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***Trademarks and Appropriability
in the Digital Era:
Evidences from Swedish Video
Games Industry***

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Trademarks and Appropriability in the Digital Era: Evidences from Swedish Video Games Industry ¹

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Abstract: What role can trademark play in appropriability regime, especially in a digitalized era where many innovations are easy to copy and difficult to protect, and where rapid diffusion is the norm? This study, using the Swedish video games industry as a case, aims to provide some insights and tentative answers to those questions. Combining firm-level interviews, statistical data concerning EUIPO trademarks filed by the Swedish video games industry, we present the quantitative trends of trademarking across this industry sector (i.e. timeline; distribution across technological platforms and firm sizes; correlation with turnover), as well as qualitative explanations for that. This study contributes to a meso-level explanation of the role of trademarks (registrations) in appropriability on the one hand, and to the understanding of the complexity of the general appropriability conditions (and logic) in the Digital Era, on the other.

Keywords: Intellectual Property Rights (IPRs), Appropriability, Video Games, Digitalization, Innovation.

JEL code: O32, O34

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1 Introduction

Appropriability generally refers to the extent to which firms are able to capture rents generated by their innovations (Levin et al. 1987; Teece, 1986; Winter 2006). It is usually assumed that trademarks only contribute to a (tiny) part of the overall appropriation of the value needed to justify firm level investments in technical developments. Trademarks, as a subset of Intellectual Property Rights (IPRs), are researched less than patents and copyrights.

It is also assumed that innovators' access to (downstream) complementary assets plays a significant role in actual appropriability than their ownership of IPRs. Complementary assets embrace a broad category of capabilities across the value chain including market lead-time, manufacturing capabilities, service channels, and customer bases. An innovator's complementary assets are important, particularly when it finds itself in a weak appropriability regime where imitation is relatively easy from both a technical and legal standpoint (Teece 1986, 2016; Cohen et al. 2000).

Finally, we know that between the different forms of IPs, there are big variations across industries in actual uses. Pharma and biotech firms, like AstraZeneca, and mobile equipment suppliers, like Ericsson, prefer and are mostly active in the field of *patents*. Other industries, such as the pulp-and-paper process industry, with companies like Stora Enso, rely more on *trade secrecy* both to protect and to profit from their innovations (than on patent). A trademark (i.e., a sign indicating commercial origin) is relevant in industries like fashion design (e.g. Louis Vuitton), food (e.g. Chiquita banana) and in IT-services (Android version 9.0 Pie operating system). Researchers in the *Industrial Dynamics* tradition argue that this variation is mostly due to the significant differences in the nature of the technological knowledge across industry sectors that, in turn, affects the practical possibility of maintaining secrecy (Schumpeter 1934; Merge and Nelson 1990; Malerba and Orsenigo 1996; Long 2014). The more recent innovation indicator study explains that firms within the same industry often have similar levels of *Research and Development (R&D) intensity* and share similarities in the means used to appropriate innovation returns (Smith 2006; Long and Laestadius 2012). R&D intensity refers to the ratio of R&D expenditures to total turnovers.

Little, however, is known about the ongoing digitalization (and to some extent, servitization) and its influence on using IPRs in appropriability, with a few notable exceptions particularly

on the role of open innovation (West et al. 2014). Among the various IPRs, patents are probably the most researched (Markman et al. 2004). Presumably, it is because patents are the classic form of product protection and that patent data is easily accessible. Copyrights, trademarks, and trade secrecy, commonly used in service industry and process industry, are relatively less researched. In this study, we try to begin to fill this void with a look at trademark usage, particularly trademark filing in the Swedish video/computer games industry and firms, with the aim to answer:

- What is the propensity to protect trademarks in the Digital Era and if that propensity has an effect on firms' appropriation of value?

The choice of the empirical focus – the Swedish video/computer industry - may be briefly justified. This is an industry where: I) patents are nearly irrelevant while trademarks and copyrights rank high in legal protection; II) new products are often released with new titles (as new books do), usually with new trademark filings on the titles (e.g. 'Angry birds') and sometimes on characters (e.g. 'Super Mario') (fitting in a 'frequent use' doctrine); III) a digital disruption – games distribution and use going online – has taken place. A trademark-focused appropriability study on this helps to understand the 'cogs and wheels' of a digital transformation in relation to trademarking.

This paper is organized as follows: following a literature review in Section Two, the choice of the industry sector and datasets are discussed in Section Three. In Section Four, we present the empirical results concerning the general development of trademark filings and its distribution across firms with different sizes, firms operating in different technological platforms, and firms 'born digital' or going through the digital transformations. The correlation with firms' turnovers is also discussed in Section Four. In Section Five, we conclude the paper.

By studying an industry where trademarks are highly relevant, this paper contributes to a meso-level understanding on (the mechanisms of) the rise and fall of trademarking and its effect in appropriation of value on the one hand, and to the understanding of the complexity of the general appropriability conditions in the Digital Era, on the other (i.e. a 'digital' extension of the logics of the appropriability).

2 Literature Review

Trademarks have traditionally been discussed at two levels: At the macro level, in fields like *the economics of information* (Stigler 1961; Arrow 1996), funnelling down to *the economics of IPs* (Landes and Posner 1987), trademarks as distinctive signs of the origin and quality (of the product), is introduced to remedy a market failure (Ramello 2006) that is caused by information asymmetry and uncertainty (Akerlof 1970) embedded in any interaction.

At the micro level, trademarks have long been incorporated into the studies on brand management. That is, in innovation studies (e.g. Teece 1986) categorized as down-stream (marketing) activity, opposite to (and sometimes complementing) the up-stream innovations. The explorations on the trademark – innovation linkage particularly the usage of trademark filing data in innovation studies is more of a recent phenomenon (e.g. Flikkema et al. 2015).

2.1 *The signalling function of a trademark*

What is in a trademark sign? Four signalling functions of a trademark are discussed, highly relevant to video/computer games: Firstly, and secondly, a trademark communicates the *origin* and the *quality* of the products. The *origin* embraces an ownership dimension (i.e. who made it and who owns it). For the demand side, a trademark is a remedy of market failure (Ramello 2006) often caused by information asymmetry (Akerlof 1979) and uncertainty (Arrow 1996), in a sense it lowers consumer's search costs (Landes and Posner 1987). For the supply side, a trademark is an indispensable mean for an efficient provision of the (portfolio) of products with a range of variety and quality combinations (Economides 1987). *Minecraft* trademark(s) – filed in both figurative and word forms – is associated with the firm *Mojang* and certain sophistication levels of a sandbox video game (in multiple gameplay modes).

Thirdly, a trademark signals *innovation* in a firm, as do patents. While patents are often used as an (intermediate) output measure of innovation (Smith 2006) in for example large-scale Community Innovation Survey (CIS), the role of trademarks in signalling innovation and explaining innovation appropriability is more ambiguous (Malmberg 2005). Recently, it is argued that a trademark registration often signals the creation of a new product (Mendonca et al. 2004; Block et al. 2015). Compared to a patent, a trademark is particularly useful for capturing innovation in SMEs (Flikkema et al. 2014, 2015), in service sectors (Schmoch 2003), as well as in-service transfers (from e.g. universities) (Schmoch 2014) in low-tech

sectors (Mamede et al. 2011) and in later phases of (new) product creation (shortly before its launch) (Hipp and Grupp 2005).

Fourthly, a trademark signals a *producer-user linkage*, which is the very premise of a branding strategy. Terms like ‘installed user-base’, ‘loyalties’, ‘experiences’ and even ‘market size’ may find a home here. The information-conveying functions of a trademark also ties into a differentiation effect, which justifies the practice of branding (marketing) (Ramello and Silva 2006). Firms compete in perception advertising (Economides 1987). A trademark (filed) is often the outcome of a marketing effort and in some industries (e.g. Pepsi; Coca-Cola) trademarks are primarily associated with new advertising campaigns (Fosfuri and Giarratana 2009), as well as with marketing innovations such as packaging (‘fashionisation’) (Milot 2009). This signalling effect of trademarks in its original form speaks of the potential of an installed user base, namely that firms can induce greater demand among existing customers. In the Digital Era, the nature of this linkage may change. For example, with video/computer games the consumer (gamer) is often also the creator (developer) illustrated with the ‘modda’ (modification) culture prevailed in this industry (e.g. *PlayerUnknown’s Battlegrounds* – an online multi-player game).

The extent to which these signalling functions are exploited (and modified) in the Digital Era is unclear and it is the aim of this paper to address that.

2.2 Trademark propensity

Trademark propensity here refers to the probability that a firm applies for a trademark registration. Factors that affect patenting propensity are well studied. Besides the institutional (and business cycle) factors, the micro and meso elements that can have a bearing on patenting propensity may embrace firm sizes (affecting R&D expenditure), innovation types (product/process), and R&D management (organizational) changes (Arundel 2001; Levin et al. 1987; Kortum and Lerner 1998).

