Exploring survival rates of companies in the UK video-games industry: An empirical study

Ignazio Cabras [a,g,*], Nikolaos D. Goumagias [a], Kiran Fernandes [b], Peter Cowling [c], Feng Li [d], Daniel Kudenko [e], Sam Devlin [e], Alberto Nucciarelli [f]

[a] Newcastle Business School, Northumbria University, UK
[b] Durham University Business School, Durham University, UK
[c] Department of Computer Science, University of York, UK
[d] Cass Business School, City University of London, UK
[e] Department of Computer Science, University of York, UK
[f] Department of Economics and Management, University of Trento, Italy
[g] EU-Asia Institute, ESSCA Ecole School of Management, France

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ABSTRACT

The study presented in this paper investigates companies operating in the UK video-game industry with regard to their levels of survivability. Using a unique dataset of companies founded between 2009 and 2014, and combining elements and theories from the fields of Organisational Ecology and Industrial Organisation, the authors develop a set of hierarchical logistic regressions to explore and examine the effects of a range of variables such as industry concentration, market size and density on companies' survival rates. The analysis addresses locational dimension of the video-game industry is considered by introducing an extra regionally-related variable into the models, associated with the number of video-game university programmes locally available. In addition, companies are investigated with regard to their organisational type in order to identify potential effects associated with their intrinsic organisational structures.

Findings from the analysis confirm that UK video-game companies operate in an increasingly globalised market, limiting the effects related to any operation conducted at a local level. For instance, a higher supply of specialised graduates within spatial proximity does not contribute significantly to increase the chances of survivability of video-game companies, although different locations seem to provide better conditions and higher life expectancy, mainly due to positive network effects occurring at a local level. Results seem also to suggest that investing in managerial resources increases businesses' survival rates, corroborating evidence about the significant role entrepreneurs have for companies operating within innovative and technologically intensive industries.

1. Introduction

The number of studies addressing and investigating creative industries, thus industries whose main products and services are based on the provision and development of artistic and cultural activities, has increased significantly in the past 20 years. Creative industries are a relatively new concept and tend to be characterised by intensive process and product innovation (Marchand and Hennig-Thurau, 2013). Most of empirical research on creative industry currently focuses on music and audio-visual entertainment, with many studies exploring and examining the structure of these industries and the economic impact creative companies and workforces generate predominantly within communities located in urban areas, and how these function as a driver for innovation (Clifton, 2008; Florida, 2002; Parmentier and Mangematin, 2014). However, the number of studies analysing the video-game industry and its impact on economic systems remains relatively low.

Among creative industries, the video-game industry is probably the one that experienced the highest level of growth since its first development in the early 1970s. The industry has been characterised by numerous emerging and disruptive technologies which have constantly reshaped companies operating within it, completely changing industry's production processes as well as risks and opportunities for companies. This cyclical re-shuffling poses some questions in relation to how video-game companies can survive in such a volatile market, and about the implications for economies and supply chains at a regional level.

Particularly in the UK, the video-game industry registered a significant growth, fuelled by global hits from Grand Theft Auto IV (the fastest

* Corresponding author.
E-mail address: Ignazio.cabras@northumbria.ac.uk (I. Cabras).

selling entertainment product of all time), Runescape, Broken Sword and the Fable series. The UK is now one of the top five games developing countries, just behind the US, Japan, Canada, and South Korea. Recent suggest that the amount of business activities related with digital video-games could be worth as much as £1.72 billion to the UK economy with a Gross Value Added (GVA) of £540 million, with an annual growth rate of 22% in the number of active companies between 2011 and 2013 (Mateos-Garcia et al., 2014). The growth of the UK video-games industry has also an economic impact in terms of employment and investments. The industry employs over 10800 highly skilled development staff, the majority of which are employed outside London (TIGA, 2016). Being operating in an R&D intensive industry, two fifths of UK game developers have a dedicated R&D budget and spend on average 20% of turnover on R&D activities.

Despite these impressive figures and the success of the UK video-game industry, however, there is a significant paucity of studies addressing and investigating issues and challenges faced by businesses operating within this industry.

The aim of this paper is to contribute filling this gap by exploring and examining which factors have an impact on the survival rates of companies in the UK video-game industry. By developing their analysis on a unique dataset comprising information from videogames companies between 2009 and 2014, the authors depart from the traditional approaches used in the business management and entrepreneurship fields, and use a mixed approach with elements extracted from Organisational Ecology (OE) and Industrial Organisation (IO) theories to investigate locational dimensions alongside the diverse organisational types of newly founded companies operating in the industry. In doing so, the authors develop a set of hierarchical logistic regressions using variables such as industry concentration; market size and density, exploring companies' survivability and examining the relationship between potential entrepreneurial growth and economic performance in the UK video-game industry.

The paper comprises six sections including this brief introduction. Section 2 discusses the theoretical background and rationale behind the analysis of the industry, introducing the main aspects of OE and IO theories and examining the resource partitioning model as a potential bridge between OE and IO. Section 3 provides an overview of the video-game industry, starting with a brief historical analysis and then focusing on the UK. Section 4 illustrates the data analysis, including the hierarchical logistic models used to investigate companies' survivability in the industry. Section 5 explores the results gathered from the data analysis. Section 6 concludes.

2. Theoretical background

2.1. Measuring companies' survivability and performance

Assessing the levels of survivability of companies in a given industry or market is a challenging task. Several academic studies focused on examining the factors that affect entry rates and post entry performances of new companies (Armington and Acs, 2003; Evans and Leighton, 1989; Santarelli and Vivarelli, 2007). These factors can be categorised into three main groups: environmental or exogenous; related to the companies' location or organisational settings; or related to personal attributes and psychological profiles of companies' owners and managers (Evans and Leighton, 1989; Pennings et al., 2013). Some studies investigating newly founded companies argue that entry rates in a given market are driven by profit expectations associated with a favourable economic and legislative environment (Armington and Acs, 2003; Kirchoff and Armington, 2002; Orr, 1974), along with increased labour density in areas where companies are located (Krugman, 1991). Other studies focus on owners and entrepreneurs, using their psychological profiles and corresponding personalities to predict companies' success and/or failure rates (Steward, 1996). Other studies again focus on post-entry performances, using instruments such as financial

performances and benchmarking, and growth rates as main tools to understand companies' survivability (Murphy et al., 1996).

