

The potential link between corporate innovations and corporate competitiveness: Evidence from IT firms in the UK

Abstract

Purpose – The main objective of this research is to provide a thorough empirical investigation of the potential link between corporate innovations and corporate competitiveness in the context of the UK IT industry.

Design/methodology/approach – This research employs a panel of 216 UK IT firms for the period from 2000 to 2016. The sample data for this study were extracted from the Worldscope, extracted from the Datastream database from Thomson Reuters. For the analysis of the data, the generalised method of moments (GMM) model is applied.

Findings – The results of this study provide empirical evidence that there exists a strong, positive link between corporate innovations and corporate competitiveness. Such evidence further reinforces the common view in the current literature of strategic management that due to the nature of their business, firms in the IT industry need to enhance their innovative capacities on a continual basis due to their critical role on these firms' success and survival. Also, it is found that when the proxies for corporate innovations are lagged by two periods, their impact on corporate competitiveness becomes relatively more significant. However, when they are further lagged, i.e., by three periods, such an impact turns out to be relatively less pronounced.

Research limitations/implications – The data gathered for this paper was restricted to IT-oriented firms in the UK. Using a secondary database (Datastream), the paper considered the period of 2000-2016.

Originality/value – The research makes a significant contribution to the current debate on the relationship between information technology, innovation and performance, referred to in the literature as the productivity paradox, by studying the problem in the IT industry. It supports organisations from the sector in their efforts to deal with the dynamic nature of technological innovations and of the context where they operate. Methodologically, the way we have measured the concepts of innovation and performance and the lessons learned from their analysis have also brought value to the research.

Keywords – *corporate innovations, corporate competitiveness, IT firms, R&D activities, UK.*

Introduction

In the context of increasingly intense competition in the marketplace (Jafari Sadeghi & Biancone 2017a), it is essential for firms to enhance their innovative capacities constantly so that they compete effectively, survive, and grow (James, 2010). In particular, as noted by James (2010), when economies become more and more knowledge-based, innovation turns out to be the most important tool for firms to improve their competitiveness.

Further, empirical evidence suggests that the role of innovations becomes even more critical for firms in knowledge-intensive industries such as IT, biotechnology, and so on (Sallos, Yoruk & Garcia-Perez, 2017; Freeman & Soete, 2013; Ferraris, Santoro, & Dezi, 2017; Mokhtarzadeh et al 2018). For these firms, research and development have been consistently at the core of their corporate functions, which eventually determines their success (Cabagnols & Le Bas, 2002). Fundamentally, underneath a firm's research and development efforts, there is a strong knowledge creation and usage process that drives the firms to be innovative and competitive (Carnerio, 2000; Vrontis et al, 2017; Scuotto et al 2017; Papa et al 2018).

Research linking firms' competitiveness with innovations has been examined previously (e.g. Carayannis & Grigoroudis, 2014; Carayannis & Roy, 2000), however, there are pertinent gaps in knowledge that motivated us to undertake this study. Firstly, in previous studies proxies used for both corporate innovations and corporate competitiveness were qualitative in nature (Carayannis & Roy, 2000), and as such, the impact of innovation on firm competitiveness may not be generalisable. Secondly, majority of previous studies in the area have attempted to examine the potential link between corporate innovations and corporate competitiveness using pooled data, i.e., at the national economic level (Aubert, 2018; Charmes, Gault, & Wunsch-Vincent, 2018). As suggested by Freeman and Soete (2013), there are potential biases inherent in this approach, given that the role of corporate innovations on firms' corporate competitiveness varies significantly across industries.

To address the abovementioned problems, the primary aim of the current research project is to provide a thorough empirical investigation of the potential link between corporate innovations and corporate competitiveness. Using proxies, the strength of the relationship between innovation and competition will be assessed in this paper. Thus, the findings of this research contribute to the literature by highlighting that IT-oriented firms need to enhance their innovative capacities on a continual basis due to the latter's critical role on firm success and survival. From the methodological point of view, our findings reveal that when the proxies for corporate innovations are lagged by two periods, their impact on corporate competitiveness becomes relatively more significant. Furthermore, the empirical evidence of this paper suggests that as the product cycle in the IT industry is rather short, for the sake of their competitiveness, firms in this industry have had little choice but to ensure that their R&D activities are highly effective.

The remaining of the paper is structured as follows; the next section delves on a literature review focussing on knowledge management, innovation and firm competitiveness. The third section details the methodology used in the work and final sections discuss the results and contribution of the paper.

Theory Development

KM and Innovation

Innovation as a dominant source of firm competitive advantage has been considered in a wide range of studies (e.g., Scuotto et al, 2017; Augusto et al 2014). Du Plessis (2007) suggests that innovation within an organisational context is greatly dependent on the availability of diverse forms of knowledge. Knowledge management serves as an important coordinating mechanism that connects resources and capabilities to innovation (Darroch, 2005; Rezaei et al 2020). Especially, in the context of SMEs in the high-tech sectors such as biotechnology, investing in knowledge management initiatives has a significant impact on enhancing innovation performance (Alegre, Sengupta and Lapiedra, 2013). In their research, Bobilo, Rodriguez Sanz & Gaité (2006) find that investments in R&D and intangible assets such as knowledge have a significant impact on improving firm productivity and profitability. However, the impact of the firm's corporate innovation on its overall competitiveness remains understudied.

Corporate innovations and its measurement

In their most intuitive interpretation, corporate innovations refer to "the application of better solutions which meet new requirements, existing market needs or unarticulated needs that is obtained through more effective business models, processes, products, services or technologies" (Audretsch, 1995, p.54). In the context of increasingly intense competition in the marketplace, corporate innovations now have become the most critical competitive tool for any firms as they compete in terms of how they can provide their customers with new ideas, devices or methods (Caloghiru, Kastelli, & Tsakanikas, 2014). As suggested by Caloghiru et al. (2014), while there seems to have been a consensus on how the concept of corporate innovations should be measured, there are many practical challenges when it comes to the actual measurement of these innovations. The major reason why it has been the case is that previous studies in the area of corporate innovations have failed to reach an agreement on what is the primary purpose of corporate innovations.

