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Journal of Cultural Economics
Published in cooperation with The Association for Cultural Economics International

ISSN 0885-2545
Volume 39
Number 3

J Cult Econ (2015) 39:239-258
DOI 10.1007/s10824-014-9229-y

Springer

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ORIGINAL ARTICLE

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Received: 31 October 2013 / Accepted: 4 September 2014 / Published online: 18 September 2014

Abstract This article discusses some economic and cultural features of video games and posits that this medium belongs within the core of cultural economics. We further provide an applied investigation of video game usage. Using data for Spain, we estimate zero-inflated ordered probit models to control for an excess of zeros in our ordinal dependent variable. We find that the probability of game playing increases with the consumption of other cultural goods (e.g., listening to music or watching television) or active involvement in artistic activities (e.g., writing or visual arts production). Game playing is in general an urban phenomenon; it is positively associated with the ownership of home equipment and access to new technologies, but decreases with greater time restrictions of a person. The main differences to the traditional art formats is that game playing appeals particularly to younger, usually less educated cohorts.

Keywords Cultural participation · Video games · Zero-inflated ordered probit model

JEL Classification D12 · R12 · I29 · J29 · Z11

> Games are unique. Like architecture, they combine aesthetics and functionality, art and science. Like drama, they split the author of the script from the creator of the experience. Like nothing else, they thrive on the actions of an Other. Edward Castronova, Professor of Telecommunications at Indiana University Bloomington

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> Video games sit at the confluence of history, technology, and art in such a way that's found in no other medium, a place where influences from every creative field meet, mix, and recombine. Daniel D. Synder, The Atlantic

1 Introduction

Video games have received remarkably little attention within cultural economics, despite the economic importance, as well as large potential for artistic expressions. Cowen (2008) at his plenary address at the 2008 ACEI conference refers to computer games as one of the new digital mediums that have changed cultural economics. Since that inspiring speech, it seems, however, that little has changed in the perception of video games in our field.[1] Studies referring explicitly to video games are rather rare and limited to the video game industry as a whole. The aim of this paper was to motivate the role of video games within cultural economics and to show an application of economic theory and methodology to the area of video game consumption.

Within the humanities, the arts and cultural value of the new genre of video games is recognized and studied already since a longer time. Murray (1997) elaborates on the properties and experiences of digital environments and how they link with traditional narratives. Her main point is that the new digital mediums magnify the potential of expression available for story-telling. Laurel (1991) draws a parallel to performing arts and explains how digital mediums enable their users to be not only audience members, but to play as well the roles of a drama performer. Video games are also much about visual esthetics, where iconographic landscapes (Thorburn and Jenkins 2003), cutting-edge couture of the characters or architectural creations resemble the features of contemporary art.[2]

Refraining from the cultural aspects of video games, the sheer size and growth rates of the industry make it appear highly relevant. Global game market revenue was worth USD 10.3bn in 2004 and increased more than sixfold to USD 65bn by 2011 (Reuters 2011). Consumer spending on the games industry in 2011 was dominated by Europe at USD 20.7bn (ISFE 2013), followed by the USA at USD 16.6bn (ESA 2012).[3] Recent fiscal policies in some countries suggest that the importance of the video game industry is getting recognized also on the political level. In the UK, there has been introduced lately a tax break for the video games sector (Henderson 2012).

[1] Video games, in our understanding, incorporate not only computer games (i.e., games played on a general-purpose personal computer), but also digital games played on other platforms (i.e., consoles connected to the TV or portable consoles) both on-line and off-line.

[2] In line with these arguments, the Museum of Modern Art in New York has opened in March 2013 a permanent exhibition showcasing the best in videogame design and aesthetics. According to the curator, video games are art not only due to the visual quality and the associated aesthetic experience but also due to the interaction design, which is by now the most important expression of contemporary design creativity and in the case of video games ranges from the elegance of the code to the design of the player's behavior (Antonelli 2012).

[3] Looking at single produces of the industry, its dominance is even more impressive. The release in 2010 of Call of Duty: Black Ops, a first-person shooter video game, led to sales of USD 650 m during the first 5 days, which set a five-day global record for a movie, book or videogame (Chan 2011). The game reached further USD 1bn in global sales within 15 days of its release.

The economic importance of the video games industry is reflected in some recent economic studies, which, however, focus only on the industry as a whole. Previous research has investigated the pricing of video game consoles (Cox 2008) or the association between the industry's network effects and the product cycle (Clements and Ohashi 2005) and market outcomes in a competitive market (Shankar and Bayus 2003).[4] The only economic study of video game demand, that we are aware of, is by Harada (2007), who provides a carefully executed investigation on the price and income elasticities using household data from Japan. However, the data used by Harada do not allow him to capture a number of important household-level characteristics that are usually cited as the determinants of cultural participation (e.g., education levels). Video games are also increasingly covered by other social scientists. For example, the marketing scholars Marchand and Hennig-Thurau (2013) derive a conceptual framework of value creation through video games and apply it to identify the industry's main business models and relationships among players.[5]

The underlying study contributes to that research strand by providing an analysis of a wide range of potential individual-level determinants of video games demand using rigorous statistical analysis. We employ the Survey of Cultural Habits and Practices in Spain, which is one of the first national cultural statistics that contains a separate part of the survey on the consumption of digital media, including video games. The chosen database allows us to study the importance of a whole range of factors that potentially determine video games playing.