While all these different approaches help to understand how companies can adapt and survive within different situations and contexts, it seems that access to both financial and human capital remains a crucial aspect for newly founded companies (Boone and Van Witteloostuijn, 1996; Krugman, 1991). Many studies investigating the links between companies' survival rates and financial capitals identified a positive relationship between the two (Carroll, 1997; Holtz-Eakin et al., 1993). However, caution is required when interpreting these relationships as cause-effect, as access to funding may not have an immediate impact on new companies' survival rates in any given market (Carroll, 1997; Hannan, 1993). In addition, the ability of companies to attract and retain human capital, such as employees with specific skillsets and education, appears equally important in terms of survival (Preisendorfer and Voss, 1990).

The presence of specialised labour catchments within spatial proximity also appears to have a significant positive impact on companies' post-entry performances (Bates, 1990; Santarelli and Vivarelli, 2007). This positive impact is further enhanced by the ability of companies to match their needs with skillsets supplied locally (Armington and Acs, 2003). Moreover, companies started by entrepreneurs with a broader skillset and diversified expertise tend to survive longer in the industry, particularly when entrepreneurs are supported by specialist employees (Boone and Van Witteloostuijn, 1996; Evans and Leighton, 1990).

Contrary to the extensive empirical literature that revolves around entrepreneurship, companies' performances and entry-rates, the amount of research addressing theoretical frameworks explaining companies' survivability has been limited and sparse. Two main limitations may affect research progress in this field: firstly, causality effects are difficult to identify and disentangle within entrepreneurial processes; and secondly, there is a lack of empirical research examining companies' life expectancy and innovation after they enter a given market.

2.2. Combining Organisational Ecology (OE) and Industrial Organisation (IO)

The main approaches and studies used within the OE field focus on the identification and evaluation of factors resulting in companies' organisational success and failure. According to OE, the chances of survival for a company in a given industry, or its organisational survivability, are determined (or selected) by the corresponding environment (Winter, 1990). Empirical studies are predominant in the OE field and focus on entrepreneurship factors like new organisational formations, mortality process, life cycles of the companies and organisational structure (Carroll, 1997; Hannan, 1993). OE studies examine densities (number of companies in a sector) to investigate foundation and mortality rates as well as the population dynamics and patterns of evolution within the density and markets (Carroll, 1997). Some studies have investigated companies' life cycles using demographic characteristics such as companies' age, size, organisational structure and cultural values (Amburgey and Rao, 1996). While the relationship between companies' age, size and survival rates is not clear, there is a consensus among researchers that younger companies face greater exit risks, these indicated as liability of newness. However, since younger companies tend to be small in size, it is difficult to identify and distinguish between age and size effects - these indicated as liability of smallness – when examining companies' survival rates.

Generally, OE approaches appear to provide not only the context for policy implications, but also a range of comprehensive mapping systems to understand dynamics and networks involving companies operating in a given environment or spatial context (Boone and Van Witteloostuijn, 1995). According to IO, three types of market structures have an impact on a given industry performance: i) a concentrated market, ii) a fragmented market and iii) a dual-market (Boone et al., 2009). The type of market structure is determined by the concentration and

population of firms within a given industry (Boone and Van Witteloostuijn, 1996). A concentrated market is characterised by high density and low population of companies operating in it (e.g. in the video-game industry, this is the case of the hardware side of the market). A fragmented market represents exactly the opposite case of a concentrated market, with many companies and low density population. Finally, a dual market is characterised by both high concentration and high density of the firm population.

One of the main criticisms to OE is that it generates little practical and policy implications for management (Graham and Van de Van, 1983). While acknowledging such limitation, Boone and van Witteloostuijn (1995) suggest an approached derived from cross fertilisation between OE and elements derived from IO. This is because IO approaches tend to focus on one or more specific dimensions of organisational survivability that can be directly associated with companies' financial performances, narrowing the environmental impact on companies down to market structures (Boone et al., 2012).

Both OE and IO use industry performance to investigate and understand economic markets as well as companies' behaviours (Boone and Van Witteloostuijn, 1995). However, while OE studies tend to emphasise on industry's population density to explain companies' chances of survival, IO studies focus on market concentration, roughly described as the portion of the market that is controlled by the largest four companies operating in a the market (commonly referred as 'C4'). In addition, IO studies tend to indicate high flexibility to adapt to environmental changes as the most important skill companies have to maximise profitability and consequently chances of survival, although there is a significant paucity of mortality rate-based research within the IO literature. Conversely, there are a number of empirical OE studies which explore market population densities with regard to companies' survival rates. These studies investigate companies through time, starting from their foundation, to identify opportunities and challenges that may affect their conduct and behaviour and threat their own existence.

According to Boone and van Witteloostuijn (1995), IO and OE are complementary: OE targets similarities of organisational forms within a homogenous population and explores their emergent dynamics, while IO focuses on the endogenous variety of economic organisations and related behavioural differences. Hence, insights from both literature streams appear to be necessary in order to understand the dynamics within and between organisations' types and populations.

Bridging between the OE and IO theories is the resource partitioning theory proposed by Carroll (1985), which explains the entrance of new firms into a mature market. As many industries appear to present an initial trend of increasing market concentration, the rise that gradually occurs over the long term is usually followed by the appearance of a number of small firms once the market is near to saturation (Carroll, 1985, Carroll and Swaminathan, 1992). Therefore, in a market characterised by a finite set of heterogeneous resources, firms initially attempt to find a viable position within this market by targeting their products to various resource segments. Given the increasing returns to scale, the most intense fighting occurs in the densest or most abundant resource areas, determining the rise of two different categories of firms: the 'generalists' and the 'specialists'. The generalists will initially establish themselves in their respective regions, and then will move toward acquiring larger segments of the market. This strategy will eventually lead to large generalists outcompeting smaller ones based on strong economy of scale in production, marketing, or distribution.

The competitive struggle among generalist firms in a mature industry leaves some peripheral space for the rise of specialists, which occupy the resource portion that lies outside the generalist target areas (niches). The specialist firms will choose narrow homogenous targets, mostly developing at a regional scale, and will tend to remain small, adapting themselves to the size of resources available in their respective areas of operations, contrarily to generalists that will try to expand the range of their operations. Hence, when resources are sufficient to sustain a specialist segment, the market can be said to be "partitioned" in

that it appears that generalist and specialist firms do not compete as they depend on different parts of the resource base.

