few non-responses to the survey question about radical innovation, the dummy for radical innovation is set equal to 0 when a respondent failed to respond, and we created a dummy variable that equals 1 in cases of a non-response and 0 otherwise[7]). There is evidence suggesting that firms prefer secrecy over patents for more radical innovation to avoid early public disclosure of their novel ideas (e.g. Anton and Yao, 2004). We control for the extent to which organizational knowledge is formalized, which may increase the likelihood of knowledge leakage (Cohendet and Steinmueller, 2000). The dummy variable '*formalized organizational knowledge*' is constructed, taking a value of 1 when a firm takes systematic action to codify, document, share and exploit organizational knowledge (the dummy is set to 0 otherwise). The index '*innovation collaboration*' is constructed based on whether the firm collaborated for innovation with suppliers, clients, competitors, consultants and commercial laboratories, universities and government or

public research institutes. Previous work reports a positive association between innovation collaboration and the perceived importance of formal mechanisms (e.g. Miozzo *et al.*, 2016). The dummy variable '*manufacturing*' is used to capture whether the firm is also active in the manufacturing sector (SIC 20–39). KIBS firms with some manufacturing activity can be relatively familiar with the use of formal appropriability mechanisms (Greenhalgh and Rogers, 2007). The variable '*cash holdings*' (measured by the ratio of total cash and equivalent to total assets) is used to account for the fact that formal IP protection can be prohibitively costly to obtain, especially for small firms (Graham *et al.*, 2009). A dummy variable was used to control for firms incorporated in the USA. All regressions include seven industry dummies (two-digit SIC).

It is possible that the estimated associations can be inflated due to an endogeneity problem (i.e. the self-selection of competitive strategy and appropriability by 'high-quality' firms). In the absence of instrumental variables that would fulfil both the relevance and strength requirements, proxies for firm quality should improve the robustness of our findings, even if they do not represent a perfect solution (Laursen and Salter, 2014). We thus employ three variables. The first, '*growth rate*', is measured as the growth rate of the firm's total assets. The second, '*Tobin's Q*', is measured by the ratio of the market value of a firm to its total assets (Gugler, Mueller and Yurtoglu, 2004). Finally, we account for a firm's '*human capital*', which is measured by the proportion of staff with university degrees.

Results

The summary statistics and bivariate correlations of all our variables are presented in Tables 1 and 2. Before turning to the multivariate analysis, a close look at our dependent variables is in order. Regarding the perceived importance of appropriability mechanisms, the importance of informal appropriability mechanisms outweighs that of formal appropriability mechanisms for our respondents (mean = 0.473 vs 0.324, respectively). This result is in line with previous studies (e.g. James, Leiblein and Lu, 2013). The trends depicted in Figure 1, which shows mean values of perceived importance of different groups of appropriability mechanism by competitive strategy, are broadly consistent with our predictions.

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[7]Regression results presented in Table 3 show that our findings are not sensitive to this normalization.

Table 2. Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
(1) All appropriability mechanisms' importance	1.000																
(2) Formality quotient	0.660***	1.000															
(3) Cost-oriented strategy	0.135+	0.126+	1.000														
(4) Process innovation	−0.089	−0.112+	−0.041	1.000													
(5) Number of innovations	−0.033	−0.001	−0.108	−0.069	1.000												
(6) Radical innovation	0.218***	0.147*	0.041	−0.199**	0.017	1.000											
(7) Radical innovation not reported	0.037	−0.010	0.008	0.083	−0.027	−0.392***	1.000										
(8) R&D investments	0.224**	0.121*	−0.075	−0.029	0.196*	0.161*	−0.180**	1.000									
(9) Formalized organizational knowledge	0.127+	0.093	0.055	0.016	0.113+	0.082	−0.031	0.204**	1.000								
(10) Number of employees	0.138+	0.060	0.021	0.005	0.194+	0.107	0.033	−0.063	0.074	1.000							
(11) Cash holdings	0.117+	0.124*	0.003	0.002	−0.085	0.162*	0.017	0.168**	−0.007	−0.209**	1.000						
(12) Tobin's Q	0.136+	0.125+	−0.038	0.012	−0.024	0.067	−0.033	0.161*	0.027	−0.335**	0.039	1.000					
(13) Growth rate	0.170	0.110	0.011	0.034	0.032	0.101	−0.035	0.138	0.069	−0.218+	0.012	0.698**	1.000				
(14) Manufacturing	0.211**	0.110+	−0.089***	0.006	0.075	0.057	0.145	−0.003	0.062	−0.073	0.145	0.084	−0.045	1.000			
(15) Innovation collaboration	0.203**	0.198**	−0.116+	−0.045	0.249***	0.112+	0.008	0.257***	0.078	0.285***	−0.074	0.113+	0.083	0.206*	1.000		
(16) Human capital	0.308***	0.304***	−0.100	0.006	0.042	0.154*	−0.012	0.270***	0.129+	−0.055	0.240***	0.198***	0.114+	0.089	0.151*	1.000	
(17) USA	0.159*	0.171*	0.018	0.034	−0.056	−0.050	0.047	0.101	0.390***	−0.157*	0.073	0.165*	0.080	0.183***	0.131*	0.272***	1.000

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, +$p < 0.1$. Weighted results to correct for non-response.

