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The relationship between videogames, time allocation decisions, and labour market outcomes – Evidence from the American Time Use Survey

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Abstract

Using the American Time Use Survey (ATUS), I analyze the time allocation decisions and labor market outcomes of those who play videogames. Controlling for individual and regional characteristics, I find that among students, playing videogames is negatively associated with time spent on educational activities, and I derive estimates of this association that are similar in magnitude to other recent studies. I also find that among working-age individuals, playing videogames is negatively associated with labor supply and not associated with time spent on job search. After accounting for the nonlinear effects of playing videogames, I find that more time spent playing videogames may actually attenuate or reverse the negative association found in the linear model. This paper contributes to recent research studying the impact of playing videogames on time allocation decisions in non-experimental settings and it represents a novel analysis of its effects on working-age individuals – a growing subset of people who play videogames.

JEL-Codes: I2, J22, J24

Keywords: Time allocation, labor leisure choice

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1 Introduction

This paper analyzes the time allocation decisions and labor market outcomes of students and workers who play videogames. Existing studies have found a negative relationship between the amount of time children spend playing videogames and the amount of time they spend on educational activities. Using time use data based on adolescents in a non-experimental context, Suziedelyte (2015) found that children who play videogames not only spend less time on activities related to education but also do not compensate for the increased time playing games by reducing their time spent watching TV or engaging in other leisure activities. Other studies have come to similar conclusions: Cummings and Vandewater (2007) use survey data from a nationally representative sample of children collected during the 2002-2003 school year and find a significant negative effect of videogames on time spent reading, homework, and time doing sports activities. Nakamuro et al. (2015) have also found a substitution of time out of educational activities due to videogames, though they find that the supposed negative effects of this substitution effect are moderated by time spent with parents, which has a greater influence on student success.

Due to the belief that time spent on non-educational activities must lower human capital investment and therefore earnings capacity (Becker 1965), economists have mostly argued that playing video games has negative effects on student achievement, for example through absenteeism (Ward 2013). Nevertheless, more recent research has begun to complicate the human capital-based framework. Indeed, after finding a substitution effect, Cummings and Vandewater (2007) come to no solid conclusion on the issue, noting that a negative effect of games would rely on both (1) whether time would be spent on more “useful” activities if not on videogames and (2) whether time spent on any activity is zero-sum in the sense that time spent on games gives absolutely no human capital or cognitive benefits. Even Suziedelyte (2015), who found a clear substitution effect away from educational activities, also found a positive effect of playing videogames on cognitive ability, lending support to a growing body of psychological research on the benefits of playing videogames. Nakamuro et al. (2015) also conclude that videogames may have a positive effect on child development if time spent with parents on other human capital-improving activities in the household, such as reading, is not reduced.

Concerning the broader social and economic effects of videogames, the evidence is mixed and the research is sometimes unreliable. Subrahmanyam (2000) notes that while there is a significant body of research and popular opinion that argues that videogames promote aggressive behavior and therefore violent crime, others have found the opposite (Ward 2011). At the very least, drawing such a broad conclusion from data can be difficult, as DellaVigna and Ferrara (2015) point out in their survey of the literature on the effects of media on society. One reason for this ambiguity might be due to a psychological cathartic effect of playing videogames that has been supported by qualitative studies of people who play videogames (Bourgonjon 2015) – i.e., videogames allow a release of negative energy that lessens the probability that the negative energy translates into real violence.

Other economists and social scientists have also argued that games can make individuals happier and more productive at work (Johnson, 2005; McGonigal, 2011), though the nature of the videogame and the total time spent playing are certainly important factors to consider since experimental research has found that leisure time (proxied by internet and computer use) on the job negatively affects productivity (Corgnet et al. 2014). These studies suggest that many of the negative traits ascribed to people who play videogames may in fact be promoted by typical stereotypes of "gamers" (those who make a hobby out of playing videogames) or isolated events, when in fact there could be significant economic benefits of engaging, at least to a moderate extent, in this leisure activity.

The nature of the data used to analyze "gamers" has varied widely and has complicated the ability of researchers to draw general conclusions about the effects of videogames on labor market outcomes. There are poll data from a few media outlets that have attempted to gather basic demographic statistics on people who play videogames.[1] These polls often sample a few thousand people at most, they often do not contain many characteristics of the people they survey, and they suffer from potential selection bias since researchers would ideally want to study people who play videogames even if they do not identify as "gamers". Another source of data is experimental data used often in psychology to isolate the causal relationship of playing games by randomly assigning video game play to experimental groups (Weis and Cerankosky 2010). This research has furthered our understanding of the effects of gameplay on students' study time and test scores, though the small samples and lack of comprehensive time diary data on the subjects under study are weaknesses. There have been a limited number of studies using time use data from national surveys; examples include the use of the Panel Study of Income Dynamics – Child Development Supplement (Suziedelyte 2015) in the U.S., as well as in other countries (Nakamuro et al., 2013). Time use studies have some benefits, such as giving researchers the ability to account for time spent on other activities and additional demographic characteristics. The lack of a controlled or "natural" experiment, however, makes causal analysis difficult.