Moreover, when the population of a given organisational form shrinks, the market share of larger companies' is expected to increase substantially. As a result, market concentration increases when population density drops, although this is not always the case. Therefore, both market concentration and population density should be taken into consideration when exploring competitive dynamics within a given population. In addition, market concentration and population density frequently coincide (Hannan and Carroll, 1992). In such case, resource partitioning would provide a valuable tool to explore the limits of OE as well as to define a more rigorous IO-based analysis (Baum and Mezias, 1992).

The resource partitioning theory seems to represent a natural intersection between OE and IO fields with regard to understanding companies' survivability. By addressing the interrelationship between two organisational trends in the industry, the model identifies companies' competitive conducts dictated by their sizes with survival rates affected by age and size (and associated with liability of newness and liability of smallness respectively), arguing that new and small companies face increased mortality rates. However, the positive effects of age and size can be easily reversed, especially in changing environments, due to the inertia that the companies nourish through their growing and aging process (Carroll and Hannan, 2000).

3. The video-game industry

3.1. A brief historical overview

The development and commercial release of the video-game *Computer Space* in 1971 marked the birthday of the video-games industry (Kent, 2010). Video-games, as inherently all digital products at that time, required the existence of two interdependent components, namely *hardware* and *software* – a combination still used today. The hardware is the *platform* that enables players to interact with the video-game or software. Due to technological limitations, both software and hardware were initially integrated into a single product, a *booth* able to support one video-game only. However, increasing manufacturing and distributions costs and the relatively large size of the booth limited the diffusion of this product. To overcome these limitations, companies started to develop and distribute coin-operated machines, or "coin-ops". With coin-ops, users were able to play video-games on the spot by 'paying as you play', a business model similar to the one used for commercialising arcade-games such as flippers and slot machines (Kent, 2010). Coin-ops distributors tended to place their machines mostly in leisure parks, public houses and bars, which could guarantee regular catchments of potential players.

In 1972, a new company, Atari, launched the video-game *Pong*. The following year, with the commercial success registered by Pong and a substantial decrease in size and manufacturing costs of Central Processing Units (CPUs), Atari developed and launched Atari 2600, the first console in the video-game industry (Kent, 2010). Consoles proved to be revolutionary devices, able to enable players to experience more than one video-game, widen the demography of potential users and make video-gaming highly accessible and more family friendly. Consoles also produced a horizontal disintegration of the industry's value chain, creating significant market space for videogame developers. New independent companies of developers and publishers started to appear. Developers were either small companies or individual entrepreneurs involved in the design and development of video-game software packages, while publishers (or publishing companies) provided the funds to the industry by maintaining a portfolio of videogame titles (either developed internally or acquired by external partners), and by focusing on product marketing and sales (Newman, 2013).

The appearance of developers and publishers had a significant impact on the video-games industry, and placed console manufacturers

at the centre of a two-sided market structure (Rochet and Tirole, 2003; Lee, 2012). Technological advancements in the industry improved consoles in terms of speed, performance and graphic resolution. This progression set the pace of the videogame-industry, with a new generation of consoles being introduced approximately every five years making the market cyclical (Balland et al., 2011). The last generation of consoles, the seventh since the dawn of the industry, arrived in 2014, with the launch of *Playstation 4* by Sony.

Console manufacturers currently operate in a very challenging market. Regardless of rapid technological changes, production and distribution costs of console manufacturing increased market entry barriers and limited the number of hardware manufacturers to a handful of large multinational companies such as Sony, Microsoft and Nintendo (Lee, 2012). In recent years, a number of smaller competitors tried to introduce and launch low cost gaming platforms. One notable example is the crowdfunded console *Ouya*, which tried to take advantage of the digital distribution channels focusing on production cost minimisation (Goumagias et al., 2014). However, most of these attempts can be considered as niche approaches.

In the mid-2000s, the advent and fast development of smartphones, tablets and other handheld devices, transformed these as portable gaming platforms. In addition, the rapid improvement in wireless internet connectivity provided new opportunities for the digital game industry (Newman, 2013). Today, mobile and tablet based games represent the fastest growing market segment (Feijoo et al., 2012), supported by the significant growth of mobile technology as multitask platforms (Battard and Mangematin, 2013) and by the diffusion of innovative monetisation and business models, such as *free-to-play* or *freemium* (Goumagias et al., 2014). Mobile gaming has also expanded the reach for game-developers to a much wider demographic group both in terms of space and time. *Casual gaming*, as mobile gaming is commonly defined, is accessible anywhere, anytime. More than 40% of the player-base are female customers, with the typical game-player aging 30 years or above in many countries (Srinivasan and Venkatraman, 2010).

Today, the global video-games industry is highly concentrated. As shown in Table 1, the six largest national industries represent about two thirds of the market worldwide, with the US leading in terms of turnover, followed by UK and Japan. With an annual turnover of about £42 billion in 2014, the industry experienced an average annual growth rate above 8% at a global level since 1999, well above growth rates registered in the global economy or by other creative industries (Euromonitor, 2014).

The hardware side of the video-game industry is dominated by Sony (*PlayStation 4*, *PlayStation Vita*), Microsoft (*Xbox One*) and Nintendo (*WiiU*, *Nintendo DS*), which control about 88% of the global market. Sony accounts for about £5.1 bn in terms of unit sales, followed by

Microsoft (£4 bn) and Nintendo (£3.8 bn). Similarly, the software side of the video-game industry is characterised by heavy concentration, with seven large publishing companies representing about 64% of the global software market (Euromonitor, 2014). However, the rest of software market is more fragmented, with several smaller publishing and distributing companies operating from different locations, developing and commercialising video-game titles (Lee, 2012). These companies produce videogames (and related copyrights) either using in-house studios or by outsourcing, through acquisitions of or in partnership with independent third-party studios.