Spain is also an interesting case study, as it comes close in several characteristics to the European average. ISFE (2012) reports that 35 % of online respondents in Spain have bought a game in 2012. According to the same source, the identical share of 35 % is the average share of those who have bought a game in one of the 16 European countries surveyed. The Spanish percentage lies above Italy (28 %), Germany (29 %), Denmark (30 %), Finland (32 %), Portugal (33 %) and Great Britain (34 %). Furthermore, ISFE (2012) lists that in Spain, 40 % of the online population declares that they play video games. The 5 % point difference between those who play and those who purchase can be explained by people playing free games, having purchased a game earlier than in 2012 or have obtained the game by means of an illegal download. According to the Spanish Association of Distributors and Publishers of Entertainment Software (ADESE 2013), only seven out of 100 internet users download illegally video games.[6] Piracy remains an issue for the

[4] See also Egenfeldt-Nielsen et al. (2008) for a more general overview of the economic organization of the video game industry.

[5] Interestingly, Marchand and Hennig-Thurau (2013) also advocate the potential of video games research in their academic discipline and argue that "marketing scholars still devote far less attention to [the video games industry] than to other entertainment industries, such as movies, television, or music" (p. 142).

[6] BSA (2011) shows piracy rates for software as a whole and indicates that Spain exhibited in 2010 a software piracy rate of 43 %. This is higher than in some Central or Northern European countries, but comparable with France (39 %) or Portugal (40 %), somewhat lower than Cyprus (48 %), Iceland and Italy (49 % each), and much lower than Greece and most of the Eastern European countries. Moreover, Spain was just on the world average of software piracy. Rodriguez-Andrés (2006) study how income inequality influences national piracy rates across a sample of 34 countries. He does not present any particular evidence for Spain and finds that the USA are the only outlier in the regression analysis in terms of very low rates of piracy.

video game industry, especially for consoles and PC-oriented video games. However, with the emergence of smart devices, piracy is likely to decrease since many of the games are for free and illegally obtained copies do not usually function in online environments. In any case, the country studied is unlikely an outlier when it comes to piracy, but hopefully to some extent representative of Europe.

Furthermore, we are able to use rigorous statistical measures to resolve some important data issues, such as the overrepresentation of zeros. As it is often the case with many culture and leisure activities, most of the population declares that they never use video games: <13 % of the survey participants have played video games. Therefore, there is an excess of zeros in our dependent variable that should be taken into account. One possibility could be just not to consider non-players in the analysis; however, this group could be not randomly selected from the whole population, and this may lead to biased results. A second alternative is to estimate a model that explicitly addresses the potential bias of the overrepresentations of non-participants. We have followed this approach, and we have estimated zero-inflated ordered probit (ZIOP) models. This methodology allows to account for the econometric challenge that arise when the dependent variable is characterized by excess zeros (i.e., is zero inflated). The zero-inflated bias arises if one value of the dependent variable has two populations: in addition to the "proper" zeros in the variable, there are "extra" ones, thus inflating the number of zeros. In cultural participation, including video gaming, this could mean that the observed zeros could be attributed to two distinct populations. First, it could reflect those people who have no interest in culture and never participate in a cultural activity. Second, it could cover people who did not participate in culture in the given period due to various constraints, but are interested in culture and participate in general. For the first type of people, the probability of participating is effectively zero, while for the second, it is a possibility. The point is that both observations are fundamentally different and failing to account for the presence of these distinct types can bias statistical results. In applied cultural economics, zero-inflated models are increasingly often used since the influential study by Ateca-Amestoy (2008) that employed such models to estimate theater attendance. Furthermore, Ateca-Amestoy and Prieto-Rodriguez (2013) assessed the forecasting properties of these models for arts participation. Their findings demonstrated that the predictions work well out-of-sample, and therefore, these models can be used to extrapolate the estimated behavior to individuals not surveyed. In our case, the underlying video games variable, however, is an ordered variable, which, from a technical point of view, creates an additional estimation difficulty. Hence, we extend the previous approaches and show how a ZIOP model can be applied when the observed outcome is not a count variable but and ordered one.

In order to investigate whether demand of video games is related to a person's involvement in other cultural activities, one would ideally estimate cross-price effects. Building on cross-price elasticity would enable us to formally establish whether video gaming is substitutive or complementary to other cultural activities. However, this approach cannot be pursued due to the lack of prices in our dataset, i.e., we do not have enough information to estimate demand curves for video games and the corresponding cross-price effects with other cultural goods. Therefore, the

approach undertaken in this study is an economic analysis of the determinants of video games playing, where the intensity of involvement in other cultural activities is taken into account as covariates of video games playing.

The paper is organized as follows. Section 2 discusses previous research on cultural aspects of video games. Section 3 describes data and methodological issues. Section 3 presents the empirical model; results are presented in Section 4. Finally, Section 5 presents concluding remarks and outlines possible venues for future research.

2 Data and methodology

The first step in conducting the quantitative analysis is to identify a suitable database. We have chosen the Survey of Cultural Habits and Practices in Spain (SCHP) as our data source. The survey was conducted by the Spanish Ministry of Culture and Sports during the period from 2010 to 2011. In each trimester of those 2 years, a new random sample was interviewed, resulting in a final sample of 14,486 individuals. The respondents are representative of the Spanish population aged above 12 years in terms of education level, economic activity, type of residence and other factors.[7]

The SCHP is an opinion survey that covers the most important fields of cultural practices and the consumption products that are subject to intellectual property rights, such as music, video games and other software. The database includes information on the intensity of consumption of books, television, radio or music, whether a person was actively involved in a range of cultural practices, or has followed an art course.