While this paper also uses time use data and cannot account for a causal effect it nevertheless makes an important contribution to the study of the impact of videogames on time allocation

[1] A recent survey in Reason magazine polled gamers on a number of political and social views, in addition to their demographic characteristics (Reason.com, 2014). LifeCourse Associates also recently published a study (with sample size of 1,227) that received attention from the online streaming site Twitch TV (LifeCourse Associates, 2014). The Electronic Software Association funds a more detailed and targeted yearly survey (http://www.theesa.com/about-esa/industry-facts/). A recent report can be found here: http://www.theesa.com/wp-content/uploads/2015/04/ESA-Essential-Facts-2015.pdf. (Accessed March 15, 2016.)

decisions. I use a measure of playing videogames that isolates the time spent *alone* in this activity, and I use a wide variety of controls afforded by the dataset, to clarify the mechanisms whereby time spent on this activity is associated with a wide range of other leisure, educational, and work activities. I use this measure for the main contribution of the paper, which is that it is the first study documenting the relationships between playing videogames and workers' labor supply and income.

For the analysis, I use the American Time Use Survey (ATUS). The ATUS was chosen because in order to study the impact of videogames on time allocation decisions and labor market characteristics one would ideally have a detailed, national survey of people who play videogames to capture as much variation as possible. Also, in addition to questions about time allocation decisions, the ATUS allows one to analyze the labor market characteristics of adults who play videogames– a not insignificant proportion of all gamers, and one that is growing. While the lack of a longitudinal dimension of this dataset or a controlled experiment do limit the questions that can be asked, it is hoped that the large and comprehensive nature of this dataset will offer a significant starting point for future research and will help address common beliefs and hypotheses in the existing research about people who play videogames.

The set of hypotheses to be explored in this paper are separated into *time allocation decisions* and *labor market outcomes*. While causal analysis cannot be undertaken due to the cross-sectional nature of the ATUS data, the rich set of controls allows one to analyze how playing videogames varies with many time allocation decisions and labor market outcomes, holding other characteristics and time allocation decisions constant.

On the question of time allocation, I am interested in the following questions:

- Is time spent playing videogames associated with more time spent on other leisure activities, such as TV or other general computer use, or does gaming simply "make up" for other leisure time normally spent doing something else?
- Among students, is there an inverse relationship between playing videogames and study time or class time?
- Does playing videogames crowd out job search for the unemployed or work time for the employed?
- How is playing games associated with labor supply (i.e. amount of hours worked)?

To address questions about the effects of videogames on human capital and labor market outcomes, I am also interested in the following questions:

- Is more time playing videogames associated with less earned income, after controlling for other individual characteristics, and after controlling for time spent on other activities?
- Is playing videogames associated with earned income in a non-linear fashion?

This paper represents a significant contribution to the effects of new media on the economy. By analyzing the time allocation decisions of gamers and non-gamers across two different sections of the population (workers and students), it is possible gain a richer understanding of the ways in which this increasingly popular activity affects time use and economic behavior at different stages of one's life. Furthermore, this is the first study to compare the labor market outcomes of those who play videogames against those who don't with a rich set of controls and time diary information.

Looking ahead to the main results, I find that students who play videogames spend 2.3 hours more time per day on leisure activities in general and 1.4 hours less time per day on educational activities. Workers who play videogames also spend more time on leisure activities in general (about 2.6 hours) and 1.5 hours less time on work-related activities. Because the ATUS samples are spread unevenly throughout the week, these results are based on weighted means. Moving to the regression analysis for the student sample, I find that an additional hour of playing videogames is associated with a 0.45-hour reduction in the time spent on educational activities, controlling for individual and state-level differences in time use. This partial effect is smaller than the one found for watching TV (where the coefficient is -0.62 instead of -0.45). For the worker sample, I find that playing videogames is negatively associated with both labor supply and labor market earnings. In the latter case, an additional hour of playing videogames is associated with a reduction in weekly earnings of about $21.50, more than the effect of time spent watching TV. Finally, after including a quadratic control for time spent playing videogames, I find that the shape is U-shaped, suggesting that the negative association between playing videogames and labor market earnings diminishes over time.

These results are generally consistent with recent research on the time allocation decisions of people who play videogames that have found that the positive benefits of playing videogames may offset, at least to a degree, the substitution out of human capital-building activities, which may explain the minor negative partial effect I find of time spent on this activity on labor earnings. My results are also a novel contribution to the research on the association between playing videogames and measures of labor supply among workers.

2 Data and summary statistics

The data come from the American Time Use Survey (ATUS), a survey conducted by the U.S. Census Bureau and sponsored by the Bureau of Labor Statistics. It is a yearly national survey of about 11,000-12,000 individuals aged 15 or older that is intended to provide detailed information about how Americans spend a typical day. The BLS takes a subset of the households that are part of the Current Population Survey (CPS) based on their demographic characteristics and follows up with them 2-5 months after the final month of their participation in the CPS to ask additional questions of one member in the household who is 15 years or older about how they spent their previous day, through one 24-hour cycle. I use the ATUS files published by the BLS on the ATUS website and I use the full range of years for which the data were available at the time that this study was undertaken: 2003-2013.[2]

The data used in this study are published across all 5 files from the ATUS dataset. The “Activity” file contains the time diary information, which is a record of each respondent’s time use over the course of an entire 24-hour day. The “Respondent” file records the respondent’s labor force and family status (if married or with children), some demographic information, earnings and hours worked, as well as time spent with family and friends. The “Who” file indicates whom a respondent was with while they were engaged in a particular activity. The other two files, “CPS”, and “Roster”, contain information on the respondent (such as race, region, and age) as well as other members of the respondent’s household.

