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

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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 seemto provide better conditions and higher life expectancy, mainly due to positive network effects occurring at a local level. Results seemalso 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.

Keywords: Video-game industry, Survival rates, Organisational ecology, Industrial organisation, United Kingdom

1. Introduction

In the past twenty years, research in the field of regional economics 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 (Chapain et al, 2013). Creative industries are a relatively new concept and tend to be characterised by intensive process and product innovation (Marchand and Hennig-Thurau, 2013). Many authors have explored and examined the importance of creative industries in relation to local economic development (Chapain and Comunian, 2010), urbanisation and 'creative classes' (Florida, 2005; Andres and Chapain, 2013); transformation in work and society (Florida, 2002; Clifton, 2008); new skills and employment (Faggian, 2013).

A large number of studies in literature focus on music and audio-visual entertainment, with many of these studies exploring and examining the structure of these industries and the economic impact creative companies and workforces generate predominantly within urban areas (see, for instance, the extensive work of Florida on cities and the 'creative class'). However, the number of studies analysing the video-game industry and its impact on regional economic systems remains relatively low.

Since its first development in early 1970s, the video-games 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.

The aim of this paper is to explore and examine which factors have an impact on the survival rates of companies in the UK video-game industry. 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 regional studies field, and use a mixed approach with elements extracted from Organisational Ecology (OE) and Industrial Organisation (IO) theories to investigate locational dimensions alongside the diverse organizational 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 two 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 three provides an overview of the video-game industry, starting with a brief historical analysis and then focusing on the UK. Section four illustrates the data analysis, including the hierarchical logistic models used to investigate companies' survivability in the industry. Section five explores the results gathered from the data analysis. Section six 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 (Santarelli and Vivarelli, 2007; Evans and Leighton, 1989; Armington and Acs, 2010). These factors can be categorised into three main groups: environmental or *exogenous*; related to the companies' location or organizational settings; or related to personal attributes and psychological profiles of companies' owners and managers (Pennings et al. 2013; Evans & Leighton 1989). 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 (Orr, 1974; Kirchhoff and Armington, 2002; Armington and Acs, 2010), 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 (Stewart, 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 (Krugman 1991; Boone & van Witteloostuijn 1996). Many studies investigating the links between companies' survivability 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 (Caroll 1997; Hannan 1993). In addition, the ability of companies to attract and retain human capital, such as employees with specific skillset 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, Armington and Acs 2010). This positive impact is further enhanced by the ability of companies to match their needs with skillsets supplied locally (Armington and Acs 2010). 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 (Evans and Leighton 1990; Boone and van Witteloostuijn 1996).

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 and Industrial Organisation theories

OE focuses 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 highly determined (or selected) by the corresponding environment (Winter, 1990). Empirical studies are predominant in the OE field and focus on entrepreneurship, with particular emphasis on new organisational formations, mortality process, life cycles of the companies and organisational structure (Hannan, 1993; Carroll, 1995, 1997)**.** Many OE studies examine densities with regard to companies' foundation and mortality rates, investigating population dynamics and patterns of evolution within industries and markets (Carrol, 1995). Other studies investigate companies' life cycles using demographic characteristics such as companies' age, size, organisational structure and cultural values (Amburgey and Rao, 1996). While the relationship between age, size and companies' survivability is not clear, there is a consensus among academics 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). Nevertheless, 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 a cross fertilisation between OE and elements derived from IO.

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). 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.

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' survivability, 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 (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.

Bridging between the OE and IO theories is the resource partitioning model 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 towards acquiring larger segments of the market. This strategy wills eventually 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. 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.

The resource partitioning model seems to represent a natural intersection between OE and IO fields with regard to understanding companies' survivability. By addressing the interrelationship between two organizational 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 (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; Mirva et al 2008). 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 on 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 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 & 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 (Euromonitor 2014). 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 £5.1bn in terms of unit sales, followed by Microsoft (£4bn) and Nintendo (£3.8bn – Euromonitor 2014). 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.

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

	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	4,624.4	4,629.5	4,866.4	4,556.0	3,440.7	2,820.6
UK	3,774.8	3,452.0	3,241.0	2,874.8	2,984.3	3,389.3
Germany	2,147.6	2,288.7	2,419.3	2,271.4	2,439.4	2,444.1
France	2,951.6	2,647.3	2,602.5	2,308.7	2,365.0	2,522.6
Korea	905.3	1,134.9	1,297.7	1,439.8	1,602.6	1,678.8
China	650.3	774.1	955.0	1,193.6	1,475.3	1,616.1
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)	5,978.50	7,134.60	8,569.50	9,923.90	11,272.60	12,084.20
Software Concentration (%)						
C4	44.30	46.00	46.60	48.20	49.10	N/A

3.3 The video-game industry in the UK

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 ZX80 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, from the scene the UK videogame console market went quickly under 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 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 between 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 (NESTA, 2013). Between 2011 and 2013, the number of games companies grew at an annual rate of 22 per cent, mainly driven by iOS companies producing games and application for Apple (about comprise three–quarters of the companies formed in the 2010s, NESTA 2013).