3.2. The UK video-game industry

The UK video-game industry began with clones of Atari's *Pong*, introduced in the UK market in the mid-1970s. While the US video-game industry developed on the skills and expertise provided by software developers operating in the personal computer industry led by established companies such as Apple and IBM; in the UK the industry developed in the early 1980s around the so-called 'bedroom coders', a whole generation of self-trained programmers, mostly teenagers still in school, who programmed and ran businesses out of their bedrooms (Izushi and Aoyama, 2006). Bedroom coders operated mainly on cheap programmable home computers and relatively unsophisticated platforms such as the Sinclair ZX Spectrum, the Commodore C64, and the Atari ST (Burnham, 2001). The majority of bedroom coders had no academic qualification and weak connection with the software-development industry. They were essentially independent programmers who provided the basis for the foundations of major video-game developer companies such as Codemasters (founded in 1986), or small studios such as Interactive Studio (founded in 1991, renamed Blitz Games in 1999) and Optimus Software (founded in 1988, renamed Atomic Planet in 2000).

Differently from what happened in the US and Japan, where video-game companies were already significantly investing in marketing and branding in both platform-consoles and published titles, the customer basis for UK video-game industry developed more informally using computer magazines and fanzines often available in local software stores, where gamers exchanged information on how to win games and developers shared programming codes (Izushi and Aoyama, 2006). Trade shows and conventions also provided a platform for exchange between amateur programmers and professional developers, with a number companies and spin-offs starting from encounters made during these events (Izushi and Aoyama, 2006).

In the early 1990s, the UK videogame console market went quickly under the control of only two companies, Sega and Nintendo. This situation was investigated by the British Monopolies and Merger Commission (MMC) which identified the presence of a duopoly where both

Table 1
The economic impact of global video-game industry.
Source: Euromonitor Passport Database, 2014.

	2009	2010	2011	2012	2013	2014
Global Market (£ mn)	41,035.8	41,366.0	41,199.7	39,244.2	40,013.4	40,147.4
Growth rate	−0.04	−0.001	0.033	−0.06	0.005	0.06
Largest national markets						
USA	14,212.3	13,560.8	12,432.2	11,226.8	11,486.1	11,333.6
Japan	4624.4	4629.5	4866.4	4556.0	3440.7	2820.6
UK	3774.8	3452.0	3241.0	2874.8	2984.3	3389.3
Germany	2147.6	2288.7	2419.3	2271.4	2439.4	2444.1
France	2951.6	2647.3	2602.5	2308.7	2365.0	2522.6
Korea	905.3	1134.9	1297.7	1439.8	1602.6	1678.8
China	650.3	774.1	955.0	1193.6	1475.3	1616.1
Software (£ mn)	16,381.10	15,596.20	14,788.70	13,413.40	13,663.90	14,665.00
Hardware (£ mn)	18,676.30	18,635.20	17,841.50	15,906.90	15,076.90	13,398.20
Digital (£ mn)	5978.50	7134.60	8569.50	9923.90	11,272.60	12,084.20
Software concentration (%)						
C4	44.30	46.00	46.60	48.20	49.10	N/A

Table 2
The UK video-game industry.
Source: Euromonitor Passport Database, 2014.

	2009	2010	2011	2012	2013	2014
Market size (£ mn)	3774.7	3452.00	3241.0	2874.90	2984.2	3389.30
Growth rate	−0.08	−0.15	−0.12	−0.19	0.03	0.11
Software (£ mn)	1702.90	1536.10	1423.10	1145.20	1051.50	967.70
Hardware (£ mn)	1704.80	1424.20	1164.50	922.40	995.10	1362.70
Digital (£ mn)	367.00	491.70	653.40	807.30	937.60	1058.90
Concentration (%)						
C4	60.68	65.93	72.92	83.39	85.99	N/A
Density	2020	2488	2808	2893	2437	N/A
Distribution (%)						
Physical	74.40	71.10	66.00	58.00	60.20	N/A
Digital	25.60	28.90	34.00	42.00	39.80	N/A

Table 3
Name and description of variables.

Variable name	Description
Status	Company status: active (1); inactive, dissolved/liquidated or dormant (0).
NO_DIR	Number of directors, used as a proxy for company size.
REG	UK administrative regions where companies are located; mapping based on postcodes (Factorial variable; benchmark: Yorkshire and the Humberside)
Type	Developer (1) and Publisher (0). classification based on companies' registered SIC (2007) code: 6201/1 Leisure software production activities, and 5802 Video-game publishing activities[*]
NO_COURSE	Number of undergraduate and postgraduate programmes related to video-game creation, design, production provided by universities or FE colleges in the region.
Age	Age of companies measured in years of activity.
DEN_FD	Population density of video-game companies at a national level (measured from the dates of each company's foundation).
DEN_FD_R	Population density of video-game companies at a regional level (measured from the dates of each company's foundation).
CON_FD	Concentration rate based on the four largest video-game companies operating in the UK national market (measured from the dates of each company's foundation).
MS_FD	Size of UK video-game market

[*] Companies are allowed to choose more than one SIC code to represent their economic activities.

Sega and Nintendo were console producers and software producers at the same time. Medium and small software companies in the UK were forced to develop videogames for one of the two platform consoles, while large software companies (who owned copyright of many successful videogames at that time) could develop and commercialise their games for both platforms. Bedroom coders gradually disappeared, with new developers formed in courses on video-game design and programming offered by several higher and further education institutions (Izushi and Aoyama, 2006).

In more recent years, the UK video-game industry has experienced an entrepreneurial boom with nearly 90% of the companies starting their activities in the 2000s or the 2010s (Mateos-Garcia et al., 2014). Between 2011 and 2013, the number of games companies grew at an annual rate of 22%, mainly driven by iOS companies producing games and applications for Apple (which comprise about three–quarters of the companies formed in the 2010s, Mateos-Garcia et al., 2014).

Today, the UK video-game industry generates an estimated annual turnover of £3.34 bn in 2014 (Table 2). The industry is mostly export-oriented, with over 95% of UK game businesses export at least some of their games/services to markets overseas (Mateos-Garcia et al., 2014). The software side of the industry accounts for about £2.3 bn and shows a high level of concentration, with the market share of the four largest companies passing from 60.7% in 2009 to 85.9% in 2013. Between 2013 and 2014, hardware sales increased by 36% mainly following the launch of a new generation of consoles, while the increase in software sales was just 2%. Data also indicate a steady decline of physical distribution channels compared to the digital ones, which represent a less cheap alternative for the local developers and publishers. This process corroborates the rapid consolidation process of the UK software market which potentially affects the survival of many SMEs currently operating in the industry (Carroll and Hannan, 2000).