The ATUS is based on a stratified random sample, it oversamples women, and it oversamples from weekends. For these reasons, the ATUS includes weights that can be used to generate representative estimates that are consistent across a given week. They are included in the “Respondent” file and are used to generate all the summary statistics and results in this study. In the latest methodology for generating weights – implemented starting with the 2006 dataset – the ATUS provided weights that are representative of “person-days in a quarter”, rather than “person-days in a month”. I have harmonized the post- and pre-2006 weights to produce consistent cross-sectional and across-time estimates that can be used to calculate the average daily time spent on an activity. Activities are coded on several levels, including information on leisure, home production, and work activities. One leisure category, coded as “playing games”, allows me to identify the impact of videogames on time allocation decisions and its relationship with select labor market characteristics taken from the “Respondent” files. In the following analysis, I define a “gamer” broadly as any individual that has a positive amount of time recorded playing videogames, with the following qualification (in the next paragraph) of who is categorized as a “gamer”.

Several measures of time spent playing videogames could be employed. The first uses the broad definition taken from the ATUS for “playing games” (in the ATUS activity coding lexicon, this is part of major category “12”, 6-digit activity code “120307”). Because this measure could include table and card games, it is an imperfect way of tracking the amount of time people play videogames. Precisely because this includes time spent on other types of games, I do not use this broad measure in the empirical analysis below. The measure adopted in this paper is a narrower definition that uses information from the ATUS “Who” files about who was with the person while the activity took place. The “Alone” category was used to obtain a more accurate definition of gamers: those who play games without anyone else physically present with them at the time of the activity.

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[2] The data are available here: http://www.bls.gov/tus/#data.

Even this narrow measure of time spent playing videogames may be complicated in at least two ways. First, this measure excludes time spent playing videogames with others who are present in the room, which may be significant. Second, this variable is still likely measured with some error because puzzle (and even card) games can be played alone. These are both examples of measurement error, most likely of the classical form because the degree of mis-measurement is likely not correlated with the actual unobserved measure (i.e., time spent playing videogames). That is because in some cases, "time spent playing games alone" will underestimate the time spent playing videogames because we fail to account for the extra time spent playing videogames with other people. In other cases, "time spent playing games alone" will overestimate the time spent playing videogames because we fail to account for the fact that those people playing games alone could be playing puzzle games (and other card games) alone. To the extent that it exists, then, the classical measurement error in the independent variable will tend to lead to coefficients that are biased towards zero because of the increased variance of the independent variable caused by the error term (Wooldridge 2015).

Table 1
ATUS Variables, definitions, and means 2003-2013

Definition	Mean	Definition	Mean	Education (Highest degree obtained) in %	
Age	44.3	Working full-time*	0.633	Not finished school	18.34
Sex (=1 if male)	0.484	Working part-time	0.144	High School	29.89
Black (=1, 0)	0.119	Unemployed	0.059	Some College	25.01
Minority (=1 if Hispanic or Black)	0.254	Student (may or may not be working)	0.044	College Degree	17.35
Married (=1, 0)	0.534	Disabled	0.046	Graduate Degree	9.41
		Stay-at-home	0.083		
		Retired	0.138		
Observations (N)	148,345				

*Labor force indicators are dummy variables, equal to 1 if the condition is true, 0 otherwise. All statistics presented in this and later tables use the harmonized ATUS weights (see Section 2).
Source: ATUS 2003-2013, own calculations.

As a check on the extent of measurement error, the analysis was also conducted using the broader definition of gaming. While the results do not differ significantly across the broad and narrow definitions, it can be argued that the narrower definition ("time spent playing games alone") most accurately captures time spent playing videogames. Videogames can be argued to promote isolation more than other types of games that people might play, such as cards, chess, or outside games. Thus, for the remainder of the paper, the statistics and econometric results presented are based on the time spent playing games alone.

Table 1 presents weighted summary statistics for the entire 2003-2013 sample. There are 148,345 observations in the entire dataset, for a yearly average of about 13,500, though earlier versions of the ATUS had more observations than the later ones. In Table 2 note that students (sample size = 4,849) play games for over twice as long per day as the full sample, while working individuals (sample size = 92,957) spend the least amount of time playing games.