Currently, there are two different views, with the first one holding that the primary purpose of corporate innovations is their financial impact (Dachs, Ebersberger, & Loof, 2007; Berube, & Mohnen, 2009; Jafari Sadeghi, Nkongolo-Bakenda, Anderson & Dana 2019) among others. In particular, as suggested by Dachs et al. (2007), the most critical corporate function of any firms is to create wealth for their shareholders, and corporate innovations are among the key tools that can allow them to do so. As corporate innovations allow firms to enhance their competitive advantage and hence compete better with their rivals, they will eventually experience more impressive financial performance and hence maximise their shareholders' wealth (Del Giudice, Campanella, & Dezi, 2016; Jafari Sadeghi & Biancone, 2017b). The authors, therefore, suggest that corporate innovations can be directly measured by return on innovation investment (ROII). This measure will take into account three major dimensions of corporate innovations consisting of (1) innovation magnitude, (2) innovation success rate and (3) investment efficiency. As suggested by Urem (2009), while this measure of corporate innovations help provide a rich insight into firms' business models as one can clearly see the different innovation strategies available to firms, its main drawback is that the lack of publicly available statistics, as well as common definitions, make benchmarking a huge challenge. For example, important questions such as "what does success mean?" must be answered in a consistent manner (Lieberman & Montgomery, 2008).

From another point of view, Feldman (2004), Becker and Dietz (2009) and so on argue that although the financial impact is most observable, it does not precisely measure firms' corporate innovations. Although corporate innovations are among the most critical drivers of firms' financial performance, these are not the only ones. As a result, the authors suggest that the primary purpose of corporate innovations is the enhancement in firms' organisational capability. Corporate innovations, therefore, can be measured by the presence of formal processes and structures which help foster corporate innovations; the number of new competencies i.e., distinctive knowledge and skill domains which facilitate corporate innovations; the effectiveness of employee training on corporate innovations i.e., the quality of training and guidance on how to evaluate the market potential of a new idea; the number of new-to- firm opportunities in new markets; the number of corporate innovations which noticeably advance current markets, to name just a few (Kamaruzaman, Ali, Ghani, & Gunardi, 2019; Del Giudice, Maggioni., Romano, & Nicotra, 2014; Becker and Dietz, 2009; Jafari-Sadeghi 2020). According to Becker and Dietz (2009), although it is much more difficult to measure corporate innovations by utilising these measures, they can help measure corporate innovations more precisely.

Largely in line with the above view of Becker and Dietz (2009), Robert and Stephen (2012), and Garcia-Perez, Gheriss and Bedford (2019) argue that such a way of measuring corporate innovations is more consistent with their definitions. The rationale here is that corporate innovations certainly allow firms to enhance their organisational capabilities so that they will be in a better position to come up with more effective business models, processes, products, services or technologies, thus being likely to meet new requirements, existing market needs or unarticulated needs. However, it is not completely certain that such innovations will be welcome and hence bring in financial success. Similar to the first measure, this measure of corporate innovations is also hard and subject to a lot of judgement (Dyer & Singh, 2008). For example, there has been no benchmark to evaluate the quality of employee training and guidance on how to evaluate the market potential of a new idea. In addition, according to Sadowsky and Sadowsky-Rasters (2006), formal processes and structures which support corporate innovations tend to vary significantly across industries, and there hence has been no definite answer on how these should be in order to foster innovations.

In brief, measuring corporate innovations is not an easy task, and until now, there has been no consensus on how they should be best measured. The key challenge is that measures of corporate innovations must overcome the problem of data unavailability and at the same time, are consistent with their definitions. As a result, Robert and Stephen (2012) suggest the use of R&D expenditures as well as intangible assets as measures of firms' corporate innovations. The rationale for the use of these two measures is that firms which invest more in their research and development tend to experience a higher level of innovative capacities and vice versa. In addition, according to the authors, while it is not certain that corporate innovations will lead to financial success, they certainly will result in a higher level of intangible assets. The use of R&D expenditures, as well as intangible assets as measures of firms' corporate innovations, is a perfect choice for the IT industry given the nature of their business models (Katz & Berkowitz, 2013). Specifically, Katz and Berkowitz (2013) show that given the critical roles of corporate innovations in firms' success in the IT industry, their business models tend to be highly innovation-oriented i.e., their employees usually receive significant training and

guidance on corporate innovations and massive investments have been made in enhancing formal processes and structures that foster innovations and research and development activities. In addition, the success of IT firms' research and development tends to be directly measured by the level of intangible assets in their balance sheets (Koellinger, 2008). Following this approach, the study will, therefore, also employ R&D expenditures as well as intangible assets as direct measures of firms' corporate innovations.

Corporate competitiveness and its measurement

Generally, competitiveness has been defined as firms' ability to provide their customers with products and services which meet their quality standards at competitive prices and achieve sufficient returns on the resources used in the production of products or rendering of services (Porter, 1990). Apart from corporate innovations, corporate competitiveness can provide a direct measure of firms' success (Levinsohn & Petrin, 2009; Buenechea-Elberdin, 2017). By definition, corporate competitiveness is all about firms' advantages that allow them to outperform their rivals. Corporate competitiveness can also be measured in a variety of different ways (Nazar & Saleem, 2009). In particular, this important concept has been measured by both financial indicators and non-financial indicators. First, the financial indicators of corporate competitiveness consist of sales growth, profitability and market share (Ospina & Schiflbauer, 2010; Widyaningsih, Gunardi, Rossi, & Rahmawati, 2017; Jafari Sadeghi, Biancone, Anderson & Nkongolo-Bakenda, 2019). In particular, as suggested by Ospina and Schiflbauer (2010), these are direct measures of corporate competitiveness. Their key strength is that these measures tend to be highly observable. The norm has been to consider firms which can grow faster, are more profitable and acquire greater market share (in terms of either volume or value terms) than their rivals as more competitive. According to Stojcic (2011), these financial terms of corporate competitiveness on average have been more commonly used than marketing terms, i.e., non-financial measures primarily due to the fact that they are more understandable and easier to communicate. In addition, data on these measures tend to be highly available. However, the main drawback of these indicators is that they tend to fail to capture the long-term nature of corporate competitiveness (Capon, 2010). In particular, Capon (2010) argues that the concept of corporate competitiveness is long-term in nature, while financial indicators tend to be short term. For example, firms' sales growth, profitability and market share can experience significant fluctuations over time while it is another story with the concept of corporate competitiveness. One immediate implication here, therefore, is that they do not precisely capture firms' corporate competitiveness which is something they in practice wish to obtain in the long run (Rothwell & Dodgson, 2014).