The industry is geographically concentrated, with half of the companies based in London and the South of England, although it is possible to find some areas with a critical mass of games activity in terms of company numbers such as Cambridge, Cardiff, Dundee, Edinburgh, Manchester, Oxford, and Sheffield (Mateos-Garcia et al., 2014). These locations tend to host companies operating in other creative industries such as Design, Advertising, Software and Film, Video and TV. Infrastructure and presence of higher education programmes are also important factors for attracting video-game companies, with evidence of a link between better broadband access in an area and the extent to which games companies cluster there (Mateos-Garcia et al., 2014).

4. Methodology and data selection

While the UK video games industry is recognised as being world-class and highly innovative, it is still difficult to obtain hard data about its economic performance. The main challenges related to finding complete and reliable information about the businesses operating in the industry are mostly due to the lack of proper and complete Standard Industrial Classification (SIC) codes, which are frequently unable to capture the variety and peculiarities of video-game businesses in a consistent manner.

Therefore, in order to investigate survivability of companies in the UK video-game industry, the authors develop their analysis in two phases. In the first phase, they compile a dataset with information related to 3576 businesses operating in the industry between 2009 and 2014. Data gathered for generating the dataset were filtered from the FAME database, which provides sectoral information of the vast majority of UK registered companies captured by using the Standard Industrial Classification (SIC). The SIC classifies business establishments and other standard units by the type of economic activity in which these are engaged, using a four-digits code to identify companies. The UK government introduced a fifth digit to better identify a range of economic activities, including those associated with companies operating in the video-games industry. However, the SIC system implies that a company's corresponding code is selected directly by the company, meaning that a number of businesses elude the count. As a result, the sample analysed in this study does not capture the full population of UK video-game companies. Nevertheless, as the seven largest companies in the industry account for more than 70% of the market, the sample captures a significant amount of the economic activity within the UK video-game industry.

Table 3 provides a summary and description of all variables generated. The authors separate active companies from inactive companies, with the latter identified as dissolved, liquidated or dormant at the date of the last accounts available. These conditions are also used to determine when a given company exit the industry and to estimate population densities at regional and national levels. Furthermore, by using the SIC codes, the authors differentiate between publishers and developers (5821/0 and 6201/1 corresponding codes respectively).[1] In addition, a demographic analysis based on companies' length of activity is performed by verifying the effects of age (active or inactive) and type (publishers or developers) on survivability expectations of the selected companies. Non parametric statistical testing (Mann-Whitney *U* test) is used to verify whether companies' life expectancy, measured by

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[1] The identification of developers within samples was possible as the UK SIC 2007 code system provides a fifth digit to differentiate video-game developers from other software developers. Companies describing their economic activities as both 'publishing' and 'developing' (and so indicating two SIC codes) were identified as publishers as it is common for publishers to own development studios to support their IP portfolios.

Table 4
Descriptive statistics and tests[*] based on type and status of UK video-game companies that entered and/or exited the industry between 2009 and 2014.

		N	Minimum	Maximum	Mean	St. dev.	Z	Sig.
Type	*Publishers*	527	1.20	41.36	6.94	6.49	−8.339	0.000
	Developers	3049	1.22	56.77	7.96	5.91		
Status	*Active*	2109	1.20	56.77	9.28	6.39	−23.27	0.000
	Inactive	1467	1.22	35.59	5.69	4.67		
Active	*Publishers*	378	1.20	41.36	7.09	6.77	−12.29	0.000
	Developers	1731	2.42	56.77	9.76	6.2		
Inactive	*Publishers*	149	1.54	30.75	6.58	5.74	−1.154	0.248
	Developers	1318	1.22	35.59	5.59	4.53		
Publishers	*Active*	378	1.20	41.36	7.09	6.77	−0.778	0.436
	Inactive	149	1.54	30.75	6.58	5.74		
Developers	*Active*	1731	2.42	56.77	9.76	6.2	−26.83	0.000
	Inactive	1318	1.22	35.59	5.59	4.53		
Total		3576	1.20	56.77	7.81	6.01		

[*] Non-parametric Mann-Whitney *U*.

average age, is statistically different between two groups of companies, namely publishers and developers. Results indicate that the two groups differ significantly in terms of life expectancy, providing preliminary statistical evidence of resource partitioning in the video-games industry and hinting publishers acting as generalists and developers as specialists in the market.

In the second phase, the authors examine the presence of cause-effect relationships between selected variables and companies' survivability. These relationships are explored by developing and performing an explanatory analysis on a sample of 1925 companies, extracted from the main dataset by filtering companies with regard to year of market entry within the period 2009–2014. Survivability, used as dependent variable and captured by the companies' mortality rate, is investigated through logistic regressions, with the development of two hierarchical models operating on a single-entry single-exit event analysis. This exercise generates three models.

In the first model, variables are grouped into three categories: traditional OE and IO related variables such as industry's population density at foundation (DEN_FD), concentration at foundation (CON_FD), and software market size at foundation which includes both physical and digital products (MS_FD). The authors also include two variables, namely management team size and regional density, to further explore the geographical and organisational dimensions of the video-game companies.

The second model explores differences related to companies' rate of mortality in different parts of the country, grouping companies together based on where they started operations. Using NUTS2 classification, this exercise generates twelve geographical regions (forming the categorical variable REG). In addition, the model comprises a variable addressing regional density (DEN_FD_REG) and a variable identifying the number of undergraduate and post graduate course in the region based on information collected from UCAS (NO_COURSE).

The third model explores the video-games market structure and the dynamics between the main groups operating in the software side of the industry. The model evaluates the effect of a number of organisational-related variables on companies' survival rates, examining the presence of resource partitioning within the industry. Variables used in this model identify the type of the company in either publisher or developer (TYPE), and size of the management team size (NO_DIR). Differences in survivability between publishers and developers provide insights regarding resource partitioning within the industry along with the exact effect of the liability of newness to a video-game industry based company.