The main results of the fractional logit regressions are presented in Table 3. Models 1, 3 and 5 represent a parsimonious version of our model including only a subset of key control variables (to allow for a greater number of observations per parameter estimated), whereas Models 2, 4 and 6 include the full set of regressors. The results from Models 1 and 2 are consistent with Hypothesis 1, predicting that COFs perceive all appropriability mechanisms as being more important means of capturing value from innovation, compared with DOFs. The coefficient of the dummy for COFs from the full specification (Model 2) is positive and significant ($\beta = 1.442$, $p < 0.001$). Several of the control variables are statistically significant. Appropriability mechanism importance is positively associated with firm size, R&D investments, firm growth, the introduction of product innovations, having some manufacturing activity and human capital. However, there is some evidence that introducing numerous innovations simultaneously might compromise a firm's capacity to capture the resultant value created.

The results from Models 3 and 4 lend support for Hypothesis 2, according to which the perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms is higher for COFs than DOFs. The coefficient of the cost-oriented strategy dummy from the full specification (Model 4) is positive and significant ($\beta = 1.003$, $p < 0.01$). Again, a number of the control variables are significant. A higher perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms takes place for firms that are larger, more active with innovation collaborations and have higher human capital. Similar to findings from studies of manufacturing firms, service process innovations have a lower likelihood of being protected effectively through formal appropriability mechanisms than product innovations. The fact that the positive link between cost-oriented strategy and formality quotient holds after controlling for innovation type (product or process) supports the view that a given innovation may be protected differently depending on the strategy of the innovating firm.

Hypothesis 3 predicts that the association between adopting a cost-oriented strategy and the perceived importance of formal appropriability mechanisms relative to that of all appropriability
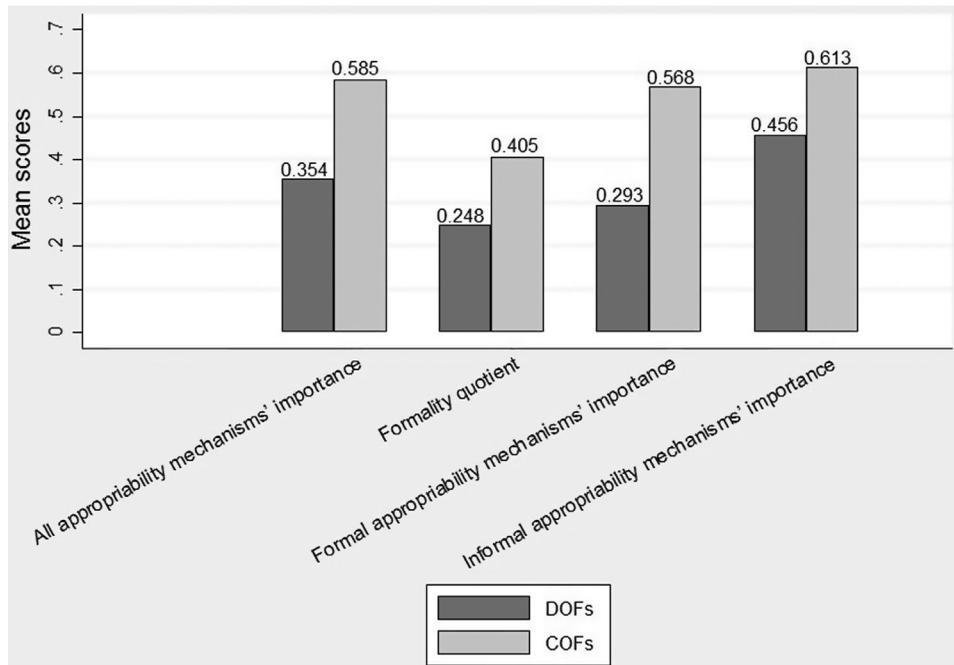
Figure 1. Mean scores of perceived importance of appropriability mechanisms by competitive strategy