Table 2
Average time per day spent in each activity (hours), 2003-2013

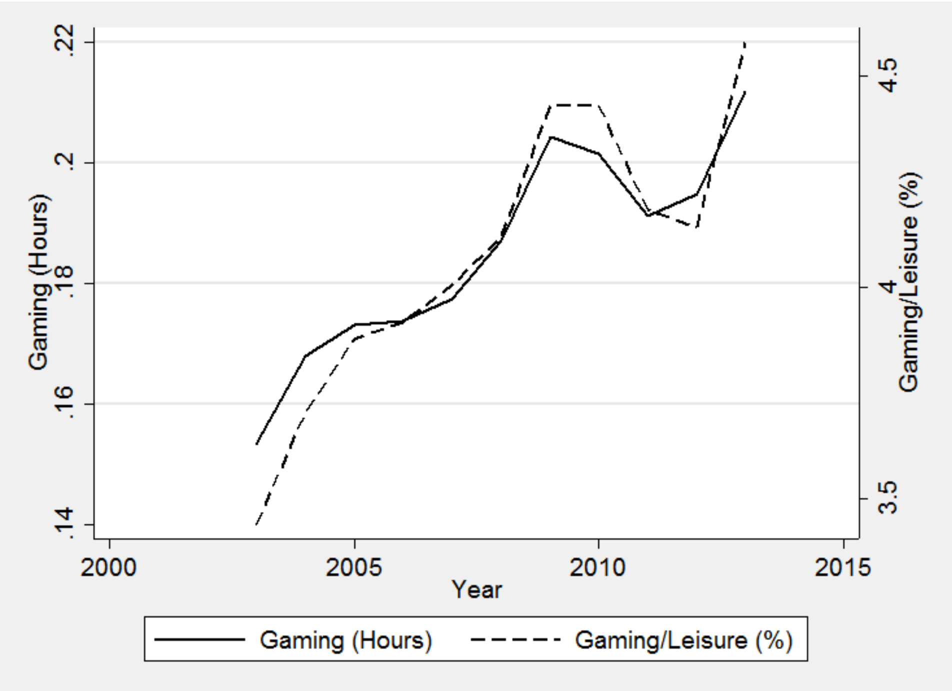
Activity	Full sample	Students	Working full-time
Personal care	9.41	10.09	9.08
Household activities	2.27	0.92	1.93
Care of non-household members	0.15	0.09	0.13
Work	3.35	0.04	5.21
Education	0.44	4.39	0.26
Consumption/Eating and Drinking	1.50	1.26	1.47
Professional care services	0.08	0.04	0.07
Household and government services	0.02	0.01	0.02
Socializing, Relaxing, and Leisure (Overall)	4.63	4.43	3.69
- Playing video games	0.20	0.48	0.14
- Watching TV	2.70	2.13	2.14
Sports and Recreation	0.33	0.78	0.31
Religion	0.14	0.13	0.12
Volunteer, and Other	1.56	1.71	1.59
Observations (N)	148,345	4,849	92,957

Means are weighted to produce estimates of daily time use. Personal care (ATUS major category 01 [Bureau of Labor Statistics, 2014]) includes activities such as sleeping, grooming, and personal health-related activities; Household activities (02, 03): Housework, home maintenance, food and drink preparation, care of children or other household members; Care of non-household members (04): non-market activities for non-household children or others; Work (05): working, work-related, and other income-generating activities; Education (06): Attending class, extracurricular activities, doing homework; Consumption/Eating and Drinking (07, 11); Socializing, Relaxing, and Leisure (12): Watching TV, playing games, entertaining and socializing with friends, attending social events, attending performing arts (other than sports); Professional care services (08): using banking, legal, childcare, real estate, and medical services; Household and government services (09, 10): use of lawn and garden, vehicle or home maintenance, performing civic obligations and using government services; Sports and Recreation (13); Religion (14) Volunteer or other (15, 16, 18): Performing volunteer services, telephone calls, traveling, other time use.
Source: ATUS 2003-2013, own calculations.

Students and working individuals both spend about the same time watching TV, though this is less by about half an hour than the full sample (which includes those not participating in market work or who are disabled). The notes to Table 2 also define all the time use categories used in this paper. In most cases aside from "working" and "leisure", I simply use the Major Category numerical classification from the ATUS coding lexicon (codes for major activities between 1-16 and 18).

Consistent with other findings on time use (Aguiar et al. 2013), Figure 1 (below) shows that the time spent on both leisure, and videogames as a percentage of leisure, has increased over time, with a spike in leisure time around the Great Recession. The solid line represents the average amount of hours playing games. The values might seem low, but recall that these are averages among the entire sample in a given year. For this reason, the increase from 0.16 to 0.22 in the number of hours spent playing videogames might seem small, but it marks close to a 50% increase. The importance of gaming in leisure time is shown by the dashed line, in which the proportion of leisure time spent on playing games has also increased from about 3.5% to 4.5% and has followed an upward trend. Other findings from an analysis of the yearly patterns (not reported) show that gamers have gotten older over time. From these summary statistics, it is clear that over the last 10 years, playing games has become an increasingly important hobby.

Figure 1
Gaming and leisure time, 2003-2013



Source: ATUS 2003-2013, own illustrations.

3 Time allocation decisions among gamers and non-gamers

3.1 Comparison of means estimates

In this section, I first conduct a basic comparative analysis of people who play videogames – people referred to below as “gamers”. I then compare the time allocation decisions of gamers and non-gamers. Table 3 (below) shows that the “gender gap” in gaming narrows with age, since among students, close to 77% of people reporting that they played videogames were male, much more than the proportion of gamers among all those surveyed. Among those who are working, 61% of gamers were male. There is still a minor gender gap when the entire sample is considered – about 55% of all individuals surveyed from 2003-2013 who say they played games were male. Among individuals across the "All" and "Working" categories, gamers are younger, less likely to be a minority, and less likely to be a parent than non-gamers.

Regarding decisions on how to allocate one's time, gamers are also different from non-gamers. First, consider the "full" and "working" sample statistics in Table 3. Between gamers and non-gamers, most of the extra time spent on leisure between the two groups (5.68 hours for workers who are gamers vs. 3.55 hours for those who are not; 6.32 hours for students who are gamers vs. 4.03 hours for those who are not) appears to come from playing videogames (gamers who are workers spend on average 1.98 hours playing videogames, students, 2.51 hours), so that for gamers, there appears to be little substitution of time between various leisure activities. In the "full" and "working" samples, for example, gamers do not spend any less time watching TV than non-gamers (2.71 vs. 2.70 and 2.20 vs. 2.14 hours respectively). Gamers do spend less time on personal care activities (such as cleaning or grooming) than non-gamers across all three samples, though the difference is relatively small. Gamers spend slightly less time on household production (such as household cleaning, food and drink preparation, interior maintenance, lawn maintenance, and household management such as financial management or household personal email) than non-gamers, though again, the difference is small.