5. Results and discussion

Table 4 shows the age of sampled video-game companies and test for statistical significance among differences using the Mann-Whitney two-samples, non-parametric test. The average publisher is about

seven years old, one year younger than the average developer, with this difference possibly indicating an increased level of operational risk. By controlling data for activity status, active publishers are considerably younger (7.09) compared to developers (9.76). This may be due to resource partitioning processes in the industry leading the publishers to behave as generalists and to face greater risks compared to developers, which conversely may specialise and target niche bubbles appearing in the industry's resource space. In this context, the strategy adopted by the specialists is facilitated by the globalised industrial value chain.

Average ages at exit-time shows no statistically significant difference between publishers and developers: the liability of newness that publishers face is not much stronger compared to that faced by developers. Corroboration to this finding comes from the assumption that publishers' younger age cannot be attributed to the liability of newness, as there is no statistically significant difference between the average age of active and inactive publishers, while this hold true between active and inactive developers.

Pearson's correlation coefficients reported in Table 5 identify relationships among variables used in the logistic models based on the smaller sub-sample of 1925 companies. Coefficients suggest a strong positive relationship between companies' status (active or inactive) and size of management team. Density concentration and software market size (both physical and digital) also indicate a strong positive relationship with companies' status, ages and types. Moreover, the type of company is strongly negatively correlated the companies' status, indicating that the intrinsic organisational structure of the UK video-game companies as extremely important for their existence. University programmes available at a local level, added to the explanatory variables and measured as a multi-level factorial, seems also to be positively associated with companies' status.[2]

Table 6 presents results gathered from the three logistic regression models. In the models, any variable's coefficient (shown as EXP(B) the table) that exceeds one has a positive effect on companies' mortality rate (e.g. survivability increases). Conversely, a coefficient that is lower than one have a negative effect on a companies' mortality rate (e.g. survivability decreases). Distance from one provides a good approximation of the strength, either positive or negative, of the coefficient's effect on the dependent variables.

The first model, Model 1, is a basic model that examines the effect variables such as density, concentration and market size on companies' survivability. The model includes also local density and management team size as explanatory variables, with both variables strongly related to locational and organisational factors. Model 1 also acts as a structural

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[2] Initially, variables identifying both global video-game market size and hardware market size were included into the analysis. However, a very strong positive correlation between these two variables and the variable describing the UK software market deemed them unnecessary within the model construction.

Table 5
Correlation table.

	Status	NO_DIR	Type	NO_COURSE	Age	DEN_FD	DEN_FD_R	CON_FD	MS_FD
Status	1								
NO_DIR	0.220[**]	1							
Sig. 2-tailed	0.000								
Type	0.418[**]	0.330[**]	1						
Sig. 2-tailed	0.000	0.000							
NO_COURSE	0.052[*]	0.041	0.066[**]	1					
Sig. 2-tailed	0.024	0.074	0.004						
Age	0.324[**]	0.020	−0.124[**]	−0.018	1				
Sig. 2-tailed	0.000	0.943	0.000	0.437					
DEN_FD	−0.294[**]	−0.051[*]	0.037	0.034	−0.696[**]	1			
Sig. 2-tailed	0.000	0.026	0.101	0.140	0.000				
DEN_FD_R	−0.036	0.022	0.098[**]	0.210[**]	−0.325[**]	0.236[**]	1		
Sig. 2-tailed	0.110	0.338	0.000	0.000	0.000	0.000			
CON_FD	−0.316[**]	0.020	0.123[**]	0.018	−0.928[**]	0.603[**]	0.306[**]	1	
Sig. 2-tailed	0.000	0.381	0.000	0.419	0.000	0.000	0.000		
MS_FD	0.313[**]	−0.003	−0.119[**]	−0.021	0.965[**]	−0.686[**]	−0.321[**]	−0.997[**]	1
Sig. 2-tailed	0.00	0.903	0.000	0.368	0.000	0.000	0.000	0.000	

[**] Correlation is significant at the 0.01 level (2-tailed).
[*] Correlation is significant at the 0.05 level (2-tailed).

platform for the development of the following two models. The base predictability of the model (without any explanatory variables) is 55%, while the saturated version (including all explanatory variables) increases the predictability above 68%, providing a more accurate extrapolation.

In this model, density (DEN_FD), concentration (CON_FD) and market size (MS_FD) all have a negative effect on the firms' survivability in all three models. Higher market concentration along with market size (EXP(B) = 1.100) appears to undermine companies' chances to survive,

although density (EXP(B) = 1.001) seems to have a very small but significant effect on survivability. This finding suggests that, as market size changes and concentration increases, the generalists occupying the resource space impose progressively higher entry barriers for new entrants, contributing to their exit rate. In such situation, developers face less operational risk compared to publishers (as indicated by the small effect of density on mortality rate). The model shows some evidence of network externalities within local clusters, as indicated by the positive effect of local density on companies' survivability. In addition,

Table 6
Hierarchical logistic regression models with company status (active, inactive) used as dependant.

	Model 1			Model 2			Model 3		
Predictive power	68.4%			70.4%			72.1%		
Active	61.5%			67.9%			73.9%		
Inactive	73.9%			72.4%			70.6%		

	Model 1			Model 2			Model 3		
	B	Sig.	EXP(B)	B	Sig.	EXP(B)	B	Sig.	EXP(B)
Explanatory variables									
Constant	−15.23	0.000	0.000	−10.32	0.012	0.000	−16.94	0.000	0.000
NO_DIR	−0.339	0.000	0.702	−0.321	0.000	0.725	−0.178	0.000	0.837
DEN_FD	0.001	0.026	1.001	0.001	0.000	1.001	0.000	0.805	1.000
CON_FD	0.095	0.000	1.100	0.119	0.000	1.127	0.145	0.000	1.156
MS_FD	0.004	0.010	1.004	0.005	0.000	1.004	0.009	0.023	1.004
NO_COURSE				−0.087	0.000	0.917			
DEN_FD_R	−0.001	0.001	0.999	−0.092	0.007	0.912	−0.001	0.020	0.999
Factorial variables									
REG[a]									
(1) East England				−5.045	0.000	0.006			
(2) East Midlands				−6.179	0.000	0.002			
(3) London				−1.685	0.001	0.185			
(4) North East				−5.573	0.000	0.004			
(5) North West				−3.635	0.000	0.026			
(6) Northern Ireland				−8.588	0.000	0.000			
(7) Scotland				−6.365	0.000	0.002			
(8) South East				−3.039	0.000	0.048			
(9) South West				−5.730	0.001	0.003			
(10) Wales				−2.016	0.001	0.133			
(11) West Midlands				−0.236	0.479	0.790			
Type[b]									
(1) Developers							−2.260	0.000	0.104
Fitness tests									
Nagelkerke R-sq.	0.225			0.269			0.328		
Cox & Snell R-sq	0.168			0.201			0.245		

[a] Benchmark: Yorkshire and the Humberside.
[b] Identified by SIC: 62.01/1.

features related to organisational structure seem also to have an impact on companies' survivability as shown by the significantly positive coefficient of management team size.