mechanisms will be higher when these firms introduce process innovations. Models 5 and 6 augment the specification of Models 3 and 4 by adding an interaction term between cost-oriented strategy and process innovation. The coefficient of the interacted variables from the full specification (Model 6) is significantly positive ($\beta = 0.802$, $p < 0.05$). Since we estimate a non-linear model, additional checks are needed to confirm the statistical significance of the interaction effect (Ai and Norton, 2003; Berry, DeMeritt and Esarey, 2010; Bowen, 2012). We thus calculate the marginal probabilities for different combinations of the two dummies for cost-oriented strategy and process innovation and their differences, when all other covariates are set equal to their sample means. As can be seen from Panel B of Table 3, the effect of having a cost-oriented strategy on the probability of perceiving formal appropriability mechanisms as relatively more important among all mechanisms is greater when COFs introduce process innovations (i.e. $\Delta Pr(Y)_2 = 0.304$, $p < 0.001$) rather than product innovations (i.e. $\Delta Pr(Y)_1 = 0.151$, statistically insignificant). Following Ai and Norton (2003), we compute the difference between the above two values to determine the interaction effect. The computed interaction effect is statistically significant (i.e. $\Delta\Delta Pr(Y) = 0.153$,

$p < 0.1$). We further check the extent to which the interaction effect obtained above (i.e. the 'total moderating effect') is mainly driven by the inherent non-linearity of the model (i.e. a 'structural moderating effect') (Berry, DeMeritt and Esarey, 2010; Bowen, 2012). We estimate a statistically significant negative and relatively small structural moderating effect (-0.032, $p < 0.05$). The direction and magnitude of the estimated structural moderating effect suggest that the estimated total moderating effect (0.153) actually arises from the inclusion of the interaction term. Taken together, these findings lend support for Hypothesis 3.

Finally, regarding national IP regime differences, results from Models 1, 3 and 5 offer some evidence that firms incorporated in the USA assign higher importance to all appropriability mechanisms and are characterized by a higher formality quotient compared with their UK counterparts. Given this study's empirical focus on KIBS firms, the prominent importance of formal appropriability mechanisms for US-based firms can be attributed to the greater potential to obtain formal protection for innovations relating to computer programs and business methods in the USA. This potential arises from the judicial interpretation that the Patents Act

Table 3. Regression results

Panel A. Fractional logit regressions

Variables	All appropriability mechanisms' importance		Formality quotient			
	(1) Coeff. (Rob.S.E.)	(2) Coeff. (Rob.S.E.)	(3) Coeff. (Rob.S.E.)	(4) Coeff. (Rob.S.E.)	(5) Coeff. (Rob.S.E.)	(6) Coeff. (Rob.S.E.)
Cost-oriented strategy	1.015** (0.394)	1.442*** (0.425)	0.647* (0.328)	1.003** (0.346)	0.305 (0.377)	0.695+ (0.403)
Cost-oriented strategy × Process innovation					0.887** (0.344)	0.802* (0.344)
Process innovation	-0.342* (0.151)	-0.392** (0.144)	-0.373** (0.144)	-0.401** (0.140)	-0.495** (0.157)	-0.521*** (0.151)
Number of innovations	-0.121 (0.093)	-0.223* (0.101)	0.051 (0.099)	-0.021 (0.102)	0.036 (0.103)	-0.035 (0.106)
Radical innovation		0.200 (0.234)		0.111 (0.304)		0.056 (0.310)
Radical not reported		0.698 (0.426)		0.455 (0.452)		0.433 (0.453)
R&D investments	0.873* (0.397)	0.731+ (0.409)	0.295 (0.414)	-0.206 (0.481)	0.278 (0.413)	-0.205 (0.480)
Formalized organizational knowledge		0.047 (0.266)		0.079 (0.272)		0.060 (0.273)
Number of employees	0.145** (0.056)	0.130* (0.061)	0.152** (0.056)	0.136* (0.067)	0.153** (0.056)	0.139* (0.067)
Cash holdings		-0.125 (0.735)		0.029 (0.592)		0.050 (0.591)
Tobin's Q		-0.015 (0.012)		0.004 (0.017)		0.003 (0.017)
Growth rate		0.084** (0.030)		0.043 (0.032)		0.046 (0.032)
Manufacturing		0.981* (0.460)		-0.035 (0.401)		-0.010 (0.404)
Innovation collaboration		0.623 (0.578)		1.200* (0.581)		1.164* (0.587)
Human capital		1.330** (0.451)		1.227** (0.425)		1.227** (0.427)
USA	0.706* (0.279)	0.288 (0.317)	0.902** (0.349)	0.517 (0.388)	0.888** (0.347)	0.513 (0.387)
Constant	-3.151*** (0.618)	-4.222*** (0.677)	-3.071*** (0.743)	-4.190*** (0.857)	-3.025*** (0.734)	-4.113*** (0.862)
Industry effects (7 dummies)	Yes	Yes	Yes	Yes	Yes	Yes
Observations	230	230	230	230	230	230
Log pseudo likelihood	-135.39	-127.91	-122.68	-117.79	-122.25	-117.48
Wald test	52.42	106.51	41.3	125.55	62.97	140.90

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$. Weighted results to correct for non-response.