The survey combines the listed information with a set of socioeconomic characteristics for each respondent, including age, level of educational attainment, marital status, family responsibilities and employment characteristics. Finally, the survey contains information on the occurrence and intensity of video games playing. A summary of the number of survey respondents that correspond to each of the discrete response categories of our video games playing measure is provided in Table 1. It can be observed that almost 84 % of the sample declares that they never play video games. This high share of those who have allegedly not played in the studied period can be interpreted as the first indication of a zero-inflated problem.

Table 2 presents summary statistics for the whole set of variables.

Using this dataset, we estimate a ZIOP model that takes account of the overrepresentation of zeros and is adequate for an ordered dependent variable. Below we present briefly the features of this model and refer the curious reader to Harris and Zhao (2007) for a more detailed technical description.

[7] Even though the survey officially claims to cover people aged around 15 and above, a significant number of younger respondents, aged 13 and 14 (314 and 216 responses, respectively), have answered the questionnaire. This enables us to produce a wider and more accurate overview of video game playing patterns in Spain.

Table 1 Dependent variable values

Frequently playing VIDEO	Frequency
Never	11,648
At least once a year	166
At least once a quarter	209
At least once a month	510
At least once a week	978
Daily	383
Total	13,894

The ZIOP estimator contains two equations: a probit selection equation and a standard ordered probit. This endogenously splits the observations into two regimes that exhibit potentially different associations with the explanatory variables. For the case of playing video games, people are classified into two groups: no gamers, always with a zero consumption, and (potential) gamers which may either have positive or null consumption. Therefore, individuals who exhibit zero-consumption patterns are potentially attributed to two different populations. The first type of non-participants has no interest in video games and exhibit perfectly inelastic demand to personal constraints. The second type of non-participants report zero consumption at the time but may consume, for example, once their constraints have changed.

Following Harris and Zhao (2007), let us define a discrete random variable y that takes discrete ordered values of $0, 1, \ldots, J$, and let r denote a binary variable, indicating the split between regime 0 (non-participants) and regime 1 (participants). The indicator r is related to a latent variable r^* such that $r = 1$ for $r^* > 0$ and $r = 0$ for $r^* \leq 0$. The latent variable r^* indicates the probability for entering regime 1 as follows:

$$r^* = \boldsymbol{z}'\gamma + \varepsilon \tag{1}$$

where $\boldsymbol{z}$ is a vector of covariates, γ is the vector of coefficients and ε is a standard normally distributed error term. Therefore, the probability of a person being in regime 1 is $\Pr(r = 1|\boldsymbol{z}) = \Pr(r^* > 0|\boldsymbol{z}) = \Phi(\boldsymbol{z}'\boldsymbol{\gamma})$, and the probability of being in regime 0 is $\Pr(r = 0|\boldsymbol{z}) = \Pr(r^* \leq 0|\boldsymbol{z}) = 1 - \Phi(\boldsymbol{z}'\boldsymbol{\gamma})$, where $\Phi(.)$ is the standard normal cumulative distribution function.

Conditional on $r = 1$, consumption levels under regime 1 are characterized by a discrete variable $\widetilde{y}(\widetilde{y} = 0, 1, \ldots, J)$ that is estimated with an ordered probit model through a second underlying latent variable $\widetilde{y}^*$:

$$\widetilde{y} = \boldsymbol{x}'\beta + u \tag{2}$$

where $\boldsymbol{x}$ is a vector of explanatory variables, β is the vector of coefficients and u is a standard normally distributed error term. The outcome equation of the ZIOP depends on a standard ordered probit estimation which is defined as:

Table 2 Descriptive statistics

	Mean	SD
Frequently playing video	0.5715	1.3752
Age	44.216	19.102
Female	0.5200	0.4996
Less than primary education	0.2390	0.4265
Primary education	0.3107	0.4628
Secondary education	0.1359	0.3427
Vocational education	0.1354	0.3421
Tertiary education	0.1700	0.3757
Self-employed	0.0773	0.2671
Employee	0.3730	0.4836
Unemployed	0.1249	0.3306
Retired	0.1988	0.3991
Disabled	0.0061	0.0781
Student	0.0940	0.2918
Independent	0.1529	0.3599
Married	0.6051	0.4889
Single dependent	0.2151	0.4109
House size	3.1239	1.3396
Number children	0.2548	0.6024
Fact (cult eq)	−9.40E−10	0.8617
Fact (comp and new tech)	−1.20E−08	0.9462
Min read working day	33.955	69.515
Min read weekend	31.760	65.489
Hours TV working day	2.6712	2.2877
Hours TV weekend	2.9040	2.1816
Hours radio working day	1.7806	2.4426
Hours radio weekend	1.2675	1.8358
Hours music working day	2.0800	2.7651
Hours music weekend	1.6555	2.2526
Writing	0.0710	0.2568
Trad visual arts	0.1668	0.3728
Photograph and video	0.2944	0.4558
Musical activities	0.0901	0.2863
Performing arts	0.0535	0.2250
Arts course	0.0679	0.2515
Province capital	0.4141	0.4926
City	0.0886	0.2841
Town	0.0967	0.2956
Small town	0.2125	0.4091
Village	0.1883	0.3910

$$\Pr(\widetilde{y}) = \begin{cases} \Pr(\widetilde{y} = 0|z, r = 1) = \Phi(-\boldsymbol{z}'\gamma) \\ \Pr(\widetilde{y} = j|z, r = 1) = \Phi\left(\mu_j - \boldsymbol{z}'\gamma\right) - \Phi\left(\mu_{j-1} - \boldsymbol{z}'\gamma\right) \quad (j = 1, \ldots, J-1) \\ \Pr(\widetilde{y} = J|z, r = 1) = 1 - \Phi\left(\mu_{j-1} - \boldsymbol{z}'\gamma\right) \end{cases} \tag{3}$$

The variables r and $\widetilde{y}$ are not individually observable in terms of the zeros; however, they stand in the following relation:

$$y = r\widetilde{y} \tag{4}$$

In words, we observe the zero outcome ($y = 0$) if the individual is non-participant ($r = 0$) or if she is a zero-consumption participant ($r = 1$ and $\widetilde{y} = 0$). The positive outcome is observed if the individual is a participant ($r = 1$) and has consumed ($\widetilde{y}^* > 0$).