To overcome the limitations of financial measures, Capon (2010) suggests the use of marketing measures such as brand reputation, customer loyalty, and employee loyalty, and so on. According to the author, the use of these marketing terms is relatively more consistent with the long-term nature of corporate competitiveness than financial terms. This view has been supported by substantial empirical evidence in the area of strategic management that there is a close link between these and firms' long-term, sustainable success (Easterby, Thorpe, Jackson, & Lowe, 2008). Equally important, as suggested by Easterby et al. (2008), these indicators, by and large, can be considered as the key drivers of firms' corporate competitiveness while the financial indicators discussed earlier are basically its outcomes. The main reason why

marketing terms have been usually seen as better measures of corporate competitiveness than financial measures is that they are relatively more stable and hence consistent with the long-term nature of the concept (Ghauri & Gronhaug, 2009; Rouf, 2017). For example, there have been prominent empirical evidence that firms with strong brand reputation tend to outperform their rivals in the long run (Levinsohn & Petrin, 2019). Similarly, in the context of increasingly intense competition in the marketplace, customer loyalty now has been shown to be central to firms' long-term competitiveness as it allows them to attract new customers and retain existing ones better, especially when the costs of doing so have been higher than ever before. Finally, according to Easterby et al. (2008), committed employers have been always the direct force of firms' corporate competitiveness for they directly involved in the process of providing firms' customers with products and services which meet their quality standards at competitive prices, thus deciding whether firms can achieve sufficient returns on the resources used in the production of products or rendering of services. In both the current literature of marketing and that of strategic management, customer loyalty and employee loyalty have been consistently seen as the most important drivers of contemporary firms' corporate competitiveness (Stojic, 2011; Saidi, 2017).

While being claimed as being superior to financial terms in measuring firms' competitiveness, marketing terms have some very important limitations which eventually undermine their use among previous studies which examine the link between corporate innovations and corporate competitiveness. The most important limitation is probably that as suggested by Easterby et al. (2011), there has been no consensus on how these terms should be defined, thus making it a huge challenge to measure them. As a result, so far, there has been no consistency in the measuring of brand reputation, customer loyalty and employee loyalty. Further, secondary data on these terms are usually not available, and primary data, therefore, has to be collected (Tushman & Nadler, 2006). Primary research instruments such as surveys, interviews, and so on will need to be used to collect primary data on the considered issues. For large-scale studies like this study, it is far from feasible to do so, given the significant resource constraints. As a result, in this study, financial terms will be used as direct measures of firms' corporate competitiveness. Specifically, following previous studies in the area of strategic management, the major proxies for firms' corporate competitiveness will be firms' profitability, their market share in the domestic market and their percentage of foreign sales by their total sales (Jafari Sadeghi, Kimiagari & Biancone, 2019). The researcher is fully aware of their major limitations, and the use of marketing terms as more rigorous measures of firms' corporate competitiveness will be saved for future research.

The link between corporate innovations and corporate competitiveness

Previous studies in the area of strategic management have documented prominent empirical evidence on a close, positive link between corporate innovations and corporate competitiveness. As noted by Cabagnols and Le Bas (2002), French firms with greater innovative capacities which are reflected by the presence of formal processes and structures were found to help foster corporate innovations. These firms were found to be in a better position to compete well with their rivals, thus securing better financial performance and success. A variety of measures of innovative capacities were highlighted in the study, namely, the number of new competencies (distinctive knowledge and skill domains which facilitate

corporate innovations); the effectiveness of employee training on corporate innovations i.e., the quality of training and guidance on how to evaluate the market potential of a new idea; the number of new-to-firm opportunities in new markets as well as the number of corporate innovations which noticeably advance current markets, among others. The authors concluded that these processes, structures and measures resulted in incorporate innovations, which in turn helped to achieve corporate competitiveness. Such a close, positive link between corporate innovations and corporate competitiveness can be well justified given that their greater innovative capacities allow these firms to respond to market changes in a more effective manner and therefore achieve more impressive financial performance.

Largely consistent with the empirical evidence reported by Cabagnols and Le Bas (2002), examining the link between corporate innovations and corporate competitiveness using a larger sample of European listed firms, Lieberman and Montgomery (2008) finds prominent empirical evidence that firms with greater innovative capacities, i.e., higher returns on innovation investments tend to possess stronger brand reputation and higher levels of customer loyalty as well as employee loyalty. According to the authors, corporate innovations allow these firms to come up with better products and services which then enhance customers experience and satisfaction, thus resulting in higher levels of customer loyalty and hence stronger brand reputation. The key difference between this study with Cabagnols and Le Bas is that the authors utilise a variety of non-financial indicators of firms' corporate competitiveness rather than financial ones under the rationale that these reflect its long-term nature better. Indeed, a common view in the current literature of strategic management is that financial indicators do not reflect corporate competitiveness well due to their short-term nature (Skarzynski & Gibson, 2008; James, 2010; Agostini & Nosella, 2017; Agostini, Nosella, & Filippini, 2017).