Continued

Table 3. Continued

Panel B. Predicted probabilities for strategy and innovation combinations

Predicted probability	Value
Pr(Y │ Cost-oriented strategy = 1, Process innovation = 0)	0.401***
Pr(Y │ Cost-oriented strategy = 0, Process innovation = 0)	0.250***
Pr(Y │ Cost-oriented strategy = 1, Process innovation = 1)	0.470***
Pr(Y │ Cost-oriented strategy = 0, Process innovation = 1)	0.166***
First difference in predicted probabilities	
ΔPr(Y)₁ = [Pr(Y │ Cost-oriented strategy = 1, Process innovation = 0) − Pr(Y │ Cost-oriented strategy = 0, Process innovation = 0)]	0.151
ΔPr(Y)₂ = [Pr(Y │ Cost-oriented strategy = 1, Process innovation = 1) − Pr(Y │ Cost-oriented strategy = 0, Process innovation = 1)]	0.304***
Second difference in predicted probabilities	
ΔΔPr(Y) = ΔPr(Y)₂ − ΔPr(Y)₁	0.153⁺

***p < 0.001, **p < 0.01, *p < 0.05, ⁺p < 0.1.

includes 'anything under the sun that is made by man' (Samuelson, 2008). However, the country effect becomes insignificant as more firm-level variables are accounted for in Models 2, 4 and 6.

Sensitivity analysis

To corroborate our results, we conducted several additional analyses. First, acknowledging the existence of possible differences within the group of DOFs, we replicate the analysis presented in Table 4, after discriminating among firms competing on the basis of service leadership, unique services or customer intimacy. Service leadership firms become the reference category and we introduce two dummies for unique service and customer intimacy firms in the regressions presented in Table 4. The significantly positive coefficient of the strategy-oriented dummy in Model 1 continues to support Hypothesis 1 ($\beta = 1.895$, p < 0.001). Using a Wald-type test, we compare the magnitude of the estimated coefficients of COFs and customer intimacy-oriented firms. The test confirms that COFs are indeed more likely to perceive all appropriability mechanisms as important means of capturing value from innovation than are customer intimacy-oriented firms ($\chi^2 = 5.71$, p < 0.05). The significantly positive coefficient of the cost-oriented strategy dummy in Model 2 ($\beta = 1.436$, p < 0.001) provides further support for Hypothesis 2. The significant positive coefficient of the interaction effect between a cost-oriented strategy and process innovation in Model 3 ($\beta = 0.800$, p < 0.05) is consistent with the main regression results, reiterating support for Hypothesis 3. Furthermore, because differentiation-oriented firms appear to be (insignificantly) more innovative than cost-oriented firms (ln number of innovations = 1.19 vs 0.69, respectively; p = 0.102), we check the robustness of the results by replicating the analysis after excluding observations on the top 25% innovating firms in our sample. As can be seen from the results presented in Models 4–6, the aforementioned associations are confirmed.

Second, we check the sensitivity of our results to possible biases arising from idiosyncratic perceptions about firm strategy by our respondents. To minimize this possible source of bias, we repeat the analysis using a restricted sample, excluding

Table 4. Fractional logit regression results: further analysis of differentiation-oriented firms