In comparison, studies on factors affecting trademarking propensity – in the field of using trademarks as innovation indicators – is more implicit. To elaborate, new software releases can be linked to trademark registration (Fosfuri et al. 2008). Service mark filing can be used in management consulting firms to handle problems arising from imitation and to construct

competitive responses (Semadeni and Anderson 2010). The so-called Creative and Cultural Industries (CCIs) – characterized by ‘soft innovation’ (Stoneman 2010) – generally displays varieties of motivations in registering trademarks (Castaldi 2018). Again, the influence of digitalization is under-addressed and this paper aims to address this gap.

2.3 Trademarks in appropriability

Trademarks as an IPR are an integral part of the innovation appropriability regime (Amara et al. 2008). While the general motives of trademarking includes protecting, marketing, and exchanging (Block et al. 2015) across industries. The practical usage of trademarks varies a lot between industries. Technological knowledge differs across industry sectors (Merge and Nelson 1990; Malerba and Orsenigo 1996; Long 2014) and that, in turn, affects the practical possibility of maintaining secrecy. Trademarks are often not discussed alone in appropriability, but together with other forms of IPs (Statman and Tyebjee 1981) and other modes of appropriability (Thomä and Bizer 2013). Trademarks are also used in sectors (e.g., fashion) where patents are not a viable option to protect innovation and to appropriate returns from innovations (Scafidi 2006).

For start-ups, trademarks can help entrepreneurs to entice potential investors (Block et al. 2014). IP is often one of the typical reasons for merger and acquisitions in the (Swedish) video games industry (FAITH report 2017). Trademarks can be used to measure intangible forms of innovation (Flikkema et al. 2014) and help the survival of start-ups (Helmers and Rogers 2010). In markets with a low concentration (therefore often also low entry barriers), trademarks – not patents – are the instruments preferred by start-ups in creating a competitive advantage (Abimbola 2001; De Vries et al. 2017).

In general industry dynamics, trademarks can stimulate competition (Greenhalgh and Rogers 2012), reinforce the competitive positions of incumbents, and act as barriers to entry (von Grävenitz 2003). Moreover, trademarks are inseparable from business model innovations (Graham et al. 2015).

Despite all these advantages in trademarking, only about half of all start-ups in technology sectors actually file trademark applications. This is particularly surprising as filing trademarks have comparatively low costs (compared to that in patents) (Block et al. 2015).

To summarize, much is unknown about trademarks' role in appropriability. How, when, and in which condition trademark filings explain appropriability, particularly in the Digital Era, needs more empirical research, something to which this paper aims to contribute.

2.4 Trademark in Digital Era

The influence of digitalization on trademarking behaviour of firms is generally under-studied; however, some scholarly writings on digital IPs at the general level may be summarized with a focus on the dimensions with a possible bearing on trademarking behaviour. Firstly, in general, informational (digital) products have a problem in protection. It may be traced back to Kenneth Arrow's (1962) 'information paradox' in appropriability: the buyer needs to know what she/he is paying for to make the decision; but if she/he already knows, why should she/he pay to get the same thing again? In particular, the fundamental properties of (*digital information*) (e.g. online games) make it problematic to balance protection and disclosure.

Secondly, it is argued that some digital technologies – by providing practical solutions (e.g. authentication procedures, secrecy and access) (Elkin-Koren and Salzberg, 2013) - can act as important pillar constituting a Teece-ian (1986) *tight appropriability regime* (Hurmelinna-Laukkanen & Puumalainen, 2007) against imitation.

Thirdly, there is a cultural dimension highly relevant here and two opposite views are presented: At the legal (reasoning) side, there are two strands of thoughts summarized by Robert Merges (2009, 2011). The first one argues that intellectual properties such as copyrights or patents should get out of the way of the things that digital technologies make possible and states that the best IP policy is a minimalist IP policy. This line of argument is labelled by Merges (2011, 239) as '*digital determinism*' (Benkler 2006). The second one goes beyond the technological logic and address the potential for human interaction and the benefit of group-level creativity and is labelled as '*collective creativity*' (Lessig 2004). In both strands of thoughts, individual property rights are often seen as part of the problem, rather than part of the solution. The important benefits of openness (via digital media) and the induced collective creativity are acknowledged, if not over-addressed (see Frey 1997, 2003; Throsby 2001; Cohen et al. 2011; Scherer 2012; Thoren 2012).

Contrary to the *collective creativity* line of argument, Merges (2009, 2011) argues that in the (digital) era, when transaction cost generally goes down (e.g. online games instead of CD-ROM games), the traditional virtues of individual property ownership (autonomy, decentralization, flexibility) are in no way obsolete, but become even more useful. From an evolution perspective, this discussion may even be traced back to Harold Demsetz's (1964, 1967) theorization of property rights, namely when (and how) to internalize externalities, which is closely related to the (transactions) costs of that internalization. When the gains of internalization (of beneficial/harmful effects) become larger than the (transactions) costs of internalization, new property rights emerge.

In the video/computer games industry where there is an observed stylized fact that transaction cost is going down in the Digital Era: games moving online; physical retailers getting marginalized (CD-ROM/DVD no longer needed); (big) publishers being squeezed due to the possibility of publishing games via digital platforms (Steam; Apple Store). Would the importance of IPRs (including trademarks) then go up? One aim of this paper is to investigate if digitalization in the video game industry has increased the need for trademarks.

3 Method

3.1 Choice of industry and firms

This is a meso-level study. The following section discusses why the Swedish Video Games industry is a good example of an industry where trademarks are likely to be an indicator of innovation and where the influence from digitalization can be observed.

The Swedish video games industry is a sector: I) experiencing a rapid *digital expansion*: between 2006 and 2016 the compound annual growth rate (CAGR) of the revenue was 34%; the numbers of firms – documented in the industry organization as limited liability firms increased fourfold, from 53 firms in 2007 to 281 firms in 2016 and nearly 10% of the firms today are associated with Virtual Reality (VR), which is considered as one of the forefront platforms; II) primarily consisting of developers (game studios) and where hardware development is virtually non-existing, implying that trademark and copyright, rather than patent, are the most relevant IPRs; III) dominated by small firms active in a large

international market: the consumption of online game is international, where recognition is important and likely to require trademark registrations.

Among the formal means of IPs, copyrights and trademarks are the most relevant ones for Swedish video/computer games industry. A *copyright* – protecting authorships in audio-visual works (pictures, video recordings, sounds) and in software (WIPO, 2013) – is, however, (often) not subjected to registration and therefore not statistically traceable. A *patent* is relevant here only when some technical solutions regarding data processing capability, such as game engines, are concerned.

Trademark registration for video/computer games traditionally includes ‘company name’, ‘company logo’, ‘game title’ (e.g. *Europa Universalis; Blood Eagle*) and ‘game sub-title’. The trademarks can be figurative as well as with words (Greenspan et al. 2014). Typically, new products/games are released with new titles – as new books do – and some titles do describe what the game is about (e.g. *Heavy Rain; The Last of Us; Bioware*). Recent additions to the above-mentioned categories include characters, weapons, and even images of the characters that was previously only copyright protected (Anderson 2014). The most common combination, however, is the company names/logos in conjunction with the titles (of the game) in a trademark registration.

House mark or company name is relevant but perhaps not a viable innovation indicator, because it says very little on the completion of a (new) product development project (e.g. a new game). *House mark* is a legal term used for identifying the *provider* of a wide variety of goods/services (USPTO Trademark Manual of Examining Procedure October 2017 1402.03(b)). It is commonly used in chemical, pharmaceutical, publishing (also on video games), food packaging, and fashion industries. With a strong house mark or company name, the proprietor does not have to register a new trademark in anticipation of the launch of a newly developed product. Many industries and firms (e.g. IBM; Calvin Klein) use house marks in conjunction with multiple secondary trademarks. In the gaming industry, the complementarity goes the other way: a house mark (company name/logo) is a (tiny) part of the whole trademark portfolio and the titles (trademarks) – fanciful, suggestive, and descriptive – often remain important in facilitating consumers’ choices.

Moreover, in our study of the 281 companies, few (if any) has a house mark of international recognition or usefulness, to rely on. The individual games are distinct, in the sense that a buyer of a game will not have a strong loyalty to a particular game developer or rely on a reputation held by a certain game developer. This may be the case for the very largest video games publishers, but not in our sample of small games developers. These features of the video games market justify the belief that trademark filings are a good proxy for innovation.

3.2 Choice of the data sources

We used a mixed-methods (Johnson and Onwuegbuzie 2004) research method, namely combining quantitative data and qualitative data to understand the ‘what’ and the ‘why’ questions.

Quantitative data includes three sources: I) statistical data from the Swedish video game industry association (‘Dataspelsbranschen’ in Swedish) including member firms list, firm’s distribution across technological platforms (as primary platform) and key game titles (that supports our trademark database search); II) statistical data from the Swedish companies registration office (‘Bolagsverket’ in Swedish) on firms’ turnovers (2006-2016) and establishment years; and III) trademark filing data from the *European Union Intellectual Property Office* (EUIPO).