Similar to the above studies, Hagedoorn (2012) also finds empirical evidence that there is a strong, positive link between corporate innovations and corporate competitiveness among US firms. Specifically, the author finds a high level of employee loyalty and commitment among firms with greater innovative capacities. It is argued that at these firms, on average make more effective investments on employee training and development with a view to enhancing their corporate innovations. As suggested by Kafouros (2005), more significant investments in employee training and development are clear indicators that firms are committed to the personal development of their employees, which then would be translated into a higher level of employee satisfaction and hence loyalty which is required for the successful implementation of firms' innovation strategies which need the long-term commitment from employees. Hagedoorn (2012) reports that empirical evidence is, by and large, consistent with the view in the current literature of strategic management that employee training on innovations can be considered as a stone that can kill two birds (Link, 2011). While enhancing their innovative capacities, firms can also improve their employee commitment and loyalty - a very critical dimension of their corporate competitiveness. Almost in the same vein, Robert and Stephen (2012) find a higher level of R&D expenditures as well as intangible assets as measures of firms' corporate innovations among firms which are deemed as having greater corporate competitiveness. The main reason why it has been the case is that, according to the authors, in highly research-intensive organisations, employees tend to have a lot of autonomy and flexibility in making their own decisions, thus being more satisfied with their jobs.

However, as Cohen and Levinthal (2009) suggest, the common problem among previous studies which try to establish the potential link between corporate innovations and corporate competitiveness is that there has been no agreement on the extent to which the two factors are related to each other. In other words, inadequate evaluation of the extent to which corporate innovations affect corporate competitiveness has been documented. This has been largely attributed to the difficulty in measuring these two factors, especially due to the qualitative nature of several proxies for both corporate innovations and corporate competitiveness. Indeed, according to Caloghiru et al. (2014), a very critical issue when examining the link between these two factors is the effective measuring of these two factors. For example, when proxies for corporate innovations such as the presence of formal processes and structures which help foster innovations and the effectiveness of employee training on innovations are employed, it is hard to comment on the magnitude of their impact on corporate competitiveness due to the difficulty in constructing variables that can precisely measure these. This line of arguments provides a strong case for the use of R&D expenditures as well as intangible assets as proxies for corporate innovations (James, 2010).

Based on the preceding discussion, the links between corporate innovations and corporate competitiveness, especially under a scenario of knowledge management, can hardly be overemphasised. We suggest that organisational initiatives leading to the generation and market introduction of corporate innovation will not only raise the firm's financial performance but also make it distinct in the marketplace, thus serving to make its products/services more attractiveness in the eyes of customers. Hence, we hypothesise:

'There is a strong, positive link between a variety of proxies for the firm's corporate innovations and its corporate competitiveness.'

This is depicted in the conceptual framework (Figure 1) guiding the study.

Please insert **Figure 1** here

An overview of the IT sector in the UK

According to the Office for National Statistics (2017), along with the creative industry, the IT industry has consistently experienced the most impressive growth over the last 10 years, and it will continue being one of the key drivers of the country's economic growth in the future. As one of the fastest-growing sectors in the UK, which is currently worth more than £70 billion, the IT sector accounts for approximately 4.5% of the UK's gross value added. In the meantime, it has consistently employed more than 1 million employees or nearly 4% of the country's total active population. As suggested by the Office for National Statistics, in 2018, the role of the IT sector will be even more critical primarily due to the fact that other industries are becoming more and more dependent on IT in order to function and operate more efficiently. In other words, as the UK economy becomes more knowledge-based, the sector will play a more critical role, and it has been estimated that it will contribute about 50% of the country's GDP (Gross Domestic Product) by 2030 (Office for National Statistics, 2017).

At the time being, the IT sector has been dominated by huge firms such as Microsoft, Ubisoft, Google, IBM, Accenture, Apple, Capgemini, Cisco, BT, EE, TalkTalk, Sky UK and

so on (Office for National Statistics, 2017). These firms have been competing severely with each other in areas such as hardware development, software development, services, infrastructure, information as well as a digital business. The general consensus has been that the impressive growth of the IT sector in the UK has been driven by three major forces consisting of (1) the increasing popularity of the internet, largely as a result of the increasing use of smart devices; (2) the impressive growth of e-commerce and (3) the prominent trends in automation and digitalisation in other industries (de Almeida, Lesca and Canton, 2016; Katz & Berkowitz, 2013). For example, it has been estimated that e-commerce sales reached more than £600 billion in 2016, thus accounting for about 20% of total business turnover in the whole country. In the meantime, sales made by EDI (Electronic Data Interchange) have been nearly £400 billion. What is even more striking is that by 2016, more than 90% of all firms in the whole economy have had internet access. These factors have created a lot of room for growth, but at the same time, have also made competition in the sector become more intense than ever before. To take advantage of the currently prominent trends in automation and digitalisation in other industries and translate these into growth, it is essential that UK IT firms will need to enhance their innovative capacities in a continual manner through effective research and development. As suggested by Freeman and Soete (2013), in any knowledge-based economies, firms now tend to compete with each other in terms of their corporate innovations. This helps explain why most successful IT firms in the sector have also been those that have been most research-intensive organisations (Koellinger, 2008; Hamed & Omri, 2013; Jafari Sadeghi, Jashnsaz, and Honari Chobar, 2014; Del Giudice, and Maggioni, 2014). Overall, the statistics about the UK IT sector point out the close link between corporate innovations and corporate competitiveness among firms in this sector.

Research Methodology

Data and Construct and variable measures

In the current study, proxies for corporate innovations will be R&D expenditures and intangible assets (Bresciani, Ferraris, & Del Giudice, 2016; Duodu & Rowlinson, 2019; Ferraris, Bresciani, & Del Giudice, 2016, Caputo, et al. (2016). In the meantime, those for corporate competitiveness will be various financial indicators, which have been employed by previous studies in the area (Ho 2005).