	Full sample			Excluding top 25% of innovating firms		
	All appropriability mechanisms' importance	Formality quotient		All appropriability mechanisms' importance	Formality quotient	
	(1) Coeff. (Rob.S.E.)	(2) Coeff. (Rob.S.E.)	(3) Coeff. (Rob.S.E.)	(4) Coeff. (Rob.S.E.)	(5) Coeff. (Rob.S.E.)	(6) Coeff. (Rob.S.E.)
Variables						
Cost-oriented strategy	1.895***	1.436***	1.127*	2.031***	1.589***	1.236*
	(0.464)	(0.405)	(0.466)	(0.540)	(0.472)	(0.520)
Differentiation: unique service	0.592	0.607	0.593	0.572	0.591	0.587
	(0.438)	(0.425)	(0.427)	(0.488)	(0.524)	(0.526)
Differentiation: customer intimacy	0.674*	0.609	0.616	0.827*	0.618	0.634
	(0.342)	(0.409)	(0.406)	(0.369)	(0.412)	(0.407)
Cost-oriented strategy × Process innovation			0.800*			0.945*
			(0.351)			(0.376)
Process innovation	−0.428**	−0.431**	−0.552***	−0.585**	−0.538**	−0.712***
	(0.148)	(0.136)	(0.150)	(0.178)	(0.170)	(0.198)
Number of innovations	−0.247*	−0.034	−0.049	−0.235^{+}	−0.038	−0.069
	(0.102)	(0.104)	(0.108)	(0.140)	(0.118)	(0.122)
Radical innovation	0.277	0.178	0.126	0.204	0.172	0.104
	(0.240)	(0.311)	(0.316)	(0.271)	(0.292)	(0.296)
Radical not reported	0.892*	0.616	0.594	0.693	0.396	0.367
	(0.409)	(0.421)	(0.423)	(0.429)	(0.452)	(0.454)
R&D investments	0.835*	−0.101	−0.105	0.757	−0.084	−0.067
	(0.416)	(0.499)	(0.498)	(0.481)	(0.530)	(0.528)
Formalized organizational knowledge	0.098	0.136	0.115	0.034	0.017	−0.038
	(0.263)	(0.268)	(0.269)	(0.310)	(0.295)	(0.303)
Number of employees	0.144*	0.146*	0.148*	0.160*	0.129^{+}	0.130^{+}
	(0.062)	(0.072)	(0.072)	(0.071)	(0.078)	(0.077)
Cash holdings	−0.150	−0.032	−0.002	−0.165	0.430	0.481
	(0.735)	(0.580)	(0.583)	(0.780)	(0.683)	(0.692)
Tobin's Q	−0.015	0.002	0.002	−0.009	0.013	0.012
	(0.014)	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)
Growth rate	0.083*	0.041	0.045	−0.036	−0.085	−0.088
	(0.035)	(0.037)	(0.037)	(0.190)	(0.190)	(0.194)
Manufacturing	0.945*	−0.084	−0.064	0.698	−0.466	−0.461
	(0.465)	(0.416)	(0.419)	(0.559)	(0.517)	(0.513)
Innovation collaboration	0.617	1.200*	1.163*	0.823	1.563**	1.533**
	(0.547)	(0.580)	(0.586)	(0.558)	(0.573)	(0.578)
Human capital	1.389**	1.259**	1.260**	0.012*	0.011*	0.011*
	(0.447)	(0.428)	(0.431)	(0.005)	(0.005)	(0.005)
USA	0.254	0.492	0.489	0.182	0.025	0.053
	(0.319)	(0.413)	(0.412)	(0.382)	(0.462)	(0.456)
Constant	−4.808***	−4.727***	−4.645***	−4.649***	−4.205***	−4.095***
	(0.696)	(0.888)	(0.894)	(0.804)	(0.998)	(0.988)
Industry effects (7 dummies)	Yes	Yes	Yes	Yes	Yes	Yes
Observations	230	230	230	170	170	170
Log pseudo likelihood	−126.54	−116.71	−116.39	−94.02	−83.54	−83.17
Wald test	124.70	148.26	168.68	83.09	72.59	87.14

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, $^{+}p < 0.1$. The default strategy category is 'Differentiation: service leadership'. Weighted results to correct for non-response.

respondents with less than 3 years of experience in their company at the time of the survey (as a result, the sample size dropped to 182 observations). The results reported in Models 1–3 of Table 5 suggest that the main relationships continue to hold.

Third, acknowledging the fact that our publicly traded sample firms might be competing by adopting different strategies when they are active in multiple product markets, we replicate the analysis using a restricted sample of firms which operate in no more than three industrial segments (as a result, the sample size dropped to 161 observations). The results reported in Models 4–6 of Table 5 show that our findings continue to hold.

Finally, we check the sensitivity of the results regarding Hypothesis 1. We replace the dependent