Who are the firms in this study? This is an industry full of hobby-based *indie* (independent) developers not appearing in any statistics. A selection is made (Figure 1):

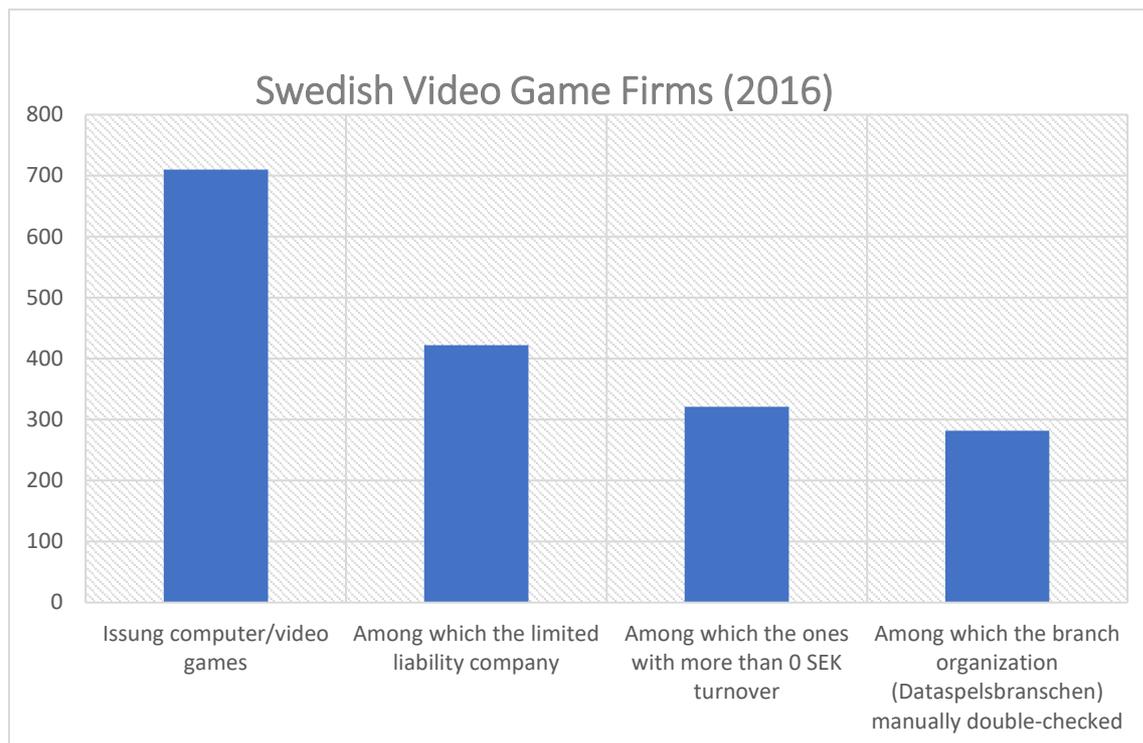


Figure 1. Swedish Video Game Firms (by 2016)

Sources: the authors' calculation based on data from Bolagsverket and Dataspelsbranschen.

To elaborate, there are in total 710 firms (in 2016) registered in Bolagsverket that issue video (computer) games ('Utgivning av dataspel' in Swedish). Only 422 of them are limited liability companies (AB, Aktiebolag). Furthermore, only 321 firms have turnover in excess of zero SEK, meaning that many firms do not have sales. The industry association further manually excluded board (and card) gamers and (small) retailers who are not in the video games developer business from that list. The remaining list has 281 firms, which serves as our departure point for data processing.

The choice of EUIPO data – to examine the trademarking propensity of Swedish video games developers – is mainly because the games consumption market is international and the intellectual property office (PRV) of Sweden is therefore not a viable source. We actually verified PRV data on some samples and the Swedish video games firms register very little with the national Swedish authority. The data collection at EUIPO was performed on two fronts: a) the owner (of the trademark) name contains the firm's trade name; b) the trademark name contains their most famous game titles. We used the filing date by the company rather than registration/grant data by the EUIPO, to determine the propensity to protect trademarks

in a particular year. The Nice classification – in 9 (software), 41 (entertainment services), 16 (book), 28 (toys, console) (World Intellectual Property Organization 2018 is double-checked to ensure that trademarks are for video games. A Nice classification (of the trademark registration) is not a viable departure as it embraces too many firms who are not in this industry.

The final data – in total 470 filed EUIPO trademarks by these 281 firms – can be truncated due to the complexity in tracking trademark registrations and ownership: a) A Swedish game studio's IP may be owned and registered by its international publisher; b) a game title may be registered by the individual founder(s) in early years, rather than by the company established later; c) Thirdly, the frequently occurred cross-border merger and acquisition in this industry, make it even more difficult to trace trademark ownerships. We studied Swedish registered companies in the video games industry – and their trademarks – but the ultimate owners, such as a parent company, may not be Swedish. To summarize, the EUIPO trademark data can be truncated, but this is, as far as we know, is the best source we could get to determine trademark filing propensity. Without the knowledge of all the titles released by the 282 firms, it is difficult to ascertain if all the trademark registrations actually have been identified.

In the definition of the size of the firms, our initial departure is the Organisation for Economic Co-operation Development (OECD) definition on micro, small, medium and big firms (OECD 2005, on turnovers rather than on the number of employees. This is because in an 'indie' dominated culture, many involved developers can be hobby-based and not formally salaried by the company and consequently not in the employee statistics. Furthermore, we found that the OECD definition – with *EUR 2 million* as the ceiling for micro enterprises — is not suitable to understand the dynamics of the Swedish video game industry. More than 60% of the firms (173 firms out of the 281 firms) have year 2016 turnover under 2 million SEK (i.e. 0.2 million EUR in a crude calculation). To lower the threshold of micro firms, we created a six-category definition of the size of the firm to be used in the correlation test. Firms are divided by six size/turnover categories: 1 (<2msek), 2 (2-10msek), 3 (10-50msek), 4 (50-100msek), 5 (100-500msek) and 6 (500+msek).

Qualitative data includes semi-structured firm-level interviews with video/computer game firms. Documents such as firm's annual reports and branch organization's index across years were used in a complementary manner. The choice of the interviewed firms is of a *theoretical*

sampling (Eisenhardt and Graebner 2007) – rather than a statistical one – and embraces the following criteria:

- a) firms operating across three major technological platforms (console, PC, and mobile): the nature of the (technological) knowledge (e.g. product/process; tacit/codified; cumulative/discrete) plays a role in appropriability in general (Merge and Nelson 1990) and in firms' IP strategies in particular (Reitzig 2004). Consequently, technological platforms play a role;
- b) firms with different sizes: firms' size is argued to have an important bearing in firms' IP behaviour. This can be traced back to the classic arguments in a Resource-based view of the firm (RBV) (Penrose 1959; Barley 1991), as well as to more specific IP related studies particularly in patent (propensity) studies (Scherer 1983; Arundel 2001);
- c) firms established in different periods namely those who 'born digital' or not: year 2010 is used as a mark-line, because it is argued – in our pilot studies - that this is the year when digital distribution (via Steam; Apple Apps Store etc.) picks up the speed.

There are 22 firm-level interviews including two with their external IP attorney offices. The firm coverage at the PC/mobile/others platform level and at the small/micro size are rather equal (4 or 5 each), with only one in console platform and one in medium-sized and one in big-sized categories. Among which there were only three firms established before 2010. This is an intentional choice reflecting Swedish actors predominantly being in PC and mobile platforms (rather than in console), in small/micro sizes and in 'born digital' categories. In the big-sized and the medium-sized firms, staffs with different positions (founder/CEO/CTO/CMO, developer, company lawyer) were covered.

Five additional interviews – two with the branch association staffs and three with end -- users/gamers - were conducted for analytical triangulation. As we only cover firms with revenues (having reached break-even), there is a risk that the dynamics of the IP behaviour - of many emerging ('born digital') but invisible actors – is missing. Firm interviews were semi-structured, each lasting 45–90 minutes, with questions relating to the usage of the IPs – if any – and the underlying reasoning of that (strategy). The interviews were transcribed and coded for cross-analyses and triangulation with the statistical data and with multiple researchers.

4 The Results

The following section presents the quantitative trends as well as qualitative explanations related to Swedish video/computer game firms' trademark (filing) behaviour.