This research studies data from a panel of 216 UK IT firms, representing performance over the period 2000–2016. The sample data for this study were extracted from the *Worldscope* database from Thomson Reuters. The database *Worldscope* offers key financial value in the form of annual and quarterly report data (e.g. sales, net income total assets) for a large number of firms mostly listed in European Union countries. The two main criteria used for the selection of the sample was the country where the firm was registered (i.e. UK) and the perceived relationship with the Information Technology sector, defined by the type of products and services provided by the firm, ranging from software solutions for individuals and businesses to the development of hardware for different purposes such as network security. Although the size was not considered as a factor to exclude any firm from the study, the resulting sample was formed by 216 mostly small to medium firms.

As has been discussed, the major proxies for firms' competitiveness are their profitability, their market share in the domestic market and their percentage of foreign sales (foreign sales

divided by total sales). These proxies help measure the different aspects of firms' corporate competitiveness and have been widely used by previous studies in the area of strategic management. Moreover, the major proxies for firms' corporate innovations are the level of their R&D expenditures and intangible assets. This is based on the rationale that on average firms which invest more in their research and development activities tend to experience a higher level of innovative capacities and vice versa. The variables of interest are constructed as below.

Profitability: This variable is constructed by scaling firms' operating income (*Worldscope Datastream* item WC01250) by their net sales or revenues (*Worldscope Datastream* item WC01001). A higher ratio between these two firm fundamentals indicates that firms are more profitable and vice versa.

Market share in the domestic market: This variable is not directly available from *Worldscope Datastream*. However, the norm among previous studies in the area has been to take the percentage of firms' net sales or revenues over the total net sales or revenues of the whole industry in the same year (Tushman & Nadler, 2006). Following that norm, the market share in the domestic market of the sample firms has been calculated by dividing their net sales or revenues by the total net sales or revenues of the whole industry in the same year.

Percentage of foreign sales: This variable is constructed by scaling firms' foreign sales or revenues (*Worldscope Datastream* item WC07101) by their net sales or revenues (*Worldscope Datastream* item WC01001). A higher ratio between these two firm fundamentals indicates that firms are depending more on foreign markets for sales and vice versa. As discussed earlier, the general consensus in the current literature has been that firms with a higher proportion of foreign sales can be reasonably considered as having a higher level of corporate competitiveness since they can compete well with even foreign rivals (Robert & Stephen, 2012). As suggested by Robert and Stephen (2012), regardless of the fact that foreign sales are driven by many factors including firms' strategies, i.e., whether they focus on the domestic market or foreign markets, a more prominent presence in foreign markets in all cases would still indicate that they are highly competitive.

Level of R&D expenditures: This variable is constructed by scaling firms' R&D expenses (*Worldscope Datastream* item WC01201) by their total operating expenses (*Worldscope Datastream* item WC01262). There has been a lot of debate about how this variable can be constructed. As suggested by Becker and Dietz (2009) and Guidara and Boujelbene (2016), this measure can be constructed by dividing R&D expenses by net sales and revenues to get an idea about how much firms are willing to invest their resources in R&D activities. However, according to Dachs, Ebersberger and Loaf (2007), this way causes significant biases since very large firms may invest a lot in their R&D activities but due to the huge size of their net sales or revenues, R&D expenditures still account for just a small proportion of these, thus giving a false impression that these firms do not adequately invest in these important activities. By scaling firms' R&D expenses by their total expenses, that problem can be removed in an effective manner. In particular, Dachs et al. (2007) are of the view that constructing the variable in that way can effectively capture the level of research intensity of firms, i.e., how much of total operating expenses are allocated to R&D activities and hence how much firms are committed to these important activities. As a result, under that rationale, in the current research

project, the level of R&D expenditures will be constructed by scaling firms' R&D expense by their total operating expenses.

Level of intangible assets: This variable is constructed by scaling firms' intangible assets (*Worldscope Datastream* item WC02649) by the book value of their total assets (*Worldscope Datastream* item WC02999). A higher level of asset intangibility in all cases would indicate that firms' balance sheets are dominated by more intangible assets, thus reflecting a higher level of research intensity.

Data analysis

For the analysis of the data for years between 2000 and 2016, the generalised method of moments (GMM) model is applied. GMM estimator that enables testing of the robustness of the previous results (Blundell, Bond & Windmeijer, 2001). This method not only eliminates serial correlation and heteroskedasticity, but it also avoids the endogeneity problem (Bond, 2002). Therefore, in order to address the relationship between corporate innovation and corporate competitiveness, the following SYS-GMM model is developed:

$$\text{Model 1: } \text{COM}_{it} = \alpha_0 + \alpha_1 \text{INO1}_{it-n} + \alpha_2 \text{INO2}_{it-n} + e_{it}$$

The Model (1) posits that there is a linear link between corporate innovations and corporate competitiveness. In particular, the dependent variable in this model will be corporate competitiveness (COM_{it}). COM_{it} stands for the level of corporate competitiveness of firm i in year t . As discussed in the literature review, following previous studies in the area, the key proxies for this dependent variable will be (1) profitability, (2) market share in the domestic market and (3) the percentage of foreign sales (foreign sales divided by total sales). In the meantime, the independent variables are corporate innovations which are captured by the level of R&D expenditures and the level of intangible assets, i.e., INO1_{it-n} and INO2_{it-n} . As discussed earlier, there are various measures of corporate innovations consisting of the level of R&D expenditures and the level of intangible assets. It is worth noting that in this model, the independent variable is lagged by n years. The main reason why it is the case is that as suggested by Kafouros (2005), firms' investments in enhancing their corporate innovations in all cases would not have an immediate impact on their corporate competitiveness. Indeed, a vast body of current research in the area has acknowledged the lagging nature of the impact of corporate innovations on corporate competitiveness (see Bembe and Mohnen 2009) and Berraies (2019). As a result, following previous studies in the area, in the current research project, the independent variable will be lagged 1, 2 years to see how the direction, as well as the magnitude of the link between it and the dependent variable, may change. As such, panels A1, A2 and A3 are for Model (1) when the proxy for the dependent variable is profitability, market share in the domestic market and percentage of foreign sales, respectively and when the independent variables are lagged by one period. Meanwhile, panels B1, B2 and B3 are for Model (1) when the proxy for the dependent variable is profitability, market share in the domestic market and percentage of foreign sales, respectively and when the independent variables are lagged by two periods.