Table 5. Fractional logit regression results: sensitivity analysis

Variables	Respondents with more than 3 years of experience in the company			Firms operating in no more than 3 industrial product markets		
	All appropriability mechanisms' importance	Formality quotient		All appropriability mechanisms' importance	Formality quotient	
	(1) Coeff. (Rob.S.E.)	(2) Coeff. (Rob.S.E.)	(3) Coeff. (Rob.S.E.)	(4) Coeff. (Rob.S.E.)	(5) Coeff. (Rob.S.E.)	(6) Coeff. (Rob.S.E.)
Cost-oriented strategy	1.454**	1.106*	0.794	1.293*	0.800[+]	0.481
	(0.528)	(0.449)	(0.492)	(0.599)	(0.464)	(0.504)
Cost-oriented strategy × Process innovation			0.807*			0.910*
			(0.374)			(0.420)
Process innovation	−0.341*	−0.361*	−0.467**	−0.393*	−0.483**	−0.642**
	(0.157)	(0.145)	(0.160)	(0.169)	(0.186)	(0.208)
Number of innovations	−0.195[+]	−0.123	−0.133	−0.234[+]	−0.221*	−0.243*
	(0.113)	(0.120)	(0.120)	(0.130)	(0.111)	(0.114)
Radical innovation	−0.018	−0.371	−0.441	0.027	0.055	−0.014
	(0.260)	(0.334)	(0.355)	(0.315)	(0.319)	(0.329)
Radical not reported	0.894[+]	0.778	0.734	0.468	−0.089	−0.105
	(0.496)	(0.477)	(0.481)	(0.494)	(0.533)	(0.526)
R&D investments	0.471	−0.594	−0.610	0.893[+]	−0.146	−0.129
	(0.494)	(0.576)	(0.573)	(0.514)	(0.664)	(0.657)
Formalized organizational knowledge	0.163	0.312	0.302	−0.266	−0.190	−0.229
	(0.295)	(0.312)	(0.312)	(0.369)	(0.370)	(0.370)
Number of employees	0.092	0.050	0.051	0.134	0.117	0.122
	(0.067)	(0.067)	(0.066)	(0.091)	(0.095)	(0.095)
Cash holdings	−0.583	−0.055	−0.023	0.588	0.960	1.025
	(0.666)	(0.587)	(0.593)	(0.858)	(0.655)	(0.650)
Tobin's Q	0.015	−0.011	−0.015	−0.013	0.009	0.008
	(0.092)	(0.059)	(0.060)	(0.013)	(0.013)	(0.013)
Growth rate	0.065	0.034	0.041	0.117***	0.120**	0.124**
	(0.149)	(0.099)	(0.101)	(0.026)	(0.038)	(0.040)
Manufacturing	1.438**	0.154	0.169	0.882	−0.448	−0.456
	(0.492)	(0.387)	(0.381)	(0.597)	(0.591)	(0.581)
Innovation collaboration	0.993	2.427***	2.388***	0.171	1.871*	1.827*
	(0.635)	(0.621)	(0.630)	(0.741)	(0.865)	(0.869)
Human capital	0.021***	0.017**	0.017**	0.011[+]	0.012*	0.012*
	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
USA	0.100	0.636	0.631	0.143	−0.002	0.026
	(0.347)	(0.397)	(0.393)	(0.431)	(0.471)	(0.470)
Constant	−4.199***	−4.184***	−4.097***	−3.360***	−3.221***	−3.190***
	(0.738)	(0.863)	(0.875)	(0.849)	(0.890)	(0.881)
Industry effects (7 dummies)	Yes	Yes	Yes	Yes	Yes	Yes
Observations	182	182	182	161	161	161
Log pseudo likelihood	−98.24	−85.79	−85.59	−89.96	−74.09	−73.80
Wald test	111.90	158.95	161.35	110.88	110.28	131.32

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, [+]$p < 0.1$. Weighted results to correct for non-response.
N = 230. Weighted results to correct for non-response.

variable, which was measured using the transformed perceived importance of all appropriability mechanisms (i.e. 'all appropriability mechanisms' importance') with a raw measure: the significance assigned to each appropriability mechanism (running from 1 to 5) is added up across the eight appropriability mechanisms. Reflecting this change, we now employ a negative binomial regression specification (since the conditional variance exceeds the conditional mean of the perceived importance of all appropriability mechanisms).

The results reported in Table A2 in the Appendix are qualitatively similar to those of Models 1 and 2 of Table 3. Overall, these sensitivity checks lead us to conclude that our findings are rather robust.

Discussion and conclusions

This study advances our understanding of how KIBS firms capture value from innovation by

exploring the role of these firms' competitive strategy. The study articulated a theoretical account of how firms adopting different competitive strategies will treat their IP rights differently, tending to emphasize different appropriability mechanisms. Taking a problem-solving perspective (Nickerson and Zenger, 2004; Nickerson, Silverman and Zenger, 2007) and considering two broad strategy types (Conner, 1991; Porter, 1980, 1985; Treacy and Wiersma, 1995), we argued that the different competitive actions that cost-oriented and differentiation-oriented firms take to identify, select and solve client problems will affect their approach to capturing value from innovation.

We found evidence that COFs tend to perceive all appropriability mechanisms as being more important means of capturing value from innovation than DOFs. Furthermore, the perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms tends to be higher for COFs than for DOFs. These findings are consistent with the view suggesting that there are important differences in the way innovation takes place in the two sets of companies. It differs fundamentally in terms of the types of market targeted, the types of client problem addressed, the selected approaches to solving client problems, the realized returns to innovation and, ultimately, the innovators' capacity to capture the resultant value from innovation. Finally, the positive association between adopting a cost-oriented strategy and the perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms is shown to be stronger when KIBS firms introduce process innovations.