The most notable difference between gamers and non-gamers in the "full" and "working" samples is in the time spent on "socializing, relaxing, and leisure" and the time spent working: people who play games are spending about that much amount of time less at work (in the "working" sample, the difference is 5.31-3.81=1.5 hours), and they are not spending any less time socializing than people who do not play games.

Among the "student" sample specifically, a few additional patterns emerge.

Table 3
Demographic (averages) and basic time use statistics (average hours per day), 2003-2013 standard deviations in parentheses

	All who:		Working and:		Student who:	
Variable	**Do not play games**	**Play games**	**Does not play games**	**Plays games**	**Does not play games**	**Plays games**
Age	44.6	41.9	41.1	36.6	18.9	17.6
	(17.9)	(21.9)	(13.9)	(15.5)	(5.6)	(3.9)
Male	0.478	0.545	0.53	0.606	0.438	0.769
	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.4)
Minority	0.26	0.193	0.244	0.176	0.34	0.329
	(0.4)	(0.4)	(0.4)	(0.4)	(0.5)	(0.5)
Married	0.547	0.4	0.579	0.450	N/A	N/A
	(0.5)	(0.5)	(0.4)	(0.5)		
Parent	0.415	0.39	0.445	0.413	N/A	N/A
	(0.4)	(0.5)	(0.5)	(0.5)		
Weekly Earnings			$793.1	$635.6	N/A	N/A
			(616.1)	(544.5)		
Personal care	9.41	9.37	9.09	8.94	10.09	10.09
	(2.4)	(2.3)	(2.2)	(2.2)	(2.3)	(2.5)
Household activities	2.30	1.85	1.95	1.70	0.98	0.64
	(2.7)	(2.2)	(2.4)	(2.1)	(1.75)	(1.1)
Care of non-household members	0.16	0.14	0.13	0.13	0.09	0.05
	(0.8)	(0.6)	(0.7)	(0.6)	(0.6)	(0.32)
Work	3.49	1.89	5.31	3.81	-	-
	(4.3)	(3.3)	(4.3)	(3.9)		
Education	0.42	0.58	0.26	0.29	4.63	3.25
	(1.7)	(1.9)	(1.3)	(1.3)	(4.1)	(3.5)
Consumption/Eating and Drinking	1.51	1.43	1.47	1.41	1.28	1.19
	(1.2)	(1.1)	(1.2)	(1.1)	(1.1)	(1.0)
Professional care services	0.09	0.07	0.07	0.05	0.04	0.03
	(0.4)	(0.3)	(0.4)	(0.3)	(0.3)	(0.2)
Household and government services	0.02	0.02	0.02	0.02	0.01	0.002
	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.1)

Table 3 (Cont.)

	All who:		Working and:		Student who:	
Variable	**Do not play games**	**Play games**	**Does not play games**	**Plays games**	**Does not play games**	**Plays games**
"Socializing, Relax-ing, and Leisure" (Overall)	4.43	6.68	3.55	5.68	4.03	6.32
	(2.3)	(2.0)	(2.0)	(1.8)	(2.4)	(1.9)
Playing video games	-	2.14	-	1.98	-	2.51
		(1.9)		(1.8)		(2.4)
Watching TV	2.70	2.71	2.14	2.20	2.10	2.28
	(2.8)	(2.5)	(2.3)	(2.2)	(2.3)	(2.3)
Sports and Recreation	0.33	0.38	0.31	0.31	0.78	0.78
	(1.0)	(1.0)	(1.0)	(0.9)	(1.5)	(1.4)
Religion	0.14	0.11	0.12	0.10	0.13	0.11
	(0.6)	(0.5)	(0.6)	(0.5)	(0.6)	(0.6)
Volunteer, and Other	1.58	1.39	1.60	1.45	1.78	1.38
	(1.8)	(1.5)	(1.7)	(1.4)	(2.0)	(1.5)
Observations (N)	136,536	11,809	87,228	5,729	3,961	888

Notes: For definitions of the time use variables, see the notes to Table 2.
Means are weighted to produce estimates of daily time use.
Source: American Time Use Survey, 2003-2013, own calculations.

Unlike in the "all" sample, gamers who are students spend less time on other leisure and socialization activities (non-TV, non-gaming) such as socializing with others, relaxing, and attending social events, though the difference is minor (4.03-2.1 = 1.93 hours for non-gamers vs. 6.32-2.51-2.28 = 1.53 hours for gamers). Similar to the "all" and "working" samples, gamers who are students do not spend any less time on personal care than non-gamers.

Where does all that extra time go, if not away from other forms of socialization – in other words, among students, what are gamers doing much less than non-gamers? Comparisons of time spent by gamers and non-gamers on educational activities, which could include class time (for degree, certification, or licensure, or for personal interest), research or homework, extracurricular club, music, or other performance activities, or registration and administrative activities, suggests an answer. To analyze this question, regression analysis will be employed in the following section.