4.1 Trademark propensity over time

The timeline summary of the 470 filed trademarks – over the last two decades – are presented in the following four figures. Figures 2 and 3 show the trademark registration then – in that particular year – and Figure 4 shows the stock of trademark (filing) to 2016:

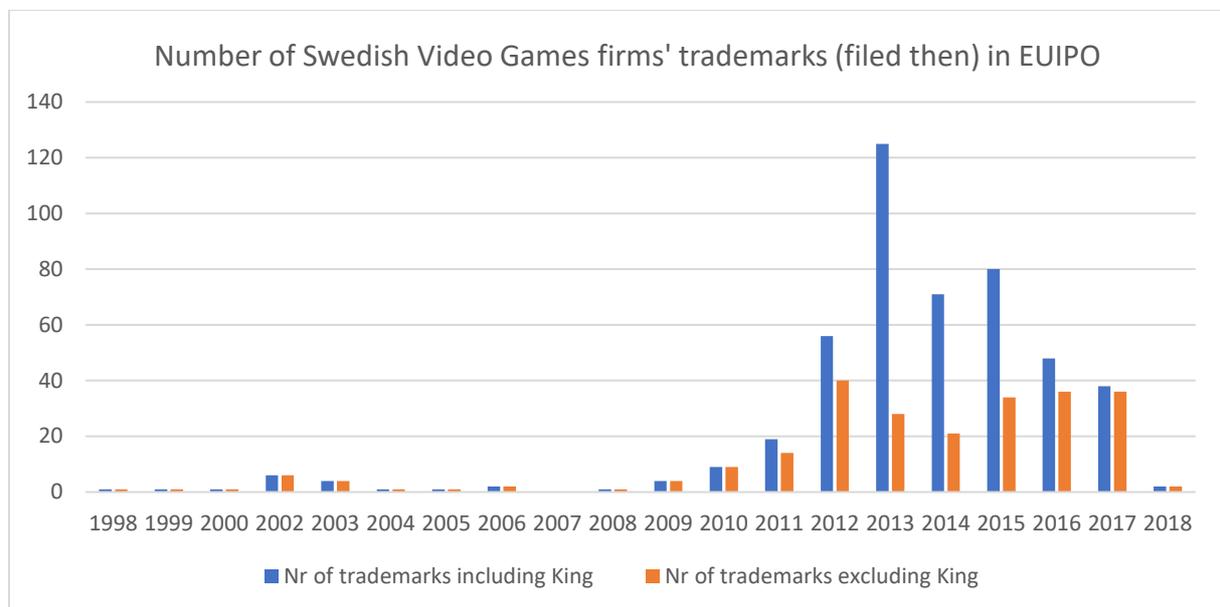


Figure 2. Number of Swedish Video Game Firms' EUIPO Trademark Filings Then.

Source: the authors' calculation based on searches in the EUIPO database for the firms.

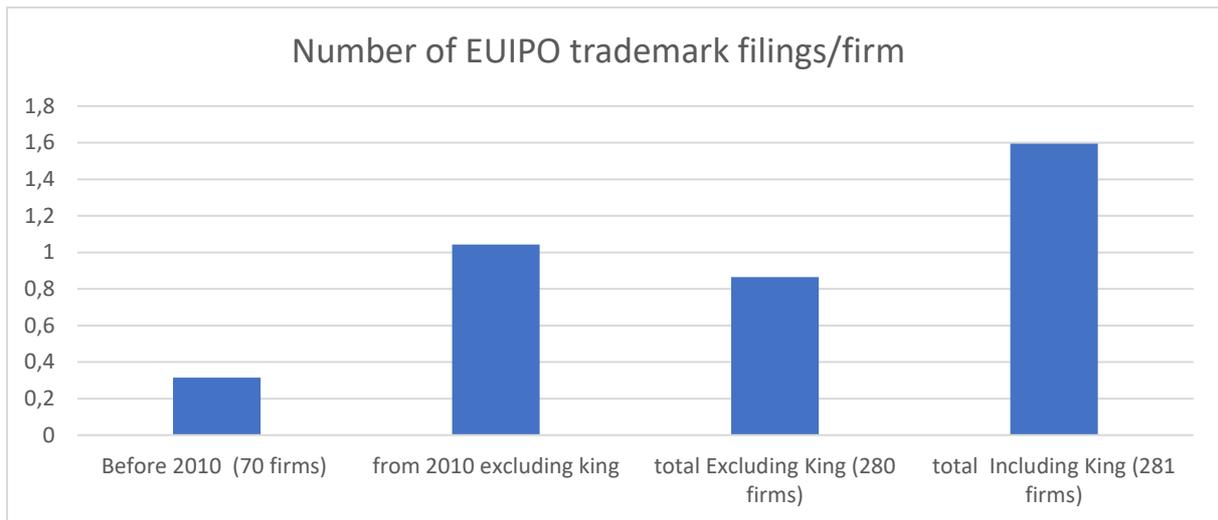


Figure 3. Number of Swedish Video Game Firms' EUIPO Trademark filings (then) per firm. Source: the authors' calculation based on searches on the firms in the EUIPO database.

There is a 'digital' take-off of the trademarking filing (Figure 2) also at the per firm level (Figure 3): the filings picked up the momentum of growth approximately at years 2010-2011 when games started to go online. There were only 22 trademark filings (0, 3 trademarks/firm) made before 2010 and 220 filings after that (approx. 1 trademark/firm excluding *King*, an outlier). Bearing in mind that this is a survivor list. Namely, only firms who have managed to survive to 2016 (with revenues) are listed. This growth is to be evaluated against the general growth of the number of firms in this industry. The number of firms has quadrupled, with 68 firms documented in 2006 in the branch organization, against 281 firms in 2016 (Swedish Game Developer Index 2007, 2017). So comparably, trademark filings grow faster than the number of firms and with a 'digital' momentum.

It may also be argued that this (trademark) filing growth may not be that impressive since exit actors' trademark filings are not captured in this survivor list. For example, there were 68 firms documented in 2006 in the branch organization's archive while only 12 firms – appeared in the survivor list – were established in 2006. Presumably, this is not a big problem, not only because the base (number of firms) was very low, but also because of a structural change of the ownership over IPs in this industry, alongside the rise of digital distribution. In the past, developers often had to give away their IPs – to (international)

publishers – in exchange of financing, marketing, and publishing (resources), which is not necessarily the case today. Publisher’s ownership over IPs is less of a default today.

There is an outlier among the 470 filed trademarks of the 281 firms – King (Digital Entertainment) – the developer of ‘Candy Crush Saga’ (established in 2003, first filing in 2011 and acquired by US-based Activision Blizzard in 2016). This is a ‘hits’ phenomenon common in the music and film industry. King alone owns 228 Trademarks in EUIPO (nearly half of the Swedish trademark filings). For said reason, in the following we present graphs – relevant only for after 2010 filings – in two columns namely ‘King included’ and ‘King not included’ (re); For the remaining data, the distribution seems to be more reasonable (with linkage to firm size though).

Who are the survivors (in an industry with a high rate of entry and exit)? Is there any connection between their survival and their trademark filings? Figure 4 is a ratio, with the ‘number of firms with trademarks filing today’ as the numerator and the ‘number of firms’ as the denominator, indicating that there is a linkage between firms’ survival and trademark filings.

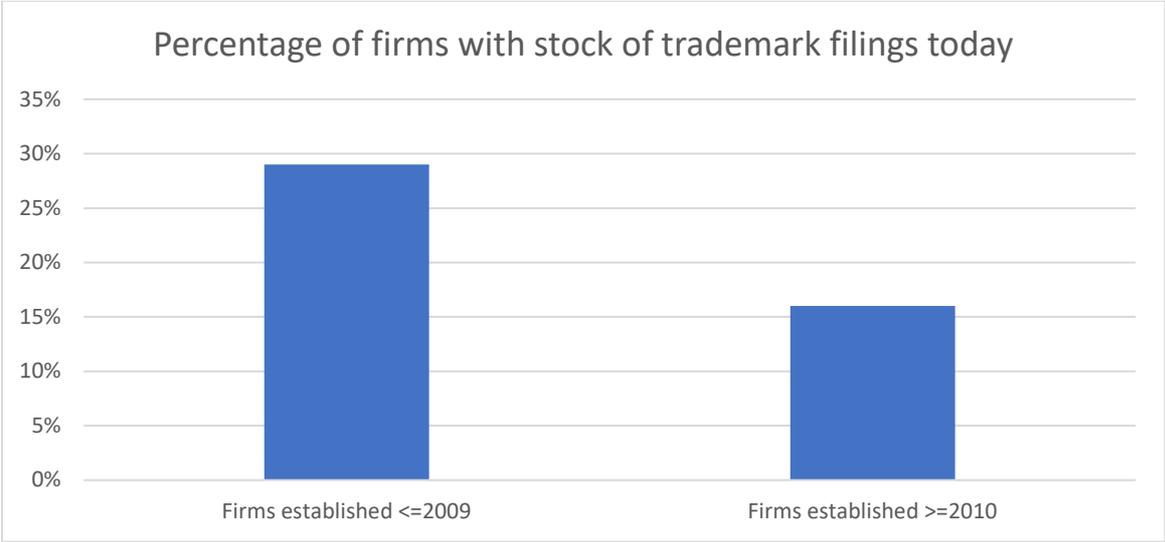


Figure 4. Percentage of firms established then but with stock of trademark filings today (to 2016)

Source: the authors’ calculation based on searches on the firms in the EUIPO database.