Our study contributes to two literatures. First, we contribute to research exploring how firms profit from innovation (Arundel, 2001; Hall *et al.*, 2014; James, Leiblein and Lu, 2013; Leiponen and Byma, 2009). We further our understanding of how firms capture value from innovation in the KIBS sector of the economy, which has been overlooked by previous studies. We propose and find evidence for the existence of linkages between competitive strategy and IP rights protection. These linkages hold even after controlling for the effects of innovation-, industry- and institutional-level factors that earlier research studied. Thus, consistent with the problem-solving perspective, there seem to be gains when firms align their

approach to value capture with the type of clients they select to serve and the problems they choose to solve. We also show that the positive association between adopting a cost-oriented strategy and the perceived importance of formal appropriability mechanisms relative to that of all appropriability mechanisms is stronger when COFs introduce service process innovations. This finding, which is broadly consistent with Barras' (1986) 'reverse product cycle' analysis, suggests that as COFs systematize processes to gain market share and expand to new markets, they have strong incentives to protect their IP early in the 'cycle' (otherwise, customers or competitors may exploit innovation-related knowledge). The heightened importance of formal protection for process innovation by cost-oriented KIBS firms hints at an additional source of possible differences in innovation by service firms relative to manufacturing firms (Mina, Bascavusoglu-Moreau and Hughes, 2014; Miozzo and Soete, 2001; Tether, 2005).

Second, we contribute to the strategy literature (Bowman and Ambrosini, 2000; Miles and Snow, 1978; Porter, 1980, 1985; Treacy and Wiersma, 1995) by finding evidence which supports the argument that a firm's approach to value capture is closely associated with the firm's broader competitive strategy. Although previous work has studied the links between competitive strategies and overall firm performance (Dess and Davies, 1984; Kim *et al.*, 2004; Zott and Amit, 2008), our study is the first (of which we are aware) to examine the influence of a firm's competitive strategy on the use of different appropriability mechanisms to capture value from innovation. The findings that COFs are more active in taking action to protect their innovation using various appropriability mechanisms, and favour formal appropriability mechanisms (more than DOFs), are consistent with the view that, because they compete on the basis of scale, scope and production efficiencies, they become more aware of the need to take action to capture value from innovation. As they systematize their knowledge to obtain scale, imitation by competitors becomes relatively easier. Also, because they engage with a relatively large network of suppliers and clients, relying on contractual agreements with several parties may be prohibitively costly. In contrast, innovation by DOFs may generate client-specific innovations which are sufficiently protected through resource immobility, causal

ambiguity and/or competitors' lack of absorptive capacity. These differences between COFs and DOFs accord with the view that a firm's competitive advantage comes from the way that the firm's full set of activities are aligned with one another.

These findings have two implications for managers seeking to increase the effectiveness of their firm's appropriability strategy. First, managers need to be aware that IP rights management needs to be placed in the context of their organization's broader competitive strategy. Value appropriation tactics should be decided only after accounting for a firm's broader strategic objectives. This requires cross-functional coordination to capture value from innovation (i.e. engaging a firm's IP rights counsel or Chief Intellectual Property Officer in the strategy-making process). The second implication is that the particular challenges experienced in service innovation (particularly service process innovation) imply that an early (pre-emptive) use of IP rights may be a necessity for service firms competing on the basis of scale and efficiency. Otherwise, if a competitor obtains formal protection first, then innovating firms may be blocked from developing new service offerings facilitated by these new methods of service production and delivery.

Our study is subject to limitations. First, our study is designed to uncover associations rather than to establish casual relationships between the competitive strategy and value appropriation from innovation. It seems reasonable to assume that a firm's innovation and appropriability strategies tend to account for the firm's longer-term strategic objectives (i.e. its competitive strategy in a Chandlerian sense; Chandler, 1962). However, we acknowledge that it is also possible that the conjectured potential to appropriate value from innovation will influence the competitive decisions of this firm. As a result, the relation between the two sets of variables is likely to be endogenous to a number of factors, including industry structure, the regulatory environment, professional standards and demand trends. Assessment of the direction of causality would require further analysis using longitudinal panel data over multiple respondents. Furthermore, as already mentioned, it is possible that the estimated association between competitive strategy and value appropriation may be affected by a different endogeneity problem: the self-selection of value capture approaches and competitive strategy by 'high-quality' firms. Despite our efforts to capture observable firm heterogeneity, our approach does not represent a perfect solution, particularly with respect to unobservable firm qualities.

Second, administering a parsimonious survey instrument (developed for time-constrained company executives) compromises our capacity to capture the complexity of a firm's competitive strategy. The relatively small effective sample of firms which were included in our analysis further restricts our ability to perform an exhaustive analysis of the competitive strategy–value appropriation association, such as to examine possible differences within cost- and differentiation-oriented groups of firms, or the cases of firms which are 'stuck in the middle'.