The following model, Model 2, examines the differences in survivability among different regions of the UK, using variables such as regional density (DEN_FD_R) and local supply of academic programmes (NO_COURSE) focusing on video-game development and design. The introduction of the locational variable into the model marginally increases its predictability power to from 68.4% to 70.4%. Coefficients associated with Nagelkerke and Cox & Snell R-Square tests all indicate an improvement in terms of goodness-of-fit compared to Model 1.

Results gathered from Model 2 suggest that companies may face different operational risks depending on their location, and that higher education programmes available at a local level may positively affect companies' survivability (EXP(B) = 0.917). In the model, both market concentration and management team size (NO_DIR) show significant impacts, possibly hinting to positive network externalities at a local level that may lead to industrial clustering. By ranking different regions based on their survivability index, companies located in Scotland and East Midlands show substantially higher challenges to survive compared to companies located elsewhere. Although the impact of locational variables appear to be relatively week, all but one of them show significant, positive effects. This finding confirm location as an important attribute with regard to predicting companies' survivability in the market, possibly linked to networking opportunities and potential positive spill-overs that companies' agglomerations can create or benefit from at a local level.

Companies located in East England show good survivability rates compared to the benchmark, followed by those located in the South West and the North East of England which also seem to enjoy increased (albeit small) odds of surviving within five years from foundation. Conversely, companies located in London and the South East of England show increased mortality rates. Higher challenges experienced by companies operating in these two regions in terms of survivability could be explained by the fact that a strong positive correlation between entries and exits in a given industry is usually associated with increased competition captured by companies' density at a local level (Hannan, 1993). However, given the large variation in sample sizes extracted for different regions, these findings should be considered carefully.

The third and final model, Model 3, focuses on companies' form of organisation, using type as a factorial variable with publishers as benchmark category. The introduction of types of company as a factorial variable increases the predictability of the model to 72.1%, producing better results with regard to models fit (Nagelkerke and Cox & Snell tests are higher compared to those computed for previous models). Findings generated from Model 3 indicate that different types of companies face different levels of operational risk, further corroborating the presence of resource partitioning in the industry. As shown by the coefficient (EXP(B) = 0.104), developers (identified in the market as specialists) face substantially lower mortality rates compared to publishers (generalists). In addition, the positive effects associated with regional density and management team size remain statistically significant in all the three models, with industry concentration remaining the most important factor predicting companies' mortality rate.

6. Concluding remarks

The study presented in this paper explored and examined the companies operating within the UK video-game industry with regard to their levels of survivability in the industry. Using a unique dataset of video-game companies founded between 2009 and 2014, the authors developed a set of hierarchical logistic regressions to investigate the effects of a range of variables such as industry concentration, market size and density have on companies' survival rates. In particular, the locational dimension of the video-game industry was explored by

introducing an extra regionally-related variable into the models, associated with the number of video-game university programmes locally available. In addition, companies were selected by type to investigate potential effects associated with the intrinsic organisational structure on the models' predictive powers.

Findings from the hierarchical logistic regression analysis confirm that UK video-game companies operate in an increasingly globalised market, limiting the effects related to any operation conducted at a local level. For instance, a higher supply of specialised graduates within spatial proximity does not contribute significantly to increase the chances of survivability of video-game companies, although different locations seem to provide better conditions and higher life expectancy, mainly due to positive network effects occurring at a local level. This corroborates evidence of agglomeration and clustering effect in the industry (Mateos-Garcia et al., 2014) and may affect survival rates for UK video-game companies at a sub-national level. Results from the model seem also to suggest that investing in managerial resources increases the survivability of companies, corroborating evidence about the significant role entrepreneurs have for companies operating within small, new and technologically intensive industries (Carroll and Hannan, 2000).

From a methodological perspective, the analysis has combined elements and theories from the OE and IO fields. On the one hand, IO theoretically intensive approaches tend to focus on companies' financial performances as sole drivers of survival rates, using these tools to understand market structures. On the other hand, OE empirically-based approaches are mainly based on market densities and focus on foundation rates and companies' conducts in order to predict survival rates. Within the existing literature, many scholars identified complementarity between these two fields of research, highlighting the advantages derived from cross-fertilisation. Results from this study suggest that locational variables increase the predictability of an empirical investigation, although organisational variables bear more significance when it comes to predictive power. Hence, a combination between IO and OE approaches seem optimal in investigating and examining survival rates in the video-game industry, and can be applied to other creative industries.

Using the lenses of resource partitioning theory, it appears that video-game publishers operate within the UK industry as generalists, while developers act as specialists. Publishers seem to target many customer segments within the market, trying to occupy as much resource space as possible. This situation increases the entry barriers for new publishers in the industry, with these struggling not only to establish a portfolio of video-game titles but also to compete in a globalised market. Conversely, developers tend to exploit creativity and network resources, securing enough space to focus on product innovation. In the case of developers, technological progress in the form of digital distribution and cloud gaming seems to facilitate and support their business activities. Moreover, developers appear to experience significantly lower exit rates compared to publishers, as the increasingly globalised market enable them to operate on resource bubbles within the industry more flexibly and dynamically.

The findings of this study contribute to understand a very dynamic industry and shed some light on potential future developments for UK video-game companies. For instance, the low impact of locational variables in terms companies' survival rates identified by the econometric analysis can be examined in light of recent policies adopted by the British government in support of the digital video-game industry. Since 2012, and following years of industry lobbying, video-game companies are able to claim a 25% tax break on the production of games set in the UK or that include characters from the UK, and on the basis of production staff resident in the UK (Cookson, 2014). In 2016, the Independent Games Developers Association (TIGA) called for renewing and increasing the video games tax relief up to 30%, asking the government to review and ease eligibility criteria to enable more game-makers access to existing tax breaks (Qassim, 2016).

