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ABSTRACT

This article provides an applied investigation of video game users. We estimate zero-inflated ordered probit models to control for an excess of zeros in our ordinal dependent variable. We find that video games playing is not negatively associated with the involvement in other cultural practices. On the contrary, instead of being a substitute for more traditional forms of cultural consumption, 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, and it is positively associated with the ownership of home equipment and access to new technologies but decreases with a person's greater time restrictions. The main differences to the traditional art formats is that game playing particularly appeals to younger, usually male, cohorts.

Keywords: Cultural participation, Video games, Zero-inflated ordered probit model
JEL Classifications: D12, R12, I29, J29, Z11

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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

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 their economic importance as well as large potential for artistic expression. Cowen (2008) at his plenary address at the 2008 ACEI conference refers to computer games as one of the new digital media that have changed cultural economics. Since that inspiring speech; however, it seems 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 is 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 has already long been recognized. 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 media magnify the potential of expression that is 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 also to play the roles of a drama performer. Video games are also much about visual aesthetics, where iconographic landscapes (Thorburn and Jenkins, 2003), cutting-edge couture of the characters, or architectural creations resemble the features of contemporary art.[2]

[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 (e.g., consoles connected to the TV or portable consoles).

[2] In line with these arguments, the Museum of Modern Art in New York opened a permanent exhibition in March 2013 showcasing the best in videogame design and aesthetics. According to the curator, video games are art not only

Apart 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 had 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] According to Lewis (2013) the video games industry, despite the economic downturns, is expected to generate worldwide revenues of $66bn in 2013 – releasing titles across consoles, PCs, Macs, tablets and smartphones. Recent fiscal policies in some countries suggest that the importance of the video game industry is getting recognized also at the political level. Lately, a tax break for the video games sector has been introduced in the UK (Henderson, 2012).

The economic importance of the video games industry is reflected in some recent economic studies, which, however, focus 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 of 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).

The underlying study contributes to that research strand as well as to the literature on cultural participation (e.g., Gray, 2003, Ateca-Amestoy, 2008) 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 containing a separate part of the survey on the consumption of

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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 products 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 650m during the first five 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.

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

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.

Furthermore, we are able to use rigorous statistical measures to address some important data issues, such as the over-representation of zeros. As it is often the case with culture and leisure activities, most of the population declare that they never use them: In this case, less than 13 per cent of the survey participants indicate that they 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 not be 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 over-representations of non-participants. We have followed this approach, and we have estimated zero-inflated ordered probit models. This methodology makes it possible to account for an econometric challenge that arises when the dependent variable is characterized by excess zeros (i.e., is zero-inflated). The zero-inflated bias arises if zero values 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 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. Zero-inflated models address this problem by estimating a finite mixture model consisting of two equations: a participation equation and a behavior equation.

In applied cultural economics, the use of zero-inflated models has increased since the publication of the influential study by Ateca-Amestoy (2008) which 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 behaviour to individuals not surveyed. In our case, however, the underlying video games variable 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 zero-inflated ordered probit model (ZIOP) can be applied when the observed outcome is not a count variable but an ordered one. These models have being developed by Harris and Zhao (2007).

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 4 presents the empirical model, and results are given in Section 5. Finally, Section 6 contains concluding remarks and outlines possible directions 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 two years, a new random sample of people over fifteen years was interviewed, resulting in a final sample of 14,486 individuals. The respondents are representative of the Spanish population aged above 15 years in terms of education level, economic activity, type of residence, and other factors.

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, and music as well as 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 gaming. Table 1 presents the summary statistics.

[Table 1]

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

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 have 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 $0, 1, \dots, J$, 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 $\mathrm{r} = 0$ for $r^* \leq 0$. The latent variable r^* indicates the probability of entering regime 1 as follows:

$$r^* = \boldsymbol{z}'\,\gamma + \varepsilon \qquad (1)$$

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 $\Pr(r = 0|\boldsymbol{z}) = \Pr(r^* \leq 0|\mathbf{z}) = 1 - \Phi(\boldsymbol{z}'\boldsymbol{\gamma})$, where $\Phi(.)$ is the standard normal cumulative distribution function.