In Model (1), α_0 is a constant term, and e_{it} , by definition, is i.i.d. (independent and identically distributed error term (Creswell, 2002)). It is worth noting that α_1 is the most

important estimation coefficient in this model since its sign and size will provide an implication about both the direction and the magnitude of the potential link between corporate innovations and corporate competitiveness.

It is hypothesised that α_1 will be positive and the greater the value that this estimation coefficient is taking, the more pronounced the potential link between the two variables becomes. Also, it is worth noting that in the current study, largely consistent with a vast body of current research in the area, the UK IT industry is defined as both UK owned companies and non-UK companies based in the UK (see Stojcic (2011) for a complete review). As suggested by Stojcic (2011), the main rationale for this definition is to have an expanded sample population so that the potential link between corporate innovations and competitiveness can be more reliably established.

All the relevant descriptive statistics and regression analyses have been performed by using Stata. As suggested by Capon (2010), this econometric package tends to work particularly well with panel data.

Findings

This paper aims to investigate the influence of corporate innovation on corporate competitiveness in UK IT firms. In this regard, proxies for firms' corporate innovations are considered as the level of their R&D expenditures and intangible assets. Moreover, the firms' corporate competitiveness includes their profitability, their market share in the domestic market and their percentage of foreign sales. Table 1 provides some key descriptive statistics on the variables that are considered in the study. Overall, as can be seen from this table, the average operating profit ratio for all UK IT firms during the sample period is roughly 6%. However, this ratio has a rather high level of volatility (around 13%), thus suggesting that there are substantial differences among the sample IT firms in the area of profitability, a finding consistent with Wu, Popp and Bretschneider (2007) that the IT industry tends to be dominated by high- performing and low-performing firms rather than average-performing ones. One immediate implication here, therefore, is that firms operating in the IT industry are likely to experience a very high level of volatility in their corporate performance. Such a pattern is by and largely consistent with the common view in the current literature that extreme competition in the IT industry has been the major drivers of volatile corporate performance among firms in this industry (Urem, 2009). In the context of increasingly intense competition among firms in the IT industry, the role of corporate innovations on IT firms' success and survival eventually has become more prominent than ever before.

Please insert **Table 1** here

It is worth noting that in term of foreign sales, it seems that at the time being UK IT firms still mainly depend on the domestic market for sales since foreign sales have consistently accounted for less than 50% of their total sales. With regard to the level of R&D expenditures, it is clear that the sample firms have invested significantly in their R&D activities, a finding consistent with the view that to survive and succeed in the IT industry with extreme competition, IT firms have had no choice but to ensure that they need to enhance their corporate

innovations on a continual basis to make sure that they can compete well with other rivals in the industry. In addition, the summary statistics contained in Table 1 also show that the level of R&D expenditures among the sample IT firms have a high level of standard deviation, which has been probably driven by the significant difference in their R&D policies. Most importantly, consistent with the view that the balance sheet of IT firms tends to be overwhelmingly dominated by intangible assets due to the nature of these firms' business, as can be seen from Table 1, the sample IT firms appear to have a high level of asset intangibility.

Table 2 contains the main empirical evidence of the study on the potential link between corporate innovations and corporate competitiveness in the context of the UK IT industry. Overall, as can be seen from this table, there is prominent empirical evidence that there is a pronounced, positive link between corporate innovations and corporate competitiveness. In particular, in Panel A1 when profitability is employed as the proxy for the sample firms' corporate competitiveness, the estimated coefficients for the level of R&D expenditures and the level of intangible assets are 0.884 and 0.651, respectively. Both two estimation coefficients are statistically significant and suggest that when the level of R&D expenditures and the level of intangible assets among the sample IT firms increase by 1%, their profitability is likely to experience a rise of 0.884% and 0.651%, respectively. Such empirical evidence in all cases would imply that the link between corporate innovations and corporate competitiveness is highly pronounced.

Please insert **Table 2** here

*Numbers in parentheses are t-statistics. AR2 reports the p-value of the test for no second-order serial correlation, which is asymptotically distributed as $N(0, 1)$ under the null hypothesis of no serial correlation. ***, ** and * indicate that the coefficient estimates are significant at the 1, 5 and 10% levels of significance, respectively.*

The prominent empirical evidence on the close link between corporate innovations and corporate competitiveness among UK IT firms contained in Table 2 above is by and largely consistent with a vast body of current research in the area of strategic management. In particular, earlier studies in the area of strategic management have documented prominent empirical evidence on a close, positive link between corporate innovations and corporate competitiveness. In brief, regardless of whether non-financial indicators or financial indicators of firms' corporate competitiveness are used, previous studies in the current literature of strategic management have documented a strong, positive link between corporate innovations and corporate competitiveness (Skarzynski, & Gibson, 2008; James, 2010).

In Panel A2 where the proxy for corporate competitiveness is the sample IT firms' market share in the domestic market, there is also prominent empirical evidence that corporate innovations and corporate competitiveness are closely related to each other. Such empirical evidence is hence largely consistent with the common view in the current literature of strategic management, as discussed earlier. In brief, the empirical evidence on the close, positive link between corporate innovations and corporate competitiveness shown in Panel A2 of Table 2 further reinforces the view on the current literature of strategic management about such a link.

Finally, the empirical evidence contained in Panel A3 when the proxy for firms' corporate competitiveness is their percentage of foreign sales clearly indicates that corporate innovations

and corporate competitiveness are closely related to each other, which is largely consistent with the empirical evidence documented in the earlier two panels.