The data analysed in this study are not able to capture the effects of such policy on digital video-game companies. However, this fiscal stimulus should provide a valid incentive to companies with regard to increasing recruitment. For instance, video-game companies could use tax breaks to attract new employees, offering more appealing positions in terms of salaries and benefit packages. This might help companies located in London and the South East of England, identified as those suffering higher mortality rates in the models developed in this study, by providing relief and potentially avoiding unnecessary closures. However, tax breaks could also help companies located outside these two areas, bringing multiple advantages with regard to agglomeration and spill-over effects, with the potential of creating new hubs for talented and skilled/trained workers for the UK digital games industry.

In addition, tax breaks could provide incentives for companies to invest in new technologies such as cloud computing, augmented reality and virtual reality. For instance, many of the companies investigated in this study have started to explore how to exploit cloud computing which appear to offer opportunities for video-game streaming services. In May 2015, NVidia, a Graphics Processing Unit (GPU) manufacturer, released a new cloud-based console.[3] Other approaches to cloud gaming include OnLive and Gaikai (Goumagias et al., 2014). However, while cloud-gaming technology has the potential to eliminate the cyclicality associated with the console-based products, video games prove to be very demanding in terms of infrastructure. Further developments in this direction may result in a complete re-shuffling of the video-game industry, bringing full integration for a wide range of digital products into a unified system.

Another potential development for this research, other than further investigate the intrinsic organisational attributes of each company, could relate to patterns of financing and accessing resources for companies operating in the industry. Evidence gathered from other studies (Grantham and Kaplinsky, 2005; Readman and Grantham, 2006) suggests that developing companies face smaller challenges compared to publishers or hybrid companies. A possible explanation may relate to the smaller financial risk that these companies are exposed to. As demonstrated by this study, publishers act as the main financial sources in the industry, facing greater challenges in terms of survivability. While developers aim to create and sustain a competitive advantage through process and product innovation, publishers have to sustain an IP portfolio and constantly increase their customer share. This is probably the reason behind the hit-driven strategy that most publishers appear to opt for, which may lead these companies to invest in spinoffs of already successful titles instead of investing in the creation of new ones.

Moreover, this particular finding could help policymakers to design policies and initiatives which could provide further incentives to UK publishers toward creating new titles. For instance, expanding title portfolios might increase the propensity to risk of publishers, with the potential of widening the range of investments these companies might be willing to undertake. In such scenario, more diversified activities and investments attempted by publishers would likely to bring advantages to the industry overall.

The UK video-game market is ranked third globally and it has a deep-rooted tradition in terms of design, creating and production of digital games. Given the paucity of studies addressing companies operating in the industry, further research is needed in order to sustain the local video-game creativity hubs within the UK, and to inform practitioners and policymakers about the significance of this industry for the British economy. Equally, further research should be conducted in order to assess and understand the impact of the video-game industry worldwide.

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Ignazio Cabras is Chair in Entrepreneurship and Regional Economic Development at Newcastle Business School, Northumbria University (Newcastle, UK). He is also a Research Associate at the EU-Asia Institute, ESSCA Ecole School of Management (Angers, France) and a Fellow of the interdisciplinary York Centre for Complex Systems Analysis (YCCSA, York - UK). His research interests are focused on economics and environment, with particular emphasis on regional growth and development, public sector management, industry and innovation, knowledge economies and ICT.

Nikolaos D. Goumagias is a Research Fellow of Newcastle Business School, Northumbria University (Newcastle, UK). His research focuses on Decision Support Systems, Applied Optimization and Operational Research, Organisational Ecology and Simulation. Currently, his research focuses on the Games Industry Analysis as part of the New Economic Models and Opportunities for digital Games (NEMOG) Project.

Kiran Fernandes is Chair of the Operations Management Group at Durham Univeristy Business School, and a Fellow of the Wolfson Research Institute. He is also a Fellow of the interdisciplinary York Centre for Complex Systems Analysis (YCCSA). He worked as a sub-systems engineer at the NASA - John C. Stennis Space Centre working for the Late Tom Cobb (Product Director for the Space Shuttle Main Engine Program). Working at NASA also allowed him to complete a professional program from the Massachusetts Institute of Technology (MIT).

Feng Li joined Cass Business School in London as Professor of Information Management in January 2012, after ten years as Chair of e-Business Development at Newcastle University Business School. For 25 years, his research has focused on using digital technologies (ICTs) to facilitate strategic innovation and organisational transformation. This has included investigation of the economies of virtual and game worlds and sustainable business models for the creative industries [LI08, LI10].

Peter Cowling joined the University of York in September 2012, to take up a 50th Anniversary chair joint between The York Management School and the Department of Computer Science, based in the interdisciplinary York Centre for Complex Systems Analysis (YCCSA). He is well known internationally for his work on decision making in games and in operations management using Artificial Intelligence (AI), specifically tree search [COW12] and heuristic search [REM11].

Daniel Kudenko is a Lecturer in the Artificial Intelligence Group of the Computer Science Department at the University of York. His research is focused around machine learning (e.g, web data mining [TIN09]), user modelling, and artificial intelligence for games (e.g. interactive drama [BAR10]). He has published over 80 peer-reviewed papers in various areas of artificial intelligence, receiving a best paper nomination at the leading international evolutionary algorithms conference,

Sam Devlin received a MEng degree in Computer Systems and Software Engineering from the University of York, UK, in 2009. In 2013, he completed his PhD on multi-agent reinforcement learning at the University of York and visited Oregon State University funded by a Santander International Connections Award. His research interests are focussed on machine learning, multi-agent systems, artificial intelligence and game theory.

Alberto Nucciarelli is an Assistant Professor at the University of Trento (Italy). He previously worked at the Eindhoven University of Technology and as Research Scientist at Philips Research doing research on ICT economics and policy, business models in the digital industry, public-private interplay in municipal broadband projects, and health economics. He published in international peer-reviewed journals and regularly acts as guest editor and reviewer for different international journals.