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

$$\tilde{y} = \boldsymbol{x}'\,\beta + \mathrm{u} \qquad (2)$$

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:

$$\Pr(\tilde{y}) = \begin{cases} \Pr(\tilde{y} = 0|\boldsymbol{z}, r = 1) = \Phi(-\mathbf{z}'\gamma) \\ \Pr(\tilde{y} = j|\boldsymbol{z}, r = 1) = \Phi(\mu_j - \mathbf{z}'\gamma) - \Phi(\mu_{j-1} - \mathbf{z}'\gamma)\ (j = 1, \dots, J-1) \\ \Pr(\tilde{y} = J|\boldsymbol{z}, r = 1) = 1 - \Phi(\mu_{j-1} - \mathbf{z}'\gamma) \end{cases} \quad (3)$$

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

$$y = r\tilde{y} \quad (4)$$

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

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:

$$\Pr(y) = \begin{cases} \left(\Pr(y=0|\mathbf{x}, \mathbf{z}) = \left[1-\Phi(\mathbf{z}'\gamma)\right] + \Phi_2\left(\mathbf{z}'\gamma, -\mathbf{x}'\beta, \rho\right)\right] \\ \Pr(y=j|\mathbf{x}, \mathbf{z}) = \Phi_2\left(\mathbf{z}'\gamma, \mu_j - \mathbf{x}'\beta, -\rho\right) - \Phi_2\left(\mathbf{z}'\gamma, \mu_{j-1} - \mathbf{x}'\beta, -\rho\right), (j=1,\dots,J-1) \\ \Pr(y=J \mid \mathbf{x}, \mathbf{z}) = \Phi_2(\mathbf{z}'\gamma, \mathbf{x}'\beta - \mu_{J-1}, \rho)\ ) \end{cases} \quad (5)$$

where $\Phi_2(.)$ denotes the cumulative distribution function of the standardized bivariate normal distribution, and ρ is a correlation coefficient between both error terms (ε and u). If ρ is statistically equal to zero and, thus, error terms are independent, equation (5) can be written as:

$$\Pr(y) = \begin{cases} \left(\Pr(y=0|\mathbf{x}, \mathbf{z}) = \left[1-\Phi(\mathbf{z}'\gamma)\right] + \Phi(\mathbf{z}'\gamma)\Phi\left(-\mathbf{x}'\beta\right)\right] \\ \Pr(y=1|\mathbf{x}, \mathbf{z}) = \Phi(\mathbf{z}'\gamma)\left[\Phi\left(\mu_j - \mathbf{x}'\beta\right) - \Phi\left(\mu_{j-1} - \mathbf{x}'\beta\right)\right], (j=1,\dots,J-1) \\ \Pr(y=J \mid \mathbf{x}, \mathbf{z}) = \Phi(\mathbf{z}'\gamma)\left[1-\Phi\left(\mu_{J-1} - \mathbf{x}'\beta\right)\right] \end{cases} \quad (6)$$

This is a less general model since it assumes independence between both error terms. Note that ρ being zero does not imply that the ZIOP model is equivalent to the estimation of two independent equations.

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 (Levy-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 as well as the degree of participation.[5] One of the first studies dealing with heterogeneity behind the no-participation outcome is provided by Ateca-Amestoy (2008).[6] 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 has a positive probability of attending. We build 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:

$$Y_i = (H_i, P_i, A_i, O_i, HH_i, D_i, G_i) \quad (7)$$

The dependent variable, Y_i, is used to measure the frequency with which 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, and 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

[5] For a comprehensive review of this literature refer to Seaman (2006).

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

cultural goods and is usually 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 therefore incorporates a vector of variables measuring the intensity of consumption of alternative goods (A_i). Those variables also take some account of time constraints of an individual, as the consumption of most cultural goods is exclusive. To assess the uses of personal resources (time and money) more formally we measure the person's involvement in the labor market. We include a set of different types of occupational status (O_i) in order to take time restrictions related to economic activity into account. 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 socio-economic variables, we account for demographic factors of a person (D_i). Finally, since the social dimension of cultural demand is usually related to geographical factors, we incorporate this information using a vector of variables related to the person's place of residence (G_i). Next, we will discuss in some depth how these variables are measured and hypothesize on 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) advance notion that human capital – such as formal education – potentially influences 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 also include 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 previous year. The covered courses encompass a range of cultural activities such as painting, audiovisual production, performance art, 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 computer games that can only be played on a computer or console games

that require a game console. 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 towards computers and new technologies (number of computers, phones, consoles, PDAs, etc.). We also include a factor analysis measuring general cultural equipment (number of books, e-books, vinyls, CDs, DVDs, etc.).[7]

Unfortunately, the survey does not include income information. Therefore, it is hoped that the equipment variables capture any income effect that may be associated with this consumption together with their own effect on video gaming.

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 physically attend a performance at a given time and place. To give 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 also have a stronger preference for new media and therefore consume more video games. Alternatively, it could be the case that people substitute watching television for playing video games, and would thus spend less time on gaming.

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 between 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 or drawing). Similarly, with regard to these alternative cultural activities, it is a priori not clear what effect should be expected.

[7] The main results of both factor analyses are presented in the appendix.