From Panel B1 to Panel B3, when the proxy for the dependent variable is profitability, market share in the domestic market and percentage of total sales, respectively and when the independent variables are lagged by two periods, the empirical evidence shows that the impact of corporate innovations on corporate competitiveness is even more pronounced. When there is an increase of 1% in the level of R&D expenditures and the level of intangible assets, the sample IT firms' profitability is likely to see a rise of 0.912% and 0.721%, respectively, compared to just 0.884% and 0.651%, respectively when the independent variables are not lagged. The relatively more pronounced impact of both the level of R&D expenditures and the level of intangible assets, when lagged on the sample IT firms' profitability, is largely consistent with the view of Kafouros (2005).

Finally, it is worth noting that when the sample IT firms' corporate competitiveness is proxy by their profitability, the potential link between corporate innovations and corporate competitiveness becomes relatively more pronounced than when it is captured by both the percentage of their foreign sales and market share in the domestic market. This is an interesting and important finding which suggests that further investigation should be made to see if it has any implication about how the concept of corporate competitiveness should be captured.

Robustness checks

As discussed earlier, the empirical evidence contained in Table 2 (from Panel B1 to Panel B3) clearly reveals that when the independent variables of Model (1), i.e., the level of R&D expenditures and the level of intangible assets are lagged by two periods, the impact of these measures of firms' corporate innovations on their corporate competitiveness appears to be more pronounced. In order to see if lagging the independent variables may have any significant effect on the magnitude of such an impact, in this robustness check, they are further lagged by one more period. The estimation results contained in Table 3 indicates that the magnitude of the impacts becomes relatively less significant than that when the independent variables are lagged by only two periods. This is an important and interesting finding which is by and largely consistent with the nature of firms' business in the IT industry. In other words, due to the fact that competition in the IT industry has been more intense than ever before, it is essential that firms in this industry must be in a position to come up with new products and services really quickly in order to be able to stand out well from competition. One immediate implication here, therefore, is that their R&D activities need to be really effective, which is largely consistent with the empirical evidence that the magnitude of the potential link between corporate innovations and corporate competitiveness turns out to be relatively more pronounced when the independent variables of Model (1), i.e., the level of R&D expenditures and the level of intangible assets which are close proxies for corporate innovations are lagged by two periods. However, it becomes less significant when these independent variables are further lagged.

Please insert **Table 3** here

Discussion of findings

The relationship between information technology and performance has been a matter of debate for decades. As a significant body of research on this subject emerges, findings are plagued with ambiguities and inconsistencies, particularly when it comes to the links between information technology, innovation and competitiveness. Carayannis & Roy (2000), for example, had suggested that technological innovation dynamics such as the speed of innovation should have a significant, positive impact on long-term firm competitiveness. On the other hand, authors such as Mithas and Rust (2016) have argued that companies are often challenged whether investments in technology will actually result in business value. This productivity paradox – first exposed by Brynjolfsson (1993), has since become the focus of analysis by scholars and practitioners from most sectors. Meanwhile, the digital era raises new questions about how technologies can improve organisational performance. This is particularly relevant for firms in the IT industry which, given the dynamic nature of their business and environment, have been under significant pressures to enhance their innovative capacities on a continual basis since their success and survival are largely shaped by their innovative capacities.

The present research, therefore, set out to contribute to the current debate on the subject by exploring the potential links between innovation and competitiveness in the context of the organisations within the UK IT industry. Data collected from 216 firms during the period between 2000 and 2016 reinforce existing views that corporate innovations have a positive, direct effect on corporate competitiveness. We found that as IT firms are heavily research-based operate in a highly competitive environment, enhancing their innovative capacities plays a critical role in shaping their corporate competitiveness and survival.

Not only are our findings consistent with those from part of the body of current research in the area of strategic management, but this research makes a significant contribution to the literature on the subject in different areas. Our approach to measuring both innovation and competitiveness opens new avenues for research and practice on this domain. By measuring innovation as a combination of the R&D expenditure of the organisation and the nature of its intangible assets, we have sought to better relate the information technology infrastructure of the firm and corporate performance. Competitiveness of the firm has been measured by considering a combination of its profitability, market share in the domestic market and their percentage of foreign sales. These findings are consistent with prior studies (e.g. Carayannis & Sagi, 2001; Santoro, Bresciani & Papa, 2018) that find that competitiveness in high-tech and cultural and creative industries is greatly facilitated by a focus on innovation.

In terms of the consistency of the link between innovation and competitiveness over time, we found that when the proxies for corporate innovations are lagged by two periods, their impact on corporate competitiveness becomes relatively more significant. However, when they are further lagged, i.e., by three periods, such an impact turns out to be relatively less pronounced. We found some empirical evidence to suggest that as the product cycle in the IT industry is rather short, for the sake of their competitiveness firms in this industry have had little choice but to ensure that their R&D activities are highly effective. This would be key in firms' efforts to launch new products and services faster than their competitors would.

Also in support of the above finding, it is worth noting that when the corporate competitiveness of our sample was captured by way of their profitability, the potential link between corporate innovations and corporate competitiveness turned out to be relatively more pronounced than when it was captured by both the percentage of their foreign sales and their

share in the domestic market. In other words, the magnitude of the impact of corporate innovations on corporate competitiveness becomes relatively less significant than that when the independent variables are lagged by only two periods. This reinforces the need for firms in the IT industry to be in a position to come up with new products and services more quickly than their rivals do if they are to stand out well from competition. One immediate implication here hence is that further investigation should be made to explore the different approaches to capture and measure corporate competitiveness.

Implications to theory

The study reports some empirical evidence on the lagging nature of the impact of corporate innovations on corporate competitiveness. The major proxies for corporate innovations appear to have a relatively more pronounced impact on corporate competitiveness when lagged by two periods, but the magnitude of such an impact starts declining when further lagging is involved. This pattern largely relates to the nature of products and services provided by firms in the IT industry. In particular, due to the fact that the cycle of IT firms' products and services tends to be rather short, and the impact of R&D activities on product development is hence rather immediate, it is critical for firms in this industry to be in a position to come up with new products and services more quickly than their rivals. One immediate implication here is that future research in the area should duly consider such nature so that the potential link between corporate innovations and corporate competitiveness can be established in a more effective manner.