Allowing the error terms from the first stage probit equation and the second stage ordered probit equation (i.e., ε and u) to be correlated, then according to Harris and Zhao (2007, p. 1076), the full probabilities for y are given by:

$$\Pr(y) = \begin{cases} \Pr(y = 0|\boldsymbol{x}, \boldsymbol{z}) = [1 - \Phi(\boldsymbol{z}'\gamma)] + \Phi_2(\boldsymbol{z}'\gamma, -\boldsymbol{x}'\beta, \partial)] \\ \Pr(y = 1|\boldsymbol{x}, \boldsymbol{z}) = \Phi_2\left(\boldsymbol{z}'\gamma, \mu_j - \boldsymbol{x}'\beta, -\partial\right) - \Phi_2\left(\boldsymbol{z}'\gamma, \mu_{j-1} - \boldsymbol{x}'\beta, -\partial\right), \ (j = 1, \ldots, J-1) \\ \Pr(y = J|\boldsymbol{x}, \boldsymbol{z}) = \Phi_2\left(\boldsymbol{z}'\gamma, \boldsymbol{x}'\beta - \mu_{j-1}, \partial\right) \end{cases} \tag{5}$$

where $\Phi_2(.)$ denotes the cumulative distribution function of the standardized bivariate normal distribution and ∂ is a correlation coefficient between both error terms (ε and u).

3 Empirical model

Empirical research on consumption patterns in the arts recognizes the importance of personal factors such as cultural capital, experience and tastes and often focuses on "rational addiction" in the framework of Stigler and Becker (1977), or "learning-by-consuming" models (Lévy-Garboua and Montmarquette 1996; Abbé-Decarroux and Grin 1992; Morrison and West 1986). Throughout those analyses, the technical sophistication of the employed methodology has increased steadily. While the earliest studies estimated binary decision models assuming that participation is a dichotomous phenomenon, more recent articles focus on the determinants, and the degree, of participation (see also Seaman 2006, for a comprehensive review of this literature). One of the first studies that deal with heterogeneity behind the no participation outcome is provided by Ateca-Amestoy (2008).[8] The author measures theater participation using count data and estimates a Zero Inflated Negative Binomial Model by characterizing two distinct behaviors for the observable attendance: a group of never-goers (who never participate) and a subpopulation that

[8] Also, Fernandez-Blanco et al. (2009) use latent class models to estimate cinema attendance finding two distinct behaviors for the observable attendance.

has a positive probability of attending. We build here on Ateca-Amestoy's insights and extend her approach to adequately incorporate an ordinal variable.

By focusing on revealed preferences, we can attribute human behavior to binding budget constraints, time constraints, social constraints or physical constraints and tastes. Formally, we are interested in estimating the following model:

$$Y_i = (H_i, P_i, A_i, O_i, HH_i, D_i, G_i) \tag{6}$$

The dependent variable, Y_i, is used to measure the frequency of a person playing video games during the last year. The variable is an ordinal variable and takes the following values: daily, at least once a week, at least once a month, at least once a quarter, at least once a year, never or almost never.

This is regressed on a measure of human capital (H_i), which is a result of formal and informal education and skills. This is a particularly important variable in research on cultural demand, as it is usually used to approximate for the cultural capital of a person (e.g., Ateca-Amestoy 2008). Cultural capital is a personal resource accumulated by past consumption of or exposure to cultural goods and usually is very difficult to quantify. In order to consume video games, specific equipment is required, which we label physical capital (P_i). Individuals who want to consume video games could potentially satisfy their need by consuming other related cultural goods, especially if one believes in the previous suggested similarities between video games and traditional cultural formats. The model incorporates therefore a vector of variables measuring the intensity of consumption of alternative goods (A_i). Those variables take also some account of time constraints of an individual, as the consumption of most cultural goods is exclusive. To assess more formally the uses of personal resources (time and money), we measure the person's involvement in the labor market. We include a set of various types of occupational status (O_i) in order to take into account time restrictions related to economic activity.[9] To analyze the effect of family time restrictions, we introduce a vector controlling for marital status and household size and structure (HH_i). In addition to these socioeconomic variables, we account for demographic factors of a person (D_i). Finally, since the social dimension of cultural demand is usually related to geographic factors, we incorporate as well this information using a vector of variables related to the person's place of residence (G_i). Now we discuss in some depth how these variables are measured and hypothesize their expected effects.