Today, the UK video-game industry generates an estimated annual turnover of £3.34bn in 2014 (Table 2). Software side of the industry accounts for about £2.3bn 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 & 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 (NESTA 2013). 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 (NESTA 2013).

Table 2: The UK Video-game Industry. Source: Euromonitor Passport Database

	2009	2010	2011	2012	2013	2014
Market size (£ mn)	3,774.7	3,452.00	3,241.0	2,874.90	2,984.2	3,389.30
Growth rate	-0.08	-0.15	-0.12	-0.19	0.03	0.11
Software (£ mn)	1,702.90	1,536.10	1,423.10	1,145.20	1,051.50	967.70
Hardware (£ mn)	1,704.80	1,424.20	1,164.50	922.40	995.10	1,362.70
Digital (£mn)	367.00	491.70	653.40	807.30	937.60	1,058.90
Concentration (%)						
C4	60.68	65.93	72.92	83.39	85.99	N/A
Density	2,020	2,488	2,808	2,893	2,437	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

Euromonitor 2014

4. Methodology and Data Selection

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 3,576 businesses operating in the industry between 2009 and 2014. Data gathered for generating the dataset were filtered from the FAME database[1]. 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 Standard Industrial Classification (SIC) codes, the authors differentiate between publishers and developers (5821/0 and 6201/1 corresponding codes respectively)[2]. In addition, a demographic analysis based on

[1] Fame Database. URL: http://www.bvdinfo.com/en-gb/our-products/company-information/national-products/fame. Accessed: 17/1/2015

[2] The identification of developers within our samples was possible because the UK uses a fifth digit to differentiate video-game development from the software development industry what is made feasible after the last revision of the International; SIC system in 2007. Moreover, companies that use two SIC codes to describe their economic activities, publishing and developing, were included in the publishers because it is very common for publishers to own development studios to support their IP portfolios.

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.

In the second phase, the authors develop and perform an explanatory analysis to verify the effect of factors such as companies' foundation time and location. The sample of 1,925 companies is extracted from the main dataset by filtering companies with regard to year of market entry within the period 2009- 2014. Survivability 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 13 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' levels of survivability, 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.

Table 3: Name and description of variables

Variable Name	Description
STATUS	Binary (1,0). The status of the company: active (1), inactive, dissolved, liquidated, or dormant. For simplicity reasons, we consider all companies that are not active, as inactive (0).
NO_DIR	Number of directors. Used as a proxy for company size.
REG	Region of the company based on its postcode. There are 11 regions in the UK. (Factorial variable)
TYPE	Developer (2) / publisher (1). The type is based on the company's registered SIC (2007) code. Companies are allowed to choose more than one SIC code to represent their economic activities: 6201/1 Leisure software production activities, and 5802 Video-game publishing activities
NO_COURSE	The number of undergraduate and postgraduate courses related to video-game creation, design, production etc., provided by universities or colleges in the region.
AGE	The age of the company
DEN_FD	The density of the population of video-game companies on national level on the day of the company's foundation.
DEN_FD_R	The density of the population of video-game companies on a subnational level, on the day of the company's foundation
CON_FD	The concentration of the 4 biggest video-game companies in the national market, on the day of the company's foundation.
MS_FD	The size of the national market on the day of the company's foundation.

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-sample, 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 survivability 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.

Table 5 reports correlations between the dependent and independent variables used in the logistic models based on the smaller sub-sample of 1,925 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. Conversely, all locational variables show a weak association with companies' status. Finally, 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[3].

Table 7 presents results gathered from the three logistic regression models. 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.

Table 4. Descriptive statistics and non-parametric Mann-Whitney U tests based on the type and status of the 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	3,049	1.22	56.77	7.96	5.91		
Status	**Active**	2,109	1.20	56.77	9.28	6.39	-23.27	0.000
	Inactive	1,467	1.22	35.59	5.69	4.67		
Active	**Publishers**	378	1.20	41.36	7.09	6.77	-12.29	0.000
	Developers	1,731	2.42	56.77	9.76	6.2		
Inactive	**Publishers**	149	1.54	30.75	6.58	5.74	-1.154	0.248
	Developers	1,318	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**	1,731	2.42	56.77	9.76	6.2	-26.83	0.000
	Inactive	1,318	1.22	35.59	5.59	4.53		
	TOTAL	**3,576**	**1.20**	**56.77**	**7.81**	**6.01**		

[3] Initially, global video-game market size, and hardware market size were also included to the analysis but due to the very strong positive correlation between them and the national UK software market deemed them unnecessary the model construction.