3.2 Regression analysis

In a given 24-hour day, individuals allocate time their between various activities. To fully account for the relationship between the variation between time spent on two activities, such as educational activities and games, no other activities should be controlled for. That is because when individuals spend more time playing games, we would like to measure how much less time this leads them to spend on educational activities without assuming that these individuals spend the same amount of time engaged in any other activity as they did before they decided to play more games (e.g., we do not want to control for time spent on other leisure activities). If we did control for time spent on other leisure activities, the partial effect of gaming on educational activities would be exaggerated because we are constraining individuals' time spent on leisure activities and not allowing them to substitute into or out of leisure activities, which they likely do, and which the comparative analysis above suggests.

To measure the association between time spent playing videogames and its association with time spent on educational activities, job search, labor supply, and weekly earnings, a regression model will be estimated. In the first model, no other time use controls are included except for gaming.

For the case of earnings, we are also interested in the *direct* impact - i.e., after controlling for time spent on all other activities excluding one activity, I estimate the association between an additional hour spent playing games and labor market earnings. I analyze the partial effect of an additional hour of playing games on earnings including all other time use variables except for one. Thus, the following two models will be estimated with the ATUS data on the "student," "unemployed," and "working" subsamples. If Y_i denotes time spent on educational, job search activities, labor supply, or labor market earnings by person *i*, model 1 is employed:

$$(1) \qquad Y_i = \alpha + Gaming_i * \beta_1 + X_i * \Gamma' + \varepsilon_i$$

Where X_i represents demographic and regional controls. Additionally, in the specific case where Y denotes labor market earnings, model 2 (direct effect) will also be estimated:

$$(2) \qquad Y_i = \alpha + Gaming_i * \beta_1 + Time_i * \Pi' + X_i * \Gamma' + \varepsilon_i$$

In model 2, $Time_i$ denotes a matrix of all other activities person *i* could spend their time on, except for one that is omitted and is assumed to not be related to earnings (volunteer work).

It is important to note at this point that a major limitation of this model is that it cannot be used to assess the causal effects of playing video games. Even after controlling for many observable individual characteristics that can be found in the ATUS dataset, several unobservable characteristics may also confound the relationship between time spent playing videogames and various education-, job search-, and work-related outcomes. The most obvious that has been cited in the previous literature is a higher preference for leisure that may be driving both higher time spent playing games and less work time or less earnings. Thus, instead of more time spent playing videogames causing lower earnings, it could be the case that individuals with lower earnings have a greater preference for leisure time and therefore spend more time playing videogames. A similar effect could manifest itself in the student subsample as well: a preference against studying or going to class due to low innate ability (or higher preference for leisure), which may increase time spent on video games as one of several possible outcomes of reduced time spent on educational activities.

Table 4 reports estimates of a regression in which the dependent variable is total hours spent on educational activities for students.

Table 4
Relationship between time spent on media and time spent on educational activities among students, dependent variable: Hours spent on educational activities

	(1)	(2)	(3)	(4)
Gaming	-0.453***	-0.458***		
	(0.04)	(0.04)		
Watching TV			-0.622***	-0.614***
			(0.03)	(0.03)
Intercept	4.588***	7.989***	5.717***	8.665***
	(0.08)	(1.33)	(0.11)	(1.27)
Individual-level and regional controls	No	Yes	No	Yes
R-Squared	0.024	0.050	0.120	0.139
Observations (N)	4,849	4,849	4,849	4,849

Notes: * p<0.1, ** p<0.05, *** p<0.01. Standard errors (in parentheses) corrected for heteroscedasticity. Individual-level and regional controls include age, age squared, sex, race, grade level, and state. Regressions are weighted to produce estimates of daily time use (see Section 2).
Source: American Time Use Survey, 2003-2013, own calculations.

The baseline results (Columns 1 and 3) show that playing videogames and watching TV are both negatively associated with time spent on educational activities. The association with time spent watching TV is larger than videogames by about 50%, and both are statistically significant (p<0.01). Including demographic and regional controls in the model does not alter the results significantly, though it does lead to a larger association with time spent playing videogames and a slightly smaller association with time spent watching TV. The results suggest that, holding demographic characteristics constant, an additional hour spent playing videogames is associated with a 0.46-hour (or about 28 minutes) reduction in time spent on all educational activities. An additional hour of TV watching is associated (again, holding other variables constant) with a 0.62-hour or 37.2 minutes less time spent on educational activities. This estimate is less than what is reported by Suziedelyte (2015), who finds a substitution effect out of time spent on education of about 45 minutes, though with larger standard errors than reported in this study.[3] Note that in Table 5 (in which model 1 is estimated for each day separately), the association between playing videogames and educational activities varies significantly over the course of the week, with the strongest effects during the week. Again, the

[3] The standard error of our point estimate is about 0.034 or 2 minutes, while Suziedelyte's (p. 1149) is about 0.12 or 9 minutes.

ATUS oversamples the weekends, which is why the weighted results in Table 4 present a slightly higher effect than what would be derived without weighting.