The quantitative trend – of a digital take-off (Figure 2-4) – is in line with the interview data:

Firstly, the threshold of trademark (filing) is low. Copyright – not subjected to registration – safeguards a game in a form of protecting the software (the code), the artwork and the sound (and music). It is, however, not easy for small firms to gain a valuable (copyright) license for making derivative works. Derivative works, common in this industry, refers to a new work derived from an existing (often copyrighted) work (*Shrek* initially as a film is developed into a game). ‘In the very early years when we were small, it was extremely difficult to license-in good names such as *Star Wars*...we have tried some but did not succeed. Only the big ones can do that. For trademark [registration], there is no such a limits’ (interviewee’ words). Size matters also in a balance between the usage of trademarks and of copyrights, in a search of form means of IPRs. The theoretical implication here is that trademark being a good indicator for SMEs innovations (c.f. Flikkema et al. 2014, 2015), not only because SMEs do not patent (much), but also because SMEs do (can) not copyright license (in-and-out) much.

Secondly, the increasing importance of trademarks is essentially due to the following summarized reasons (based on interviews):

- I) the rise of digital distribution (via e.g. Steam and Apps Store), including mobile gaming, has contributed to the recent exponential growth of games, sophisticated as well as simple ones. Game titles are easily lost in the (*online*) crowd and trademark registration – of the game titles – is one of the means to make the games visible;
- II) The increasing merger and acquisition (M&A) – common in this industry brings an awareness of the values of the trademark;
- III) While infringements at the demand side (e.g. illegal downloads and torrenting in the earlier years) is mitigated somehow due to developments in technology (e.g. two-factor authentication; in-game purchases), the infringements at the supply side (e.g. cloning of game concept/ideas) do intrude customer’s associations. Innovators need formal IPs ownership evidence to inform for example platform owners (e.g. Twitch) in a takedown notice, and consequently favour trademark registrations.

There are two theoretical elements here, one related to the *signalling function of trademark* (Section 2.1) and another related to the *emergence of property rights* (Section 2.4):

Firstly, and from the signalling perspective, digitalization, on the one hand, boosts an exponential growth of (product) offerings, and on the other hand aggravates the *information asymmetry* (Akerlof 1979), the *uncertainty* (Arrow 1996) and the *variety* (not necessarily the quality) (Economides 1987). That is detrimental to consumers in the form of *search costs* (Landes and Posner 1987) and detrimental to suppliers as the *distinctiveness* in a digital crowd is harder to build-up and easier to disappear (compared to the case in the past).

Secondly, and from the property rights perspective, digitalization (by e.g. avoiding the physical retailers) has not only lowered transaction cost and earlier pie-shared by developers (in appropriability) but also returned much of the IP control to the hands of developers (from the publishers). An (formal) ownership of IP (trademark) is important not only in attracting investment, a function also discussed by Seethamraju (2003) and Flikkema et al. (2014) independent of the digital context, but also in its exclusivity (e.g. as a formal proof to issue a take-down notice to platform owners).

Trademarks are gaining increasing importance in the Swedish video-game industry. There is an observed (Harold) Demsetz-ian (1964, 1967) path of IP development in this industry in the Digital Era. Game developers decide to internalize the value of title recognition, as the gains from internalizing the value outweigh the costs of the measures needed to exclude others.

4.2 Trademark distribution over firm sizes

While firm size, as well as the types of innovation (e.g. product/process), are classic parameters explaining patent propensity (Scherer, 1983; Arundel, 2001) and (implicitly) also trademark propensity (Flikkema et al. 2015), how is the situation in video games?

With a six-class definition of the sizes of Swedish video/computer game firms as explained in Section Three, the results are displayed in Table 1 and Figures 5 and 6:

Table 1. Swedish video games firms' trademark registration distribution over firm sizes

	1	2	3	4	5	6	6
Firm size	(<2		(10-50	(50-100	(100-500	(500+	(500+

	Msek)	(2-10 Msek)	Msek)	Msek)	Msek)	Msek) Inclu. King	Msek) Exclu. King
Nr. of trademarks	19	13	13	39	76	310	82
Trademark/firm	0,11	0,24	0,48	3,55	8,44	51,67	16,4
Nr. of firms	173	56	27	11	9	6	5
Nr. of firms with filings	16	7	10	9	6	5	4
Percentage of firms with filing	9%	13%	37%	82%	67%	83%	80%

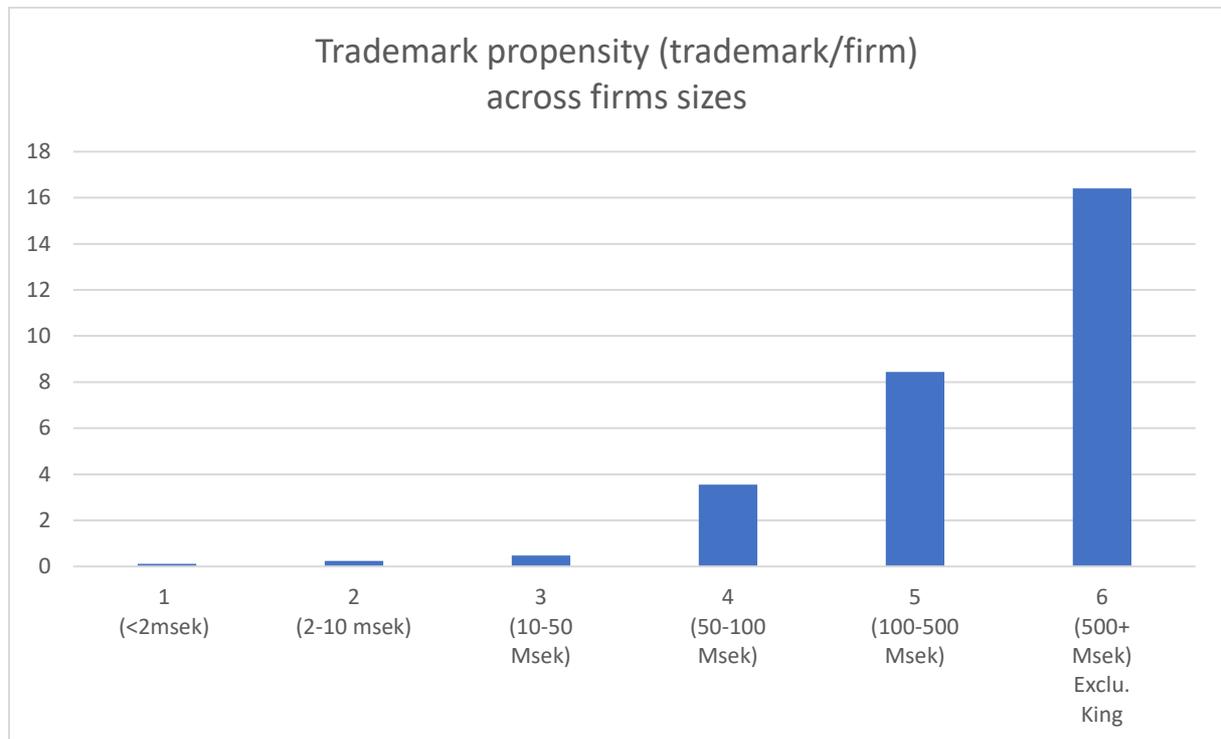


Figure 5. Swedish video games firms' trademark registration distribution over firm sizes

Sources: the authors' calculation based on data from Bolagsverket and searches in EUIPO database for the firms.

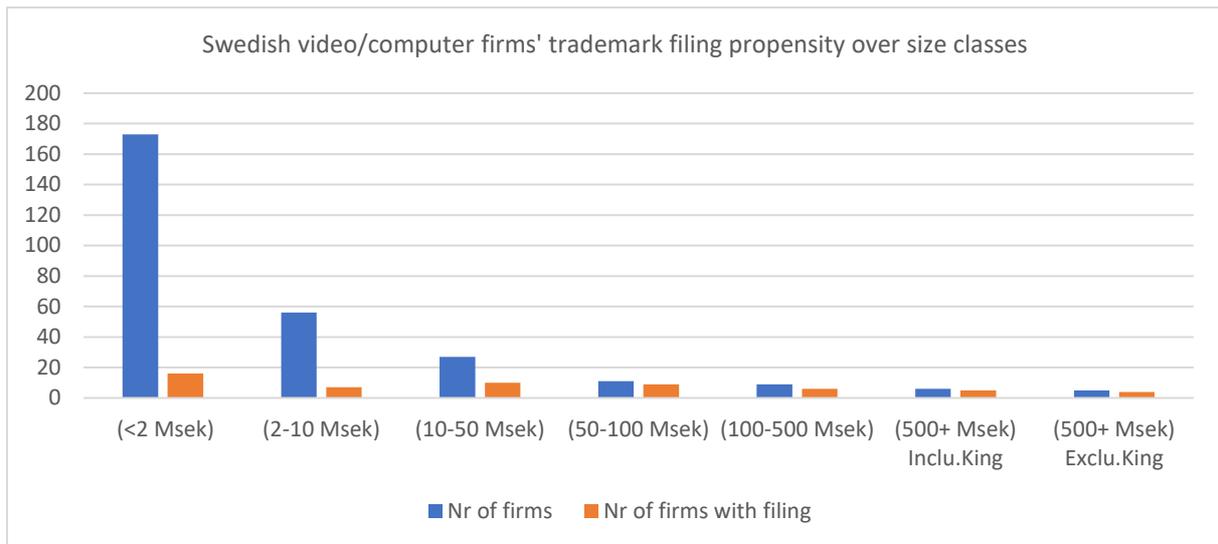


Figure 6. Swedish video/computer firms' trademark filing propensity over size classes

Sources: the authors' calculation based on data from Bolagsverket and searches in EUIPO database for the firms.