Human capital (H_i) is measured by an indicator function taking the value one for each category of education attainment (i.e., less than primary education, primary, secondary, tertiary education and vocational training). Stigler and Becker (1977) put the notion forward that human capital—such as formal education—influences potentially the ability of a person to build up her cultural capital. In other words, human capital influences a person's ability to transform her initial endowment of cultural capital and past cultural goods consumption into cultural capital. We include also a more specific variable measuring the formation of cultural capital of a person and determine whether the respondent participated in any art course in the

[9] We have to be aware of the difficulty of separating time restrictions associated to the occupational variables from the likely variations in income associated with different employment statuses.

previous year. The covered courses encompass a range of cultural activities such as painting, audiovisual production, performing arts, dancing, singing or music instrument playing. With regard to the traditional art forms, the theory suggests that a higher level of education, be it formal general education or informal cultural training, is associated with greater demand, since there will be a bigger available stock of cultural capital.

Consuming video games requires specific equipment. The video games recorded in the underlying survey are games that could be played on a computer, game console or any other device. Whether an individual has access to this equipment (P_i) is estimated using factor analysis to incorporate a measure of a person's home equipment oriented to computers and new technologies (number of computers, phones, consoles, PDAs, etc.). We include also a factor analysis measuring general cultural equipment (number of books, e-books, vinyls, CDs, DVDs, etc.).[10]

Unfortunately, the survey does not include income information. Income is typically suggested as an important determinant of cultural demand and contains two contradictory effects, which are often neglected in the literature. On the one side, with greater income, the demand for cultural goods is expected to increase provided that those are normal goods. On the other side, rising income implies a higher opportunity cost of leisure and hence less time for cultural participation. Since the survey does not include income information, we are unfortunately not able to directly account for these two effects. However, since income allows individuals to afford video games and the necessary equipment, we hope to account for this effect by directly measuring the quality of a person's home equipment related to computers and new technologies, and general cultural equipment. Later, we also introduce variables for the types of occupation which, it is hoped, approximate for the time availability of a person, as the occupational background is associated with the number of working hours and therefore affects the available leisure time.

The consumption intensity of alternative cultural goods (A_i) is estimated by including variables measuring a person's consumption of television, radio, music or books. These are all cultural activities that are not bound to a specific location and time, and as such resemble the character of video games consumption. Watching television, listening to radio or music, reading books or playing computer games can be done in a person's home or in most other informal settings at the time of a person's choosing. This would be different with many other cultural products, such as, for example, performing arts that require the individual to attend physically a performance at a given time and place. To take a more precise account of the time availability issue, we differentiate whether each of those activities took place during the workweek or on the weekends. A priori, the relationship between consumption of those alternative goods and a person's probability of playing video games is ambiguous. It could be that people who watch more television have also a stronger preference for new mediums, and consume more video games. Alternatively, it

[10] The main results of both factor analyses are presented in the "Appendix". Note that in both cases only predictions for the first factor are used in the subsequent regression analysis, since Eigenvalues associated with the other factors drop sharply.

could be the case that people substitute watching television for playing video games, and would demand less.

In addition, we include a set of variables that measures active participation of a person in a range of artistic or cultural activities. We differentiate whether somebody was involved in audiovisual production (photography or video production), performing arts, musical activities (singing, dancing or playing a music instrument) or visual arts production (painting, drawing). Similarly, with regard to these alternative cultural activities, it is a priori not clear what effect should be expected.

Measuring a person's time constraints due to involvement on labor markets (O_i) is difficult. Ideally, one would have a detailed count of the hours spent at work. Such data are, however, not available, and as it is common in this research area, we rely on indicator functions that identify eight broad types of occupations (self-employed, employed, unemployed, retired, disabled, student and housekeeping). The occupational group of a person is related to the working time and therefore impacts the leisure time. In our case, since income data are not provided in the underlying survey, the occupation categories will also serve as an approximation for the time availability of a person.

A person's leisure time is similarly affected by family burdens and ties (HH_i), assuming that housekeeping commodities are mainly produced using one's own time. The larger the household size the more time constrained a person might be and should therefore exhibit lower game playing patterns. Marital status may have a twofold effect. While the presence of a partner may enable sharing of the household production, allowing for more leisure time, it could also impose a restriction on the choice set due to the presence of a partner with whom the individual must coordinate. The effect of children is also ambiguous. On the one hand side, having children decreases a person's leisure time, on the other, it enables sharing of video games and specific equipment among children, which decreases the equipment acquisition cost per child.

Demographic characteristics (D_i) of a person are controlled for by the inclusion of a quadratic age polynomial. Taste formation is a process that requires time, and therefore, cultural participation is expected to increase over the lifetime of a person (Gray 2003). A further important determinant of cultural participation is gender. It is argued that early socialization on cultural activities, which is strongly related to a particular gender, has a strong role on future participation (Gray 2003).

Geography is accounted for by categorizing a person's place of residence. We identify five categories of habitats based on its population size and political status (provincial capital, city, town, small town, rural). Cultural participation is predominantly an urban phenomenon (Gray 2003), which is usually attributed to the existence of higher supply in larger cities. Although this factor can be more important for other types of cultural consumption such as performing arts or music concerts attendance, this might lead to cheaper access of the consumer to the latest video games, relevant equipment and gaming communities. On the other hand side, in smaller habitats, where the availability of alternative activities (such as, for example, theater) is limited, playing video games might be higher. Finally, the survey covers whole Spain, which is a heterogeneous country with large economic,

cultural and political differences across geographic regions. To account for those unobserved geographic differences we include a set of 18 indicator functions that take the value one for each of the regions of Spain (and zero otherwise).

4 Results

We begin with a discussion of the determinants that affect the probability of ever playing (inflation equation), then present the impact of the explanatory factors on the frequency of playing (ordered probit equation), and end up by relating our findings to previous results. Table 3 summarizes the results.