Table 5
Daily estimates of relationship between time spent on video games and educational activities among students

Day	Coefficient	Day	Coefficient
Monday	-0.668***	Friday	-0.288**
Tuesday	-0.686***	Saturday	-0.069**
Wednesday	-0.586***	Sunday	-0.152***
Thursday	-0.560***		

Notes: * p<0.1, ** p<0.05, *** p<0.01. Standard errors (not reported) corrected for heteroscedasticity. Coefficients derived from estimating an unweighted model of the educational activities-gaming relationship that includes individual-level and regional controls (similar to Column 2 of Table 4) for each interview day separately. Regressions are weighted to produce estimates of daily time use (see Section 2).
Source: American Time Use Survey, 2003-2013, own calculations.

Do these same substitution effects carry over to time spent on job search? Table 6 shows that there is a negligible association between time spent playing videogames and job search activities such as interviewing, job search, and waiting for an interview. The significance of the coefficient disappears once demographic and regional controls are included in the analysis. Further, Columns 3 and 4 show that time spent watching TV is more strongly associated with job search than playing videogames. We can conclude that after accounting for observable characteristics playing videogames is not negatively associated with time spent on job search.

In summary, the evidence does appear to support the argument that playing videogames leads to a substitution effect out of educational activities, with the regression results reported in Tables 4 and 5 confirming the comparison of means presented earlier. These results are insensitive to the inclusion of demographic controls such as age, sex, and race, and marital status, as well as regional controls. Even after controlling for individual characteristics, more time spent on playing videogames is indeed associated with significantly less time spent on educational activities.

Table 6
Relationship between time spent on media and time spent on job search among the unemployed, dependent variable: Hours spent on educational activities

	(1)	(2)	(3)	(4)
Gaming	-0.041***	-0.025		
	(0.01)	(0.02)		
Watching TV			-0.020***	-0.030***
			(0.005)	(0.03)
Intercept	0.412***	-1.339***	0.461***	-1.286***
	(0.02)	(0.227)	(0.03)	(0.23)
Individual-level and regional controls	No	Yes	No	Yes
R-Squared	0.002	0.068	0.002	0.072
Observations (N)	7,456	7,456	7,456	7,456

Notes: * p<0.1, ** p<0.05, *** p<0.01. Standard errors (in parentheses) corrected for heteroscedasticity. Individual-level and regional controls include age, age squared, sex, race, grade level, and state. Regressions are weighted to produce estimates of daily time use (see Section 2).
Source: American Time Use Survey, 2003-2013, own calculations.

As mentioned earlier, while these results suggest that playing videogames has a causal effect on the accumulation of human capital and should therefore reduce future labor market earnings, they cannot prove this claim, for two reasons. First, a causal analysis cannot be undertaken due to the cross-sectional and non-experimental nature of the ATUS data. Second, if playing videogames has a positive effect on cognitive ability, creativity, or even productivity, as some recent scholarship has shown, the negative effects may be offset. This countereffect is indeed what Suziedelyte (2015) found, and it has support from previous work in psychological research (such as the findings summarized in Subrahmanyam 2000). In the next section I turn to this question of the association between time spent playing videogames and labor supply and earnings.

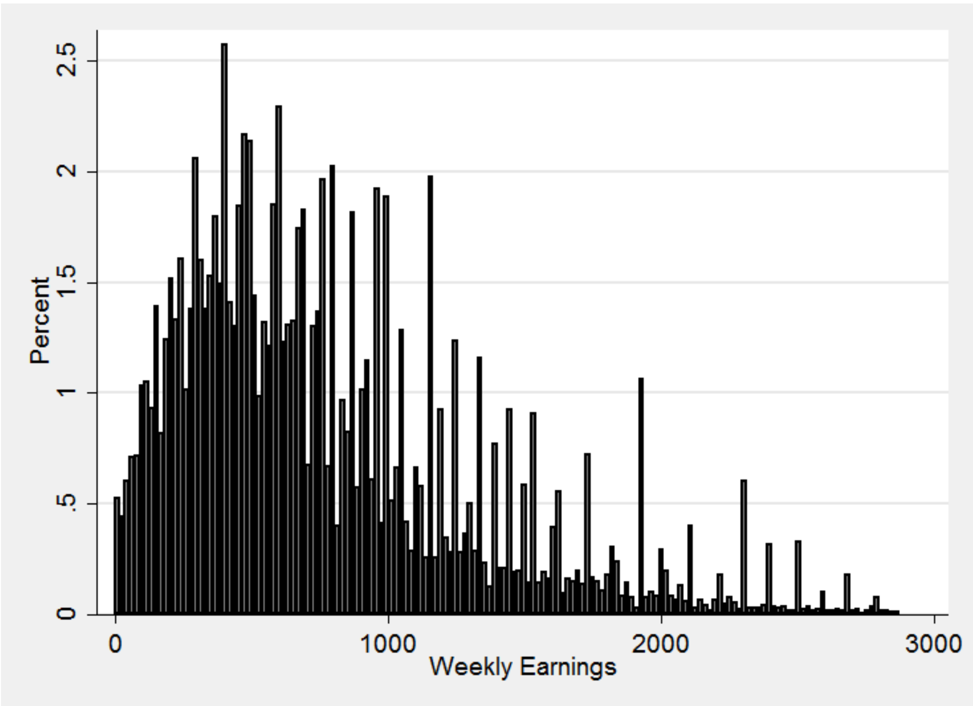
4 Labor market outcomes

In Section 3.1, a comparison of means between gamers and non-gamers in the “full” and “working” samples showed that gamers supply less hours per day on the labor market. In this section, I consider this issue using regression analysis. What is the relationship between time spent playing videogames and labor supply and earnings? Is there a corresponding negative relationship between time spent playing videogames and labor supply/earnings after controlling for other demographic, occupational, and time use statistics? Is the relationship nonlinear?