Linking back to the discussion in Section 2.4, on the tension between *collective creativity* and *benefits of internalizing the IPs*, we could observe that a Demsetz-ian (1964) 'wake up' – an internalization of IPs – occurs surprisingly late: it starts to pick up as late as class 3 and bigger firms tend to have more trademark registration.

This result confirms the conventional wisdom on the positive correlation between firm size and IP (patent) propensity (Scherer 1983): it holds in the field of trademark too. Triangulating with the interview data, two main explanations – one related to firms' resources and another one related to firm cultures (discussed in Section Two) – are offered: while growing firms start to introduce/strengthen the business function, rather than only operate with a composition of a few software engineers and graphic designers. Moreover, there is also a cultural/ideological position taken particularly by these micro firms: the founders, often with a technological background – choose to ignore the 'infringers' (of ideas). In other words, while there is a general need in the Digital Era, to develop from a hobby-based (and indie-dominated) culture to more business-minded operations, varieties of that digital transformation however exist and a Demsetz-ian 'wake up' has a close linkage with firms' sizes: size matters in trademarking, as it does in patenting.

4.3 Trademark distribution across technological platforms

It is argued that the types of innovation (product/process; cumulative/discrete) also play a role (Merge and Nelson 1990) in IP propensity. What does that mean in the Swedish video games industry? We examine the trademark registration distribution across technological platforms (Figures 7 and 8):

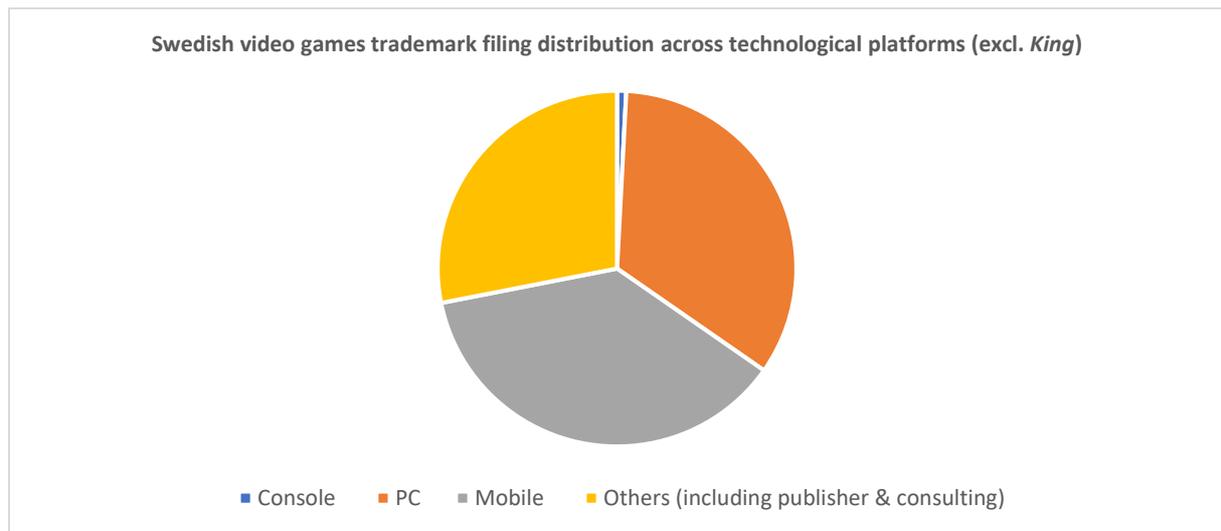


Figure 7. Swedish video games trademark filing distribution across technological platforms (excluding King)

Sources: the authors' calculation based on searches in the EUIPO database for the firms and data from Dataspelsbranschen.

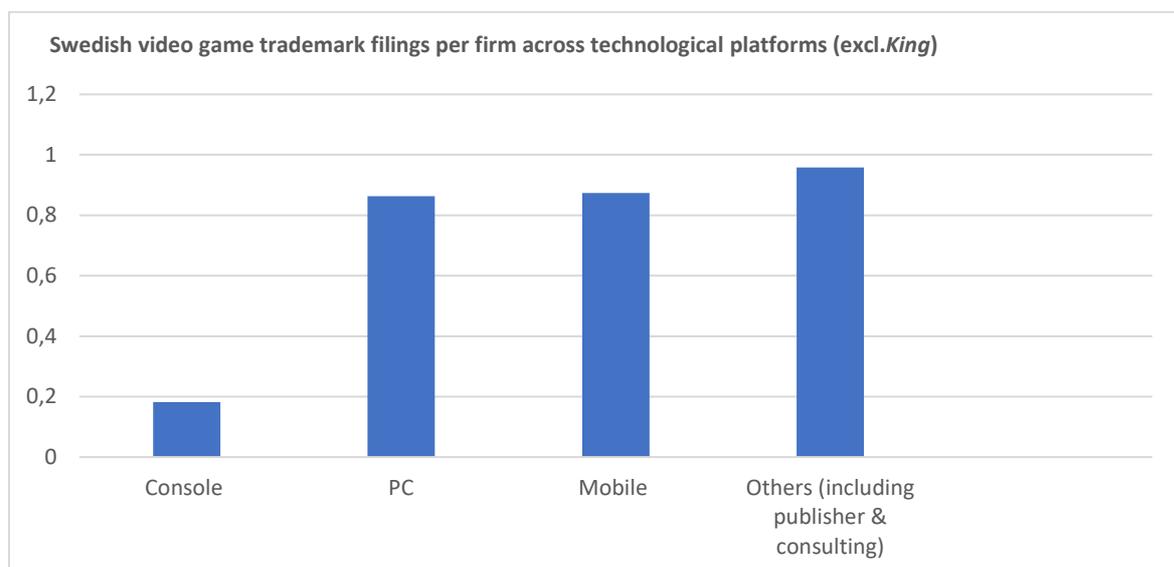


Figure 8. Swedish video game trademark filings per firm across technological platforms (excluding *King*);

Sources: the authors' calculation based on searches in the EUIPO database for the firms and data from Dataspelesbranschen.

Evidently, there are no significant differences across PC-based, mobile-based platforms and others (including publishers and consulting) in trademark registration propensity, but console-based game developers are less active in trademark registration.

To clarify, the platform here refers to the primary platform targeted and it is based on the industry association's categorization. We are aware of the fact that cross-play over multiple-platforms are becoming increasingly common today, namely many of the Swedish video games are operated in more than one technological platform (for example Minecraft has both PC and mobile versions). As we learned from the interviews, the rise of the independent (rather than in-house) game engines (e.g. Unity; Unreal) – in an era of online gaming – has essentially enabled this development, by providing tools and help shorten time-to-market. To simplify and to examine whether platform plays a role (or not) in trademarking, we allocate only the primary platform to the firms. That is to say, in our data, each firm is only identified with their primary/initial technological platform, so the data is exclusive at the platform level. Moreover, the 'others' category includes not only under-suppliers such as consultant firms but also tool developers and mostly important, the publishers (a few though). As discussed earlier, *THQ Nordic*, a publisher discussed also in Section 4.2, while primarily affecting trademark filings prior to 2010 (by owning developers' IPs), still holds 5% of the total filings after that period, which in turn, pushes up the filings in the 'others' category.

Why do the differences of the trademark filing across technological platforms exist?

Triangulating the interview data, there are big differences

- I) over the scale and the cost of the game development across technological platforms. '[A] PC-based game project can involve 1000 people and takes 36 months of time-to-market' (interviewee's words). so do many console games. While the complexity of a mobile game design and game features can vary a lot, the time-to-market is usually significantly shorter, possibly to be completed within

one month, with an involvement of 1-2 (experienced) developers and graphic designers; Consequently, there is an exponential growth of mobile games and of developers. A new online (mobile) game is hardly visible. The signalling function of a trademark, discussed in Section 2.1, thus becomes particularly important;

- II) in how the games (and the parts) are connected: many PC games (e.g. strategy games), after the first release, are complemented with various ‘expansion packages’ (i.e. downloadable contents), while (small) mobile games are often stand alone and released frequently in a separate manner. Consequently, and for mobile games, there is not such an installed user base to be used. Each new game has to be communicated/signalled – via for example trademark (filing) – in a separate manner.

To summarize, the trademarks in the mobile game sub-sector are discretely (rather than cumulatively) connected. The Merge and Nelson (1990) taxonomy on *cumulative versus discrete* patents also applies to trademark data.