Measuring a person's time constraints due to involvement on the labor market (O_i) is difficult. Ideally, one would make a detailed count of the hours spent at work. However, such data is 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 out of labor force). The occupational group of a person is related to the number of working hours and therefore impacts the amount of leisure time. In our case, since income data is not provided in the underlying survey, the occupation categories will serve also as an approximation for the economic welfare 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, having children decreases a person's leisure time, while on the other, it enables the 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 influence 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 their population size and political status (provincial capital, city, town, small town, and rural area). Cultural participation is predominantly an urban phenomenon (Gray, 2003), which is usually attributed to a 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, in smaller habitats, where the

availability of alternative activities (such as, for example, theater) is limited, the incidence of playing video games might be higher. Finally, the survey covers the whole of 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 increase the probability of ever playing (inflation equation), then present the impact of the explanatory factors on the frequency of playing (ordered probit equation), and finally relate our findings to previous results. Table 2 summarizes the results.[8]

[Table 2]

It is worth noting that the correlation between the two error terms is not significant. However, this does not imply that an ordered probit model could be estimated independently of the participation equation without getting biased estimations. It can be seen that the standard ordered probit model performs much poorer than the zero-inflated ordered models. First, the difference between the ordered probit log-likelihood, which is the restricted log-likelihood of the ZIOP model, and the log-likelihood value of the ZIOP model, is very large. The corresponding log-likelihood ratio test is significant at the one per cent and the null hypothesis of equivalence between both models can be rejected. Second, for the ordered probit only age, gender and one additional control variable are statistically significantly but only at the ten per cent level. However, according to the ZIOP estimations, more than fifteen socio-economic variables can be considered as relevant factors explaining video games playing.

Therefore, our hypothesis of the existence of two populations in the observed zero values of the dependent variable seems appropriate. A group of observed zeros could be linked with those people who have no interest in video games and have never played. The main determinants of this group membership are estimated by the participation equation. According to this equation, the probability of playing video games decreases with age but at a diminishing rate. Given the

[8] Table 2 displays also the results of a standard ordered probit model. It can be observed that the results of this model substantially differ from the preferred zero-inflated ordered probit model.

estimated coefficients, this probability decreases until the age of eighty-six, and therefore the quadratic component does not change the sign of this effect. The probability of ever playing is positively associated with being female although the effect is equivalent to a two year age difference. These two effects (age and gender) were noted by Lewis (2013) when she stated that "the average age of a gamer is now 30, and the gender split is close to even". As expected, the probability of playing 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. Finally, being involved in photography or video production increases the probability of being interested in video games. Therefore, video games is not a substitutive of photography and video production. However, the probability of ever playing is negatively correlated with music listening during workdays.

For those who have a positive probability of playing video games, 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 educational attainments (the lowest probability characterizes people with secondary but especially tertiary education) and increases with the size of the habitat. Additionally, 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, CDs, etc., present a negative link with video game use even if significant only at 15 per cent significance level. With regards to other cultural activities, the frequency of playing exhibits a positive association with watching television on any day, but particularly over the weekend, as well as listening to music at 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.).

Considering all coefficients estimated on the cultural activities included in the analysis, we find some positive linkages with video games playing (e.g., photography and video, writing, traditional visual arts) and some activities with no such significant associations (e.g., reading,

performing arts, art courses or radio listening). However, there is not a single cultural activity among those considered that appears to be substitute for video games playing or *vice versa*.

Next, 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) finds, for example, that theater but also ballet is demanded more frequently by younger audiences, who are primarily in their late 20s 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 to some psychological determinants and the affinity of the youth with digital technologies. If this were the case, and assuming constant tastes, future participation would shift towards older people, once today's youth enter higher age. In addition, the development of motion sensing games and consoles, which enable the development of games targeted at whole families, might further increase the age of the average game player. This forecast is 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 usually exhibit 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). Furthermore, our research shows that gender makes a difference; however, video games consumption is dominated by males mainly because among those who play, males reveal a higher frequency of playing than the average female player. This might suggest that males are socialized through video games as opposed to females, who socialize through exposure to traditional art forms. One possible determinant of this segregation might be attributable to the fact that game development teams usually consist of men, and hence the content more closely

resembles male perspectives and expectations (Locker, 2012).[9] 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 to the effect of an age difference of around two years. Therefore, some females 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 that of males.