I explore these questions using additional information from the ATUS. Recall that the ATUS is based on households in the Current Population Survey who are followed up with 2-5 months later. In the "Respondent" files for these individuals, information on hours worked per week, weekly earnings (from all jobs), occupation, and industry, among other information collected for the CPS, is reported.

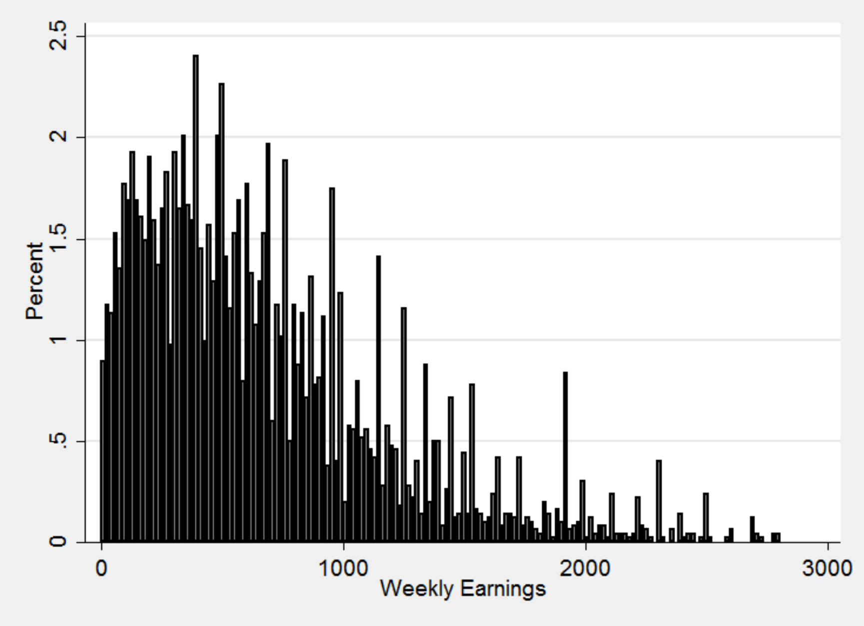
Figures 2 and 3 below report summary statistics regarding the distribution of labor market earnings among gamers and non-gamers. Between the two samples there is a difference in weekly earnings of about $140 at the mean and $130 at the median. The overall shape of the distributions between the two groups is similar. After accounting for age differences in people who play games, by focusing on the age 25-45 sample in each group, the difference in means narrows significantly – by about 50%. This suggests that further controls for education or marital status may lead to further reductions in the difference between the two groups.

Figure 2
Distribution of weekly earnings –
People who do not play video games



Notes: Mean: $742.68; Median: $611.80,
Source: ATUS 2003-2013, own illustrations.

Figure 3
Distribution of weekly earnings – People who play video games



Notes: Mean: $604.14; Median: $480.76.
Source: ATUS 2003-2013, own illustrations.

To better control for the association between playing videogames and labor market outcomes, a model is estimated via OLS in which the dependent variables (weekly earnings or daily work hours) are regressed on demographic, occupational, regional, and other time use variables. The estimates are derived using the same weights used to generate the results in earlier tables (to make the results representative for a person-day in the quarter in which the survey is taken), and the standard errors are corrected for arbitrary forms of heteroscedasticity. The results are reported in Tables 7-10.

Columns 1 and 2 of Table 7 report results from estimating model 1 – i.e., allowing for an increase in time spent playing videogames to lead to substitution of time across other activities and thus affect weekly earnings. According to these results, an hour of time spent playing videogames is associated with a $21.50 reduction in weekly earnings that is statistically significant and represents about a 3% reduction from the mean. The results for watching TV are smaller but also significant. The other coefficients in Columns 1 and 2 have the expected signs – age, sex, and marital status all contribute positively to weekly earnings while minority status contributes negatively to earnings. The age-squared coefficient has the predicted negative sign, suggesting a peak in earnings over the lifecycle. (Coefficients for education, number of children, and regional characteristics are not reported.)

Table 7
Relationship between time spent on media and labor market earnings, 2003-2013

	(1)	(2)	(3)
Gaming	-21.496***		-24.286***
	(2.39)		(2.38)
Watching TV		-13.330***	-14.894***
		(0.86)	(0.91)
Age	43.053***	43.610***	41.175***
	(0.88)	(0.88)	(0.91)
Age^2	-0.436***	-0.439***	-0.413***
	(0.01)	(0.01)	(0.01)
Minority	-78.499***	-76.708***	-83.839***
	(6.58)	(6.56)	(6.56)
Male	232.869***	236.220***	225.152***
	(5.02)	(5.02)	(5.06)
Married	55.548***	54.246***	55.422***
	(4.73)	(4.72)	(4.75)
Constant	-953.081***	-933.444***	-780.278***
	(37.51)	(37.71)	(40.40)
Controls for other time use	No	No	Yes
R^2	0.419	0.421	0.428
Observations	82,380	82,380	82,380

Notes: * p<0.1, ** p<0.05, *** p<0.01. All regressions control for occupation, industry, and state. Standard errors (in parentheses) corrected for heteroscedasticity. Regressions are weighted to produce estimates of daily time use