4.4 Trademark in explaining appropriability

This is an industry with a rapid expansion both in the number of firms as well as in its total turnovers. How is trademark registration linked with firms’ turnover? We run a correlation test – between firms’ trademark registration and firms’ turnover in 2016 – and reach the following results (Tables 2 and 3; inclu/exclu. King):

Table 2. Correlation between trademark registration and 2016 turnover by size

By group	all (branch level)	Size=1 (<2msek)	Size=2 (2-10 msek)	Size=3 (10-50 Msek)	Size=4 (50-100 Msek)	Size=5 (100-500 Msek)	Size=6 (500+ Msek)
Number of firms	282	173	56	27	11	9	6
Corr	0,5775	0,0662	0,0584	0,1527	0,5872	0,5913	0,3009
(no King)	<i>0,3964</i>						<i>-0,1998</i>

Number of firms with filings (no King)	53 52	16	7	10	9	6	5 4
Corr (only on firms with filings) No king	0,5719 0,3630	0,0381	-0,4479	0,0320	0,4590	0,9879	0,2789 -0,3058

Sources: the authors' calculation based on searches in the EUIPO database for the firms and data from Dataspelebranschen and Bolagsverket.

Table 3. Correlation between trademark registration and 2016 turnover by time of establishment and by technological platform

By group	<=2009	>=2010	Console	PC	mobile	Others
Corr. (no King)	0,8774 0,5029 (a survivor bias?)	0,5184	-0,1621	0,5259	0,995 0,9522	0,9073
Nr of firms	70	212	11	95	104	70
Corr (only on those with trademarks) (no King)	0,9722 0,794 (a survivor bias?)	0,4925	N/A (only two observations)	0,4679	0,9952 0,9951	0,956
Nr of firms with trademarks filing	20	33	2	20	18	13
Percentage of firms with filing	29%	16%	18%	21%	17%	18%

Sources: the authors' calculation based on searches in the EUIPO database for the firms and data from Dataspelebranschen and Bolagsverket.

This is a correlation test only, between firms' trademark filings and turn-overs (Table 2 and 3): trademarks appear to be a viable indicator in explaining appropriability at the branch level

(0.5775), in size class 4 (0.5872) and size 5 (0.5913), and for mobile based game developers (0.9522) (with a small sample size in class 4-7 though).

At the size front, the importance to (file) trademark starts to be visible from class 3 and remains high within classes 4 and 5, but declines in class 6. This means when firms grow to a certain size (class 6; 500+ Msek), the extent to which that trademark registration explains appropriability becomes limited. Other mechanisms are into play again (not necessarily the same as in classes 1 and 2 though).

What are the other mechanisms? Triangulating the interview data, three factors – offsetting the importance of the protection function of a trademark – may be lifted up. The first two are related to *the nature of the (technological) knowledge* dimension and the third one is related to the *digital culture* dimension discussed in Section 2.4: I) differ to the film and music products where finished products are sold, in game-play there is a *high level of interactivity* involved. That allows certain (technical) monitors after the release of the products; II) the business models derived are therefore also different. According to a PC-game developer, ‘We make money mostly from the expansions [downloadable supplement to an existing game]’. The same logic applies to mobile games: in-game-purchasing – of small items (weapons; clothes) – is one of the most common monetization modes following an initial *Freemium* (free-to-play). Finished products (without supplements) exist too in games (e.g. adventures), but technique means like two-factor authentication commonly also in software upgrading, are introduced as a remedy. Summing up, there is a Teece-ian (1986) (relatively) *tight appropriability regime* in (online) video game industry and firms, from a technical standpoint already. The legal standpoint of the appropriability regime (e.g. filing trademark to protect) is then of a secondary importance; III) culturally, both *collective creativity* and *digital determinism* (a minimalist IP policy is the best IP policy) (Benkler 2006) (see Section 2.4) are present and starkly visible in start-ups, as one interviewee formulated ‘[the patent registration office is not needed] EUIPO/PRV behövs inte...’. There is, however, no explanation identifiable – from the interviews – for the declining importance of trademark in class 6. Presumably, the house-mark plays role there.

At the platform front, the correlation between trademark filings and turnovers is particularly strong in mobile-based games (0.9522) and less so in PC (and presumably console) games (0.5259). Why is the technological platform playing role? Triangulating the interview data,

the differences in *the nature of the (technological) knowledge* plays the role again: in mobile games where development costs are relatively small, the individual product is more important than the link to previous products made by the same developer. It is then, for mobile games, practically necessary to register a new trademark (e.g. game title) towards the end of the products development period, rather than relying on the house mark (as done in console and partially PC games). The well-known distinction between *discrete* (e.g. chemicals) and *cumulative* (e.g. semi-conductors) patents across industries (Merge and Nelson 1990) may apply in trademarks too. Mobile games (and game titles) are more *discretely* connected than done *cumulatively* (compared to console and PC games). The more fragmented the (sub-)industry products are and the less known the developer is, the better signalling effect a trademark (filing) can have. Expressly, the *industry heterogeneity* (e.g. Flikkema et al. 2015) has also within-industry and cross-platform variations. Different to our (technological) products and knowledge focus, another kind of fragmentation, namely a low-market concentration, is discussed by De Vries (et al. 2017), confirming this close linkage with trademarking.

5 Concluding discussion

Through a study on an industry sector where trademark filing functions as a viable indicator of innovation, this paper contributes to a meso-level explanation on the trademark (registration) propensity and its role in explaining appropriability on the one hand, and to the understanding of the complexity of the general appropriability conditions in the Digital Era, on the other.

To elaborate, this study, firstly, confirms the conventional wisdom that firm size matters on IP propensity in general (Scherer 1983) and on trademarking behaviour in particular (Mainwaring et al. 2004): bigger-sized firms are generally more active in filing trademarks than their smaller counterparts do. What is new here is that we identify that this linkage is not linear, at least not in the case of the online (Swedish) video game industry. A Demsetz-ian (1964) ‘wake up’ – an internalization of the (intellectual) property – occurs surprisingly late in the firm development process and this is observed with both the propensity data and the correlation data (between trademark filings and turnover): a pick-up in class 3, a clear connection in class 4 and class 5, and a lower connection again in class 6. That suggests, for the very tiny video games firms (class 1e and class 2; firms with less than 10 msek in turn-

over) and for the big sized video game firms (firms with more than 500 msek in turn-over) there are other mechanisms in play.

Secondly, this study shows that (technological) platform also matters, in a sense that trademark filing appears particularly important (in explaining the appropriability) – in mobile-based games, and less so in PC-and-console-based games. This is because mobile games, as well as their multiple (title) trademarks, are *discretely* connected (stand more or less alone), rather than *cumulatively* connected (pronounced in console games and starkly visible in some PC games), and/or united under a strong house mark in perception advertising. The more fragmented the industry products are and the less known the developer is, the better signalling effect a trademark (registrations) can have. The well-known *cumulative versus discrete* patents taxonomy (Merge and Nelson 1990) is therefore applicable also in understanding the trademark linkage. Moreover, while the use of trademark data in innovation studies is still in its infancy (Flikkema et al. 2015), this linkage approach is to be further explored.

Thirdly, and most important, this study provides a ‘digital extension’ of the logics of appropriability. It contributes to an understanding on how digitization has affected an industry sector’s trademark behaviour. Despite the popular argument that IP is culturally alien to some creative classes (Laurent Bach et al. 2010), there is a gradual but clear Demsetz-ian path of IP development in Swedish video game industry. A ‘digital take-off’ has been shown to take place, namely that firms in the Swedish video games industry after 2010 tended to be more active in registering trademarks after digital distribution came to dominate. When the digitalization aggravates *information asymmetry* (Akerlof 1979) *uncertainty* (Arrow 1996) and *variety* (not necessarily the quality) (Economides 1987), the signalling functions of trademark get particularly important. There is a general need to be visible and to be distinctive from the digital crowds, which is dominant even in a technologically-tight appropriability regime.

Finally, despite a game developer-centred approach in this study, some results are illustrative also to other (creative; digital) industries where trademarks are complementary to copyrights (rather than to patents) in protection and in value appropriation. This is applicable in (digital) films, music, books, and graphics (or fashion) designs. Further research in the complementarity with copyrights – in signalling innovation – may be probed in-depth, in a digital context.

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7 References

Akerlof G. 1970 The Market for "Lemons": Quality Uncertainty and the Market Mechanism
Source: *The Quarterly Journal of Economics*, 84 (3) 488-500

Amara, N., Landry, R., Traoré, N., 2008. Managing the protection of innovations in knowledge-intensive business services. *Res. Policy* 37 (9), 1530–1547.

Anderson D. (2014) More than a game: brand and trademark use in video games and virtual worlds. *World Trademark Review*, February/March 2014

Arrow, K (1962) Economic welfare and the allocation of resources for inventions. In, *The Rate and Direction of Inventive Activity: Economic and Social Factors*, (eds). Nelson R. 609-626 Princeton: Princeton University Press

Arrow, K (1996). The Economics of Information: An Exposition, *Empirica*, 23(2), pp. 120–21.