The probability of playing video games decreases with age but at a diminishing rate. Given the estimated coefficients, this probability decreases till the age of eighty-six; therefore, the quadratic component does not change the sign of this effect. Probability of ever playing is positively associated with being female and involved in photography or video production and negatively with music listening during workdays. As expected, this probability increases with better home equipment and ownership of computers and new technologies. As for variables capturing time constraints, only those related to the structure of the household are found to be significant. Members of a large household have a lower probability of playing video games unless there are children below the age of ten, in which case this probability rises. Obviously, whatever your age, if there are children at home you may need to play video games with them now and then. This result may constitute also an indirect indication on the demand by the youngest players. It is likely that the youth exhibit a relatively high demand for video games due to their affinity with new mediums.

Next, we present results on the frequency of video games playing. For those who have a positive probability of playing, age presents a U-shaped effect on the frequency of playing with its minimum at the age of thirty-five. Playing frequency decreases for females and people with high education attainments (the lowest probability characterizes people with secondary but especially tertiary education) and increases with the size of the habitat. The frequency of playing exhibits a positive association with watching television any day, but particularly over the weekend, as well as listening to music on the weekend. Furthermore, people who play video games more frequently are also more often involved in creative writing (poetry, fiction, etc.) or traditional visual arts (painting, drawing, sculpturing, etc.). Finally, we find that household equipment, even if it is not necessary linked to computers and new technologies, it is positively associated with the frequency of playing video games. However, other cultural equipment such as books and CDs present a negative link with video game use even if significant only at 15 % significance level.

We turn next to the discussion of our results and place them in the context of previous research. Even though cultural participation is in general believed to increase with age, some cultural areas are more popular for younger generations. Borgonovi (2004, p. 1881) finds, for example, that theater but also ballet is demanded more frequently by younger audiences, who are primary in their late 20s

Table 3 Zero-inflated ordered probit estimation

	Zero-inflated ordered probit				Ordered probit	
	Ordered probit eq.		Participation eq.			
	Coefficient	*t* stat	Coefficient	*t* stat	Coefficient	*t* stat
Constant	1.00893*	6.359	5.66342*	7.542	0.84902*	4.937
Age	−0.08314*	−9.123	−0.19011*	−7.268	−0.01918**	−2.152
Age/100 squared	0.11740*	7.625	0.11057*	4.437	0.02518***	1.896
Female	−0.97329*	−21.15	0.43085*	3.217	−0.12772**	−2.565
Primary education	0.02293	0.328	0.04895	0.376	−0.00964	−0.122
Secondary education	−0.13051***	−1.683	0.04376	0.273	−0.04905	−0.557
Vocational education	−0.00165	−0.021	0.03298	0.217	−0.02248	−0.253
Tertiary education	−0.30089*	−3.480	−0.02477	−0.145	−0.07907	−0.821
Self-employed			−0.18536	−0.965		
Employee			−0.20208	−1.196		
Unemployed			−0.05963	−0.318		
Retired			0.10382	0.545		
Disabled			−0.27462	−0.662		
Student			0.24009	0.316		
Independent			−0.03836	−0.220		
Married			−0.21059	−1.372		
House size			−0.09536*	−2.811		
Number of children			0.13809**	2.196		
Fact (cult eq)	−0.03788	−1.524	0.25634*	4.067	0.00997	0.333
Fact (comp and new tech)	0.32497*	10.186	0.30223*	4.191	0.06651***	1.832
Min read working day	−0.00006	−0.200	0.00038	0.406	0.00023	0.536
Min read weekend	0.00038	1.041	−0.00036	−0.421	−0.00064	−1.496
Hours TV working day	0.02598**	2.034	−0.03430	−1.320	0.00158	0.117
Hours TV weekend	0.05511*	4.211	0.03285	1.275	0.01044	0.757
Hours radio working day	−0.01510	−1.222	0.01396	0.536	−0.00147	−0.116
Hours radio weekend	−0.00953	−0.610	−0.03012	−0.939	−0.00441	−0.264
Hours music working day	0.01847***	1.864	−0.05285**	−2.348	0.00066	0.064
Hours music weekend	0.01272	1.247	0.03274	1.238	0.00636	0.547
Writing	0.12536***	1.926	−0.14049	−0.874	0.00022	0.003
Trad visual arts	0.21071*	4.307	0.01570	0.140	0.03245	0.606
Photograph and video	0.05578	1.267	0.31622*	3.442	0.02898	0.608
Musical activities	−0.03611	−0.639	0.18469	1.268	0.02913	0.465
Performing arts	−0.11295	−1.504	0.16685	0.772	−0.03513	−0.394
Arts course	0.04833	0.665	0.01571	0.091	0.01368	0.171
Province capital	0.14290**	2.235	−0.05710	−0.406	0.01866	0.269
City	0.12943	1.506	−0.18099	−0.973	0.00965	0.100
Town	0.14621***	1.744	−0.16847	−0.924	0.01552	0.170
Small town	0.09801	1.393	−0.17900	−1.193	−0.00280	−0.037

Table 3 continued

	Zero-inflated ordered probit				Ordered probit	
	Ordered probit eq.		Participation eq.			
	Coefficient	*t* stat	Coefficient	*t* stat	Coefficient	*t* stat
Mu(1)	0.09343*	12.172			0.05183*	13.053
Mu(2)	0.21419*	17.717			0.12061*	19.928
Mu(3)	0.53474*	26.010			0.31374*	31.717
Mu(4)	1.45670*	40.489			0.93760*	46.235
ρ	−0.07708	−0.545				
N		13894			13894	
Log likelihood		−7,069.974			−8,556.653	
Rest. log likel.		−8,556.653			−9,322.063	