Our results for educational variables imply that the effect of video gaming for the highest educated groups is contrary to that of other cultural activities. Although it does not affect the probability of ever playing, those with secondary or university degrees play significantly less often compared to those who have less than primary school education. This is different for performing arts or visits to museums and art galleries, where participation increases gradually 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 also be an indication that video games are an example of a "low culture" good, being less selective than the traditional art forms and requiring a lower status in endowments such as education.[10]

Habitat size matters for the frequency of playing, with provincial capitals and towns being characterized by markedly higher frequencies than villages. However, the 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 the frequency but not the 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 game player also increases with the involvement in photography or video recording and decreases with music listening on weekdays. 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. It is interesting to

[9] A further assessment and discussion of these trends is provided in Bryce and Rutter (2003).
[10] For a study of demand for "low culture" see Castiglione and Zanola (2013).

observe that the statistically significant effects of alternative cultural goods or the involvement in artistic activities usually exhibit 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 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.[11]

The included variables measuring the extent of the time constraints of a person usually imply 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 sharing video game equipment 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 gaming probability.

5. CONCLUSIONS

Video games, similar to other products of the cultural industries, certainly have a large quality variance in cultural terms. Nonetheless, video games by affecting visual, auditory, and kinaesthetic 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

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

designers, which also redirects their attention from mastering a tool to exploring properties and potentials of new media (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 usually constrained 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 and to managers of the game industry. In this study we were able to employ econometric methods that allow for 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 zero-inflated ordered probit models, we are able to classify observed behaviors into two heterogeneous 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. In fact, we have found some positive associations between video gaming and photography and video production, writing, traditional visual arts and music listening. Furthermore, even if some cultural activities, such as reading, performing arts, art courses or radio listening, does not exhibit a significant association with video games, none of the analyzed cultural activities appears to be negatively linked with the frequency of video gaming.

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 decrease with greater time restrictions of a person. There are also some meaningful differences to 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 gaming community are eliminated. And finally, those with

secondary or higher education play less often; however, education does not impact the probability of playing.

Video game economics is a very new research area that inhibits large potential from an academic point of view.[12] 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 a 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 games. Can any differences between people playing intellectually stimulating games (e.g., strategic games such as *Civilization*), and games that rather test the players' speed and reaction times (e.g., sports simulator games such as *Pro Evolution Soccer*) be detected. A further venue for research concerns video game 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?

[12] 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.

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Table 1. Descriptive statistics

	Mean	S.D.
AGE	44.216	19.102
FEMALE	0.5200	0.4996
PRIMARY EDUC	0.3107	0.4628
SECONDARY EDUC	0.1359	0.3427
VOCATIONAL EDUC	0.1354	0.3421
TERTIARY EDUC	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
HOUSE SIZE	3.1239	1.3396
NUMBER CHILDREN	0.2548	0.6024
FACT(CULT EQ)	-9.4E-10	0.8617
FACT(COMP & NEW TECH)	-1.2E-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
PHOTO & 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

Table 2. Determinants of video games playing

	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 EDUC	0.02293	0.328	0.04895	0.376	-0.00964	-0.122
SECONDARY EDUC	-0.13051***	-1.683	0.04376	0.273	-0.04905	-0.557
VOCATIONAL EDUC	-0.00165	-0.021	0.03298	0.217	-0.02248	-0.253
TERTIARY EDUC	-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 CHILDREN			0.13809**	2.196		
FACT(CULT EQ)	-0.03788	-1.524	0.25634*	4.067	0.00997	0.333
FACT(COMP & 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
PHOTO & 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
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	-7069.974				-8556.653	
Rest. Log likel.	-8556.653				-9322.063	

Appendix

Table A1. Home cultural equipment factorial analysis

	Eigenvalue	Proportion of Explained Variance
Factor 1	2.311	0.761
Factor 2	0.822	0.274

Variable	Weights
Number of books	0.345
Number of e-books	0.076
Paper encyclopaedia	0.260
Electronic encyclopaedia	0.176
E-book reader	0.109
Number of CDs	0.299
Number of vinyl albums	0.424
Number of MP3s	0.163
Number of music instruments	0.392
VCR	0.405
Digital video reader	0.344
DVD or Blu-ray reader	0.393
Other audio-visual equipment	0.313
Photograph camera	0.347
Photo and video camera	0.433
Video camera	0.445
Smart phone with video camera	0.473
N	14486
Average Kaiser-Meyer-Olkin Measure	0.746
Bartlett test of sphericity (χ^2 with 190 d.o.f.)	28874.61

Table A2. Computers and new technologies equipment factorial analysis

	Eigenvalue	Proportion of Explained Variance
Factor 1	4.356	0.981
Factor 2	0.397	0.089

Variable	Weights
Number of computers	0.731
Computers with DVD writer	0.793
Multimedia hard disk	0.657
Video game software	0.716
Educational software	0.642
Audio/video software	0.713
Home broadband access	0.713
Cell broadband access	0.324
PDA	0.323
Video game console	0.561
Cell-Internet phone	0.542
N	14486
Average Kaiser-Meyer-Olkin Measure	0.904
Bartlett test of sphericity (χ^2 with 55 d.o.f.)	60923.36