Arundel A. (2001) The relative effectiveness of patents and secrecy for appropriation. *Research Policy*, 30 (4) 611-624.

Benkler Yochai (2006) *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. 56.

Block, J.H., De Vries, G., Schumann, J.H., Sandner, P., 2014. Trademarks and venture capital valuation. *J. Bus. Venturing* 29 (4), 525–542.

Block, J.H., Fisch, C.O., Hahn, A., Sandner, P.G., 2015. Why do SMEs file trademarks? Insights from firms in innovative industries. *Res. Policy* 44 (10), 1915–1930.

Castaldi C. (2018) To trademark or not to trademark: The case of the creative and cultural Industries. *Research Policy*, 47 606-616

Cohen, W. M., Nelson, R.R., Walsh, J.P. 2000. Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not). NBER Working Paper W7552

De Vries, G.; Pennings, E.; Block, J.; Fisch, C (2016) Trademark or patent? The effects of market concentration, customer type and venture capital financing on start-ups' initial IP applications, *Industry and Innovation*, 24 (4).

Demsetz Harold (1964) The Exchange and Enforcement of Property Rights Author(s): *Journal of Law and Economics*, Vol. 7, (Oct., 1964), pp. 11-26 Published by: The University of Chicago Press

Demsetz. 1967. Toward a theory of property rights. *American Economic Review* 57 (May): 347-359.

Economides, N., 1987. The economics of trademarks, *TradeMark Register*, 78, 523-539.

Elkin-Koren, N.; Salzberger, E (2013) The law and economics of intellectual property in the digital age. Routledge.

FAITH report: investeringar I globala digitala innehållsproducenter, utgiven av Dataspelesbranschen, December, 2017 (med finansiering från Tillväxtverket).

Flikkema, M.J., de Man, A.P., Castaldi, C., 2014. Are trademark counts a valid indicator of innovation? Results of an in-depth study of new benelux trademarks filed by SMEs. *Ind. Innov.* 21 (4), 310–331.

Flikkema, M., Castaldi, C., de Man, A.P., Seip, M., 2015. Explaining the trademark-innovation linkage: the role of patents and trademark filing strategies. *Acad. Manag. Proc.* 2015 (1), 16624 Academy of Management.

Fosfuri, A., Giarratana, M.S., Luzzi, A., 2008. The penguin has entered the building: The commercialization of open source software products. *Organ. sci.* 19 (2), 292–305.

Fosfuri, A., Giarratana, M.S. 2009. Masters of War: Rivals' Product Innovation and New Advertising in Mature Product Markets *Management Science*, 55 (2) 181-191

Graham, S.J., Marco, A.C., Myers, A.F., 2015. Monetizing Marks: Insights from the USPTO Trademark Assignment Dataset. Available at SSRN 2430962.

Greenhalgh. C. ; Rogers, M. 2012. Trademarks and performance in services and manufacturing firms: evidence of Schumpeterian competition through innovation. *Aust. Econ. Rev.* 45(1)

Greenspan, David, Boyd Gregory, Purewal Jas (2014). Video Games and IP: A Global Perspective. *WIPO Magazine* (April 2014)

Helmets, C. and Rogers, M., 2010. Innovation and the Survival of New Firms in the UK. *Review of Industrial Organization*, 36(3), pp.227-248.

Hipp, C., Grupp, H., 2005. Innovation in the service sector: the demand for service-specific innovation measurement concepts and typologies. *Res. Policy* 34, 517–535.

Joel West, Ammon Salter, Wim Vanhaverbeke, Henry Chesbrough (2014), Open innovation: The next decade, *Research Policy* Volume 43, Issue 5, June 2014, Pages 805-811

Landes, W.; Posner, R. (1987) Trademark Law: An Economic Perspective. *The Journal of Law & Economics*, 30 (2) 265-309

- Levin, R., Klevorich, A., Nelson, R., Winter, S., Richard, G. & Griliches, Z. 1987. Appropriating the Returns from Industrial Research and Development, *Brookings Papers on Economic Activity*, Vol 1987, No. 3, Special Issue on Microeconomics, 783-831.
- Lessig, L (2004). *Free culture: how the big media uses technology and the law to lock down culture and control creativity*. The Penguin Press. New York.
- Long, V (2014) *A Technological Capabilities Perspective on Catching up - the Case of the Chinese ICT Industry*, *Doctoral thesis* at The Royal Institute of Technology.
- Long V & Laestadius S (2012), *Toward a New Appropriability Regime – the case of Chinese ICT industry*, research report of Dept. of Industrial Economics and Management, Royal Institute of Technology, Stockholm, Sweden 2012, TRITA-IEO R 2012:02, ISSN 1100-7982, ISRN KTH/IEO/R-12:02-SE, ISBN 978-91-7501-281-0
- Markman, G.; Espina, M.; Phan, P (2004) Patents as Surrogates for Inimitable and Non-Substitutable Resources. *Journal of Management* 30(4) 529-544
- Malmberg, Claes.(2005). “Trademarks Statistics as Innovation Indicator? - A Micro Study.” *Circle 17*: 1–43. Paper no. 2005/17
- Malerba, F., Orsenigo, L., 1996. Schumpeterian patterns of innovation, Cambridge. *Journal of Economics* 19 (1), 47–65.
- Mamede, R., Fernandes, T., Godinho, M., 2011. Patterns and determinants of trademark use in Portugal. In: Hirsch-Kreinsen, H., Schwinge, I. (Eds.), *Knowledge-Intensive Entrepreneurship in Low Tech Industries*. Edward Elgar Publishing.
- Merges, R., Nelson, R. 1990. On the Complex Economics of Patent Scope. *Columbia Law Review* 90, 839-916
- Mendonça, S., Pereira, T.S., Godinho, M.M., 2004. Trademarks as an indicator of innovation and industrial change. *Res. Policy* 33, 1385–1404.

Millot, V. (2009), “Trademarks as an Indicator of Product and Marketing Innovations”, OECD Science, Technology and Industry Working Papers , 2009/06, OECD Publishing, Paris. <http://dx.doi.org/10.1787/224428874418>

Merges, R (2009). The Concept of Property in the Digital Era (January 5, 2009). Available at SSRN: <https://ssrn.com/abstract=1323424> or <http://dx.doi.org/10.2139/ssrn.1323424>

Merges R. (2011) Justifying intellectual property. Harvard University Press.

Ramello, G.B., 2006. What’s in a sign? Trademark law and economic theory. *J. Econ. Surv.* 20 (4), 547–565. Raustiala, K., Sprigman, C., 2012

Reitzig, M., 2004. Strategic management of intellectual property. *Sloan Manage. Rev.* 35–40 Spring 2004.

Scherer, F.M. (1983) 'The propensity to patent', *International Journal of Industrial Organization*, Vol. 1, No. 1, pp. 107-28.

Scherer F. M. (2012) Quarter Notes and Bank Notes *The Economics of Music Composition in the Eighteenth and Nineteenth Centuries*. Princeton University Press.

Schmoch, U., 2003. Service marks as novel innovation indicator. *Res. Eval.* 12 (2), 149–156.

Schmoch, U., 2014. Knowledge transfer from German universities into the service sector as reflected by service marks. *Res. Eval.* 23 (4), 341–351.

Schumpeter J. (1934) *The Theory of Economic Development: An Inquiry Into Profits, Capital, Credit, Interest, and the Business Cycle*. Transaction Publishers, 1934

Scafidi, Susan, *Intellectual Property and Fashion Design* (August 23, 2006). *Intellectual Property and Information Wealth*, Vol. 1, No. 115, 2006. Available at SSRN: <https://ssrn.com/abstract=1309735>

Semadeni, M., Anderson, B.S., 2010. The follower's dilemma: innovation and imitation in

the professional services industry. *Acad. Manage. J.* 53 (5), 1175–1193.

Smith K. (2006) Measuring Innovation. in *The Oxford handbook of innovation*, eds. Fagerberg, Jan and Mowery, David.

Stigler, G (1961) The Economics of Information, *Journal of Political Economy*. 69 (3) 213–225

Teece, D. J. 1986. Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy. *Research Policy* 15, 285-305.

Teece, D. J. 2016 Profiting from Innovation in the Digital Economy: Standards, Complementary Assets, and Business Models In the Wireless World, Working Paper Series No. 16, Tusher Center on Intellectual Capital, Haas School of Business,, University of California, Berkeley, Aug, 2016

Throsby D. (2001) *Economics and Culture*. Cambridge: Cambridge University Press.

Von Graevenitz, G., 2007. Which Reputations Does a Brand Owner Need? Evidence from Trademark opposition. GESY discussion paper No. 215. Munich School of Management.

West, J.; Salter, A., Vanhaverbeke, W., Chesbrough, H. (2014) Open innovation: The next decade. *Research policy* 43 (5) 805-811

Winter, S. G. 2006. The logic of appropriability: from Schumpeter to Arrow to Teece,' *Research Policy*, 35, 1100-1106