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

and 30s. Our study shows that both the probability and the intensity of playing video games are significantly higher for younger cohorts although, among players, the intensity also increases as people get older. It seems that there is a (technological) barrier that keeps many older people *out of game* but once this barrier is removed, older people enjoy video games regularly, up to several times more often than teenagers. The reasons for this are not straightforward. This could be attributable due to some psychologic determinants and the affinity of the youth with digital technologies. If this were the case and assuming constant tastes, future participation would shift toward older people, once today's youth enter higher age. In addition, the development of motion sensing games and consoles, that enable the development of games targeted at whole families, might further increase the age of the average game player. This forecast is a particularly favorable considering recent research on how digital games might enhance the well-being of older adults and are positively associated with successful aging (Allaire et al. 2013). In an experimental setting, based on a sample of adults aged from 63 to 92 years, the authors have shown that those who play occasionally or regularly exhibit significantly higher well-being and lower depression rates.

Female exhibit usually higher participation rates than male in some of the traditional art forms, such as theater, ballet or dance (Borgonovi 2004; Ateca-Amestoy 2008). This could be attributable to social expectations and social pressure on the adoption of defined gender roles (Gray 2003). Also our research shows gender makes a difference; however, video games consumption is dominated by males mainly because among those who play, male reveal a higher frequency of playing than the average female player. This might suggest that males are socialized through video games as opposed to female, who socialize through exposure to traditional art forms. One possible determinant of this segregation might be attributable to the fact that game development teams consist usually of men, and hence, the content resembles closer male perspectives and expectations

(Locker 2012).[11] It is nonetheless interesting to observe that, once it is controlled for other relevant factors, being female increases the probability of playing, although the association is small and comparable with the effect of an age difference of around 2 years. Therefore, some female do not appear deferred by neither video game content nor the typical socialization patterns of video games, although their playing intensity is much lower than of males. The appearance of smart phones in the last years could have an impact on the popularity of video games among females; however, information about the device used to play is not available, and thus, we cannot explore this hypothesis.

Our results for educational variables imply that the effect for the highest educated is contrary to other cultural activities. Although it does not affect the probability of ever playing, those with secondary or university degree play significantly less often, compared with those who have less than primary school education. This is different for performing arts or visits to museums and art galleries, where participation increases gradual for each education group and is characterized by clear differences across the categories (e.g., Ateca-Amestoy and Prieto-Rodriguez 2013). It is possible that this effect is attenuated by the high share of young players, who have not yet obtained much education. Alternatively, it might be also an indication that video games are an example of "low culture" good, being less selective than the traditional art forms and requiring a lower status in endowments such as education (for a study of demand for "low culture" see Castiglione and Zanola 2013).

Habitat size matters for the frequency of playing, with provincial capitals and towns characterized by markedly higher frequencies than villages. However, place of residence does not have an effect on the probability of playing. This result is in line with previous findings for performing arts, where habitat size determines frequency but not probability of attending (Ateca-Amestoy 2008).

From the analysis of the alternative activities, we conclude that many are positively associated with the probability or frequency of playing games. Watching television during weekdays or weekends, listening to music during workdays or engagement in writing and traditional visual arts (e.g., painting or drawing) are found to be complementary to video games increasing the expected frequency of playing. The probability of being a video games player increases also with the involvement in photography or video recording and decreases with music listening on the week days. With regard to music listeners, it can be concluded that those who listen are less likely to play video games; however, if they play, they do so with a higher intensity. These results might indicate that some people (e.g., music lovers) do not play while listening to music; for them, music is a "serious matter" and stands as an activity to be enjoyed on its own, whereas for video game players, music could be less important, albeit a pleasant accompaniment while they play. It is interesting to observe that the statistically significant effects of alternative cultural goods or the involvement in artistic activities exhibit usually a positive effect on video games consumption. However, the associations with some activities such as practicing performing arts or musical activities do not present statistically

[11] A further assessment and discussion of these trends is provided in Bryce and Rutter (2003).

significant results. All in all, these patterns seem to indicate that video games tend to be rather complementary to cultural consumption and practices.

Physical capital owned by a person is related to both probability and frequency. Owning home equipment implies that people are more likely to play; while the frequency of playing increases only due to the ownership of home equipment such as computers and other new technologies.[12]

The included variables measuring the extent of time constraints of a person imply usually a decreasing frequency of playing; however, the coefficients are often not significant. The strongest effects are found for household size, which decreases the probability of playing. On the contrary, the number of young children in a household is positively associated with this probability. This could be partly attributable to the possibility of video game equipment sharing among all the members of the family including older siblings and parents. Also, if there are children at home you may play video games with them. Involvement in the labor market, either on an entrepreneurial basis or as an employee, or being registered as unemployed (i.e., those who actively seek work) leads to lower, albeit statistically insignificant video games playing probability.

5 Conclusions

Video games, similar to other produces of the cultural industries, have certainly a large quality variance in cultural terms. Nonetheless, video games by affecting visual, auditory and kinesthetic senses are perhaps the richest cultural genre we have yet seen (Aarseth 2001). Most new gaming formats, whether a hero-driven adventure, genre-specific role-playing game, first-person shooter or a character-specific simulation, exhibit unprecedented potential for cultural creation in the form of visual arts, story-telling or audio soundscape. Fundamental and continuous technological improvements enable increasingly sophisticated game design. Creativity is arguably stimulated by the constant shift in the basic tools and resources of game designers, which also redirects their attention from mastering a tool to exploring properties and potentials of new mediums (Thorburn and Jenkins 2003).