Finally, our proxies for the importance of different mechanisms for appropriating value from innovation are based on perceptual measures and single-source responses, which can be problematic. Future studies could assess whether the different appropriability mechanisms are actually successful in capturing value from innovation by using objective measures of innovation-induced performance (such as revenues from new service product and process innovations, or income from licensing fees).

Despite the exploratory nature of the study, our work enriches our understanding of the factors associated with the relation between competitive strategy and different approaches to value capture. By capturing information on competitive strategy, innovative activity and appropriability mechanisms, we shed new light on how – in the increasingly important context of knowledge-intensive services – firms capture value from their innovation. This opens fertile territory for further research into capturing value by service firms, and innovators more generally.

Appendix

Table A1. Indicative quotes from annual reports on competitive strategy

Strategy typology	Quotes from annual reports – indicative examples
Operational excellence	'Integral to our offering is our highly efficient operating and financial structure which ensures that we contain our central overhead, helping us to remain competitive whilst providing added value propositions. We use our extensive scale to procure services cost effectively and share these cost benefits with our clients.' 'By offering onshore, nearshore, offshore or blended service delivery options in a time zone that suits our clients, we can provide maximum flexibility, quality and cost savings in our sales propositions.' 'We have a global network of engineering centres delivering high performance, cost-effective technical solutions to our customers.'
Service leadership	'Our vision is to be recognized as the global leader in providing security outsourcing solutions, to help customers to achieve their own strategic goals and to deliver sustainable growth for [our company] and long-term value for shareholders.' '[Our company] is now a truly global organization, with a tremendous reputation for innovation, quality and world leading delivery… Through expert services, our company helps organizations strengthen their position in the cyber arms race by assisting them in identifying risk and formulating a robust security strategy.' The combination of [our company]'s leading technology, an outstanding customer base and improving distribution capabilities means we are confident of our future success.'
Unique services	'[Our company] is a leading petroleum consultancy best known for its unique global data holdings and services… [O]ur company now offers an expanded catalogue of data types and a growing suite of petroleum exploration studies created by our multidisciplinary teams of talented scientists.' 'Given our wide expertise across conventional, renewables and energy storage technologies as well as in electrical vehicles and future transportation infrastructure requirements, [our company] has an almost unique ability to support clients with power systems integration and optimization.' 'Our support portfolio is largely made up of systems that use unusual or legacy system components and are business critical. These "outside the mainstream" services can demand premium prices.'
Customer intimacy	'We offer high value client propositions tailored on an individual basis. Developing deep client relationships is at the heart of our strategy. We will become a deeper and more integral part of their success going forward through the provision of these organizational transformation services. Our goal is to be involved with our clients in a more holistic manner across all our divisions.' 'We have a commitment to building bespoke and exceptionally responsive investment services for clients and ensuring that our services are efficient, innovative and of outstanding quality.' 'Our people allow us to cultivate deeper relationships with our customers and clients by bringing the best of [our company] to each.'

Table A2. Negative binomial regressions

	All appropriability mechanisms' importance	
Variables	(1) Coeff. (Rob.S.E.)	(2) Coeff. (Rob.S.E.)
Cost-oriented strategy	0.163[+] (0.096)	0.245* (0.098)
Process innovation	−0.091** (0.033)	−0.101** (0.031)
Number of innovations	−0.034 (0.021)	−0.053** (0.020)
Radical innovation		0.061 (0.056)
Radical not reported		0.198[+] (0.103)

Continued

Table A2. Continued

	All appropriability mechanisms' importance	
	(1) Coeff. (Rob.S.E.)	(2) Coeff. (Rob.S.E.)
Variables		
R&D investments	0.267**	0.242**
	(0.089)	(0.091)
Formalized organizational knowledge		−0.014
		(0.060)
Number of employees	0.046***	0.046**
	(0.014)	(0.014)
Cash holdings		−0.133
		(0.174)
Tobin's Q		−0.003
		(0.003)
Growth rate		0.021***
		(0.004)
Manufacturing		0.229**
		(0.080)
Innovation collaboration		0.067
		(0.116)
Human capital		0.242*
		(0.112)
USA	0.236***	0.162*
	(0.066)	(0.075)
Constant	2.428***	2.273***
	(0.182)	(0.189)
Industry effects (7 dummies)	Yes	Yes
Observations	230	230
Log pseudo likelihood	−8035.61	−7829.69
Wald test	85.55	283.61

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, [+]$p < 0.1$. Weighted results to correct for non-response.
Note: We create an alternative measure of the dependent variable representing the perceived importance of all appropriability mechanisms by using the raw (untransformed) significance scores: the significance assigned to each appropriability mechanism (running from 1 to 5) is added up across the eight appropriability mechanisms.

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