Moreover, the findings of the study help establish the linkage between corporate innovation and firm competitiveness, by considering competitiveness as an organisational-level construct of interest. In doing so, the study results help in understanding the nature of competitiveness at the industry (Bobilo, Rodriguez Sanchez & Gaité, 2006) or sub-national or regional levels (Gonzalez-Pernia, Pena-Legazkue & Vendrell-Herrero, 2012).

Implications to practice

The reported findings of the study indicate that corporate innovations play a very critical role in IT firms' success and survival. In the context of increasingly intense competition within this industry, IT firms compete with and stand out from each other, mainly in terms of their innovative capacities. It is therefore essential that these firms need to design proper innovation strategies so that there will be effective formal processes and structures which help foster innovations. Overall, the empirical evidence to a large extent indicates that the more IT firms are committed to their research and development activities (as captured by the level of R&D expenditures) and the more effective these activities are (as captured by the level of asset intangibility in their balance sheet), the higher their levels of corporate competitiveness become. It is hence essential that more effective investments should be made in research and development activities so that IT firms can stand out well from competition to enhance their corporate competitiveness.

Limitations and future lines of research

This research has several limitations. First, the data gathered for this paper was restricted to a secondary dataset. In this regard, the variables were taken from Worldscope's Datastream

database from Thomson Reuters. However, future research can conduct primary research and investigate context-specific factors that influence on the relationship between corporate innovation and corporate competitiveness.

The second limitation of this paper is the timeframe of the applied panel (2000-2016) which includes a deep economic crisis in 2008. This may jeopardise the generalisation of the findings. Therefore, future lines of research might shorten this timeframe and analyse the information in recent years. Finally, the context of this paper was limited to IT-oriented firms in the UK. Thus, further studies can apply the same analysis in different contexts as well as other sectors.

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Figure 1. Conceptual framework for the study

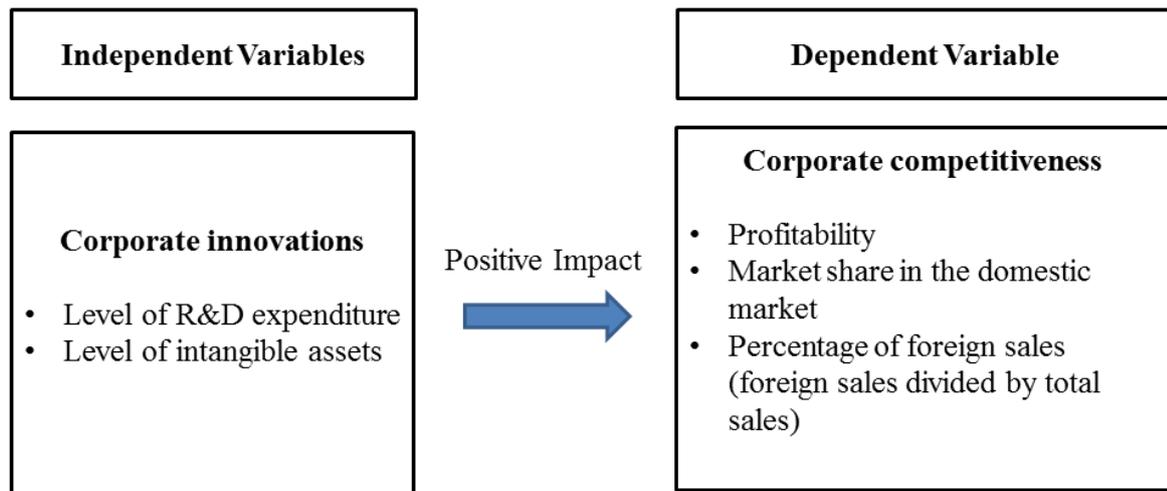


Table 1. Descriptive statistics

	Mean	Median	S.D.
Profitability	0.059	0.058	0.132
Market share in the domestic market	0.055	0.046	0.042
Percentage of foreign sales	0.241	0.250	0.149
Level of R&D expenditures	0.350	0.321	0.273
Level of intangible assets	0.396	0.412	0.163

Table 2. The link between corporate innovations and corporate competitiveness

	<i>Predicted sign</i>	Panels (the independent variables are lagged by one period)			Panels (the independent variables are lagged by two period)		
		A1 (Profitability)	A2 (Market share in domestic market)	A3 (% of foreign sales)	B1 (Profitability)	B2 (Market share in domestic market)	B3 (% of foreign sales)
Level of R&D Expenditures	+	0.884*** (3.59)	0.792*** (4.71)	0.813*** (4.25)	0.912*** (6.13)	0.837*** (5.28)	0.846*** (6.44)
Level of intangible assets	+	0.651*** (6.93)	0.576*** (5.84)	0.799*** (4.67)	0.721*** (8.10)	0.639*** (6.18)	0.852*** (4.19)
Intercept		0.001** (2.01)	0.004* (1.67)	0.003** (2.33)	0.002** (2.16)	0.003* (1.65)	0.004** (2.45)
AR2		0.06	0.05	0.07	0.03	0.02	0.03
Observations		3,517	3,517	3,517	3,517	3,517	3,517
#Firms		216	216	216	216	216	216

Table 3. The link between corporate innovations and corporate competitiveness (with further lagging of the independent variables)

	<i>Predicted sign</i>	Panels (<i>the independent variables are lagged by one period</i>)		
		A1 (Profitability)	A2 (Market share in domestic market)	A3 (% of foreign sales)
Level of R&D Expenditures	+	0.821*** (4.11)	0.810*** (4.92)	0.7.92*** (5.36)
Level of intangible assets	+	0.624*** (7.01)	0.588*** (6.03)	0.758*** (5.26)
Intercept		0.003** (2.28)	0.003* (1.60)	0.004** (2.46)
AR2		0.05	0.05	0.06
Observations		3,517	3,517	3,517
#Firms		216	216	216