Furthermore, multiplayer online games where a player influences not only the character and plot of the game, but can impact and interact with other real people are reasons why some posit that video games may be culturally superior to any of the old mass media (e.g., Aarseth 2001).

Empirical studies on the microeconomic aspects of video games consumption are rare and constrained usually to descriptive statistics of a number of socioeconomic factors of the video game consumer. Such an approach suffers from omitted variable bias and is of limited use to both policy makers as well as to managers of the game industry. In this study, we were able to employ econometric methods that allow inclusion of a range of potential determinants and have so investigated the strength and direction of their effects on game playing patterns. By means of estimations of ZIOP models, we are able to classify observed behaviors into two heterogeneous

[12] For an interesting analysis on how the ownership of gaming equipment depends on the timing of the market entry of a console producing firm refer to Cox (2006).

populations: those who never play a video game and those who exhibit positive frequencies of playing. The constituency of each group is determined endogenously using two simultaneous equations.

In line with the posited cultural content of video games, we have seen the complementary relationship with many alternative cultural goods or artistic practices. Similar to traditional art forms, the studied activity appears to be an urban phenomenon. Video games consumption is positively associated with the ownership of home equipment and access to new technologies and appears to decreases with greater time restrictions of a person. There are also some meaningful differences with traditional cultural forms. Perhaps the most striking difference is that it is a male-dominated activity. Second, game playing is particularly appealing to younger cohorts although the age effect is also important for older people once the barriers that keep many of them out of the gamers' community are eliminated. And finally, those with secondary or higher education play less often; however, education does not impact the probability of playing.

Video games economics is a very new research area that inhibits large potential from an academic point of view.[13] A large venue for research relates to the microeconomics of video games. Our knowledge is limited on what are the determinants of success of a specific video game as function of various covariates such as budget, advertising, designers, reviews, awards, genres, ratings or content. A related question, arising in this research, is how the determinants of demand change for different types of game. Can there be detected any differences between people playing intellectually stimulating games, for example, strategic games such as *Civilization*, and games that rather test the players' speed and reaction times, for example, sports simulator games such as *Pro Evolution Soccer*. A further venue for research concerns video games macroeconomics. What is the long-run demand for digital games, the role of geographic factors for the production and distribution of games, or the impact of various policy, economic and social changes on the industry and its actors?

Acknowledgments The authors wish to thank Martin Falk, John O'Hagan, Beatriz Plaza, the Editor Kathryn Graddy and participants at the European Workshop on Applied Cultural Economics in Ljubljana, workshop on "Culture, data and digitization" in Bilbao and an invited seminar at the University of Catania for helpful suggestions and insightful comments. Both authors are members of the project "Assessing effective tools to enhance cultural participation (PUCK)," which has been awarded a European Grant in the CULTURE 2007–2013 program from the European Union. Karol Jan Borowiecki is also member of the project "Renewal, Innovation & Change: Heritage and European Society (RICHES)," which has been awarded a European Grant under the FP7 framework. This research has been also funded with support from the Spanish Ministry of Economy and Competitiveness (projects ECO2011-27896 and ECO2013-46516-C4-4-R).

Appendix

See Tables 4, 5.

[13] Beyond the listed possible research venues, it is likely that we will see in future research using data from large multiplayer video games. Castronova (2001) advocates strongly for studies using data from virtual worlds as it might enable a unique context for natural experiments, a high number of participants as well as tightly controlled experimental conditions.

Table 4 Home cultural equipment factorial analysis

	Eigenvalue	Proportion of explained variance
Factor 1	2.31065	0.7611
Factor 2	0.82211	0.2741
Variable		Weights
Number of books		0.3451
Number of e-books		0.0761
Paper Encyclopedia		0.2599
Electronic encyclopedia		0.1765
E-book reader		0.1091
Number of CDs		0.2992
Number of vinyl albums		0.4242
Number of MP3s		0.1630
Number of music instruments		0.3925
VCR		0.4047
Digital video reader		0.3442
DVD or Blu-ray reader		0.3931
Other audio-visual equipment		0.3132
Photograph camera		0.3475
Photograph and video camera		0.4331
Video camera		0.4453
Smart phone with video camera		0.4733
Number of VHS tapes		0.3770
Number of DVD and Blu-ray disks		0.4321
Number of other digital videos		0.1748
N		14,486
Average Kaiser–Meyer–Olkin Measure		0.746
Bartlett test of sphericity (χ^2 with 190 d.o.f.)		28,874.614
Cronbach's alpha statistics		0.6907

Table 5 Computers and new technologies equipment factorial analysis

	Eigenvalue	Proportion of explained variance
Factor 1	4.35672	0.9811
Factor 2	0.39721	0.0895
Variable		Weights
Number of computers		0.7308
Computers with DVD writer		0.7934
Multimedia hard disk		0.6571
Video game software		0.7157
Educational software		0.6429
Audio/video software		0.7131
Home broadband access		0.7135
Cell broadband access		0.3241
PDA		0.3235
Video game console		0.5614
Cell-internet phone		0.5416
N		14,486
Average Kaiser–Meyer–Olkin Measure		0.9041
Bartlett test of sphericity (χ^2 with 55 d.o.f.)		60,923.363
Cronbach's alpha statistics		0.8643

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