Table 5: Correlation Table

	STATUS	NO_DIR	REG	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									
REG	0.053*	0.045*	1							
Sig. 2-tailed	0.019	0.046								
TYPE	0.418**	0.330**	0.048*	1						
Sig. 2-tailed	0.000	0.000	0.037							
NO_COURSE	0.052*	0.041	0.329**	0.066**	1					
Sig. 2-tailed	0.024	0.074	0.000	0.004						
AGE	0.324**	0.020	-0.054*	-0.124**	-0.018	1				
Sig. 2-tailed	0.000	0.943	0.017	0.000	0.437					
DEN_FD	-0.294**	-0.051*	0.015	0.037	0.034	-0.696**	1			
Sig. 2-tailed	0.000	0.026	0.519	0.101	0.140	0.000				
DEN_FD_R	-0.036	0.022	0.028	0.098**	0.210**	-0.325**	0.236**	1		
Sig. 2-tailed	0.110	0.338	0.217	0.000	0.000	0.000	0.000			
CON_FD	-0.316**	0.020	0.048*	0.123**	0.018	-0.928**	0.603**	0.306**	1	
Sig. 2-tailed	0.000	0.381	0.035	0.000	0.419	0.000	0.000	0.000		
MS_FD	0.313**	-0.003	-0.050*	-0.119**	-0.021	0.965**	-0.686**	-0.321**	-0.997**	1
Sig. 2-tailed	0.00	0.903	0.027	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)*

Model 1 acts as a structural 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. Density, concentration and market size all have a negative effect on the firms' survivability. Higher market concentration along with market size appears to undermine companies' chances to survive, although density 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, organisational characteristics seem also to have an impact on companies' survivability as shown by the significantly positive coefficient of management team size.

The second model (Model 2) examines the differences in survivability among different regions of the UK, using variables such as regional density and local supply of academic programmes 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 R Square 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 academic programmes available at a local level

positively affect the companies' survivability. In the model, both market concentration and management team size both show a significant impact, possibly hinting positive network externalities at a local level that may lead to forms of industrial clustering. By ranking different regions based on their survivability index, companies located in the North East and Northern Ireland (region 6) show substantially higher changes to survive compared to companies located elsewhere, although the density in these two regions does not exceed 44 and 27 companies respectively. Companies located in Yorkshire show good survivability rates, followed by South West England. London and South East also seem to enjoy increased, albeit small, odds of surviving within five years from foundation. However, given the large variation in sample sizes extracted for different regions, these findings should be considered carefully.

The third model (Model 3) focuses on companies' form of organisation, using type as a factorial variable. 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 0.328 and 0.245 respectively). 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. 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.

Table 6: The models based on hierarchical logistic regression. Dependent variable is the status of the company (active, inactive)

	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%		
Explanatory Variables	B	Sig.	EXP(B)	B	Sig.	EXP (B)	B	Sig.	EXP (B)
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									
REG (1)				-20.64	1.000	0.000			
REG (2)				-5.045	0.000	0.006			
REG (3)				-6.179	0.000	0.002			
REG (4)				-1.685	0.001	0.185			
REG (5)				-5.573	0.000	0.004			
REG (6)				-3.635	0.000	0.026			
REG (7)				-8.588	0.000	0.000			
REG (8)				-6.365	0.000	0.002			
REG (9)				-3.039	0.000	0.048			
REG (10)				-5.730	0.001	0.003			
REG (11)				-2.016	0.001	0.133			
TYPE									
TYPE (1)							-2.260	0.000	0.104
Fitness Tests									
Nagelkerke R Square	0.225			0.269			0.328		
Cox & Snell R Square	0.168			0.201			0.245		

6. Concluding Remarks.

The study presented in this paper explored and examined the companies operating within 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.

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 companies' financial performances as sole drivers of survival rates, using these tools to understand the effects related to market structures. On the other hand, the OE empirically-based approaches focus on the market densities by looking at foundation rates and companies' conduct 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. Our results 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.

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 (NESTA 2013) 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, 1992).

Using the lenses of resource partitioning, it appears that video-game publishers operate within the UK industry as generalists, while developers act as specialists. Publishers appear 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. 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 of future development for video-game companies. Many of these companies have started to explore how to exploit new technologies such as 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. 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 possible development for this research could relate to patterns of financing and accessing resources for companies operating in the industry, other than further investigate the intrinsic organisational attributes of each company. For instance, 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.

The UK video-game market is ranked second globally and it has a deep-rooted tradition when it comes to video-game design, creating and production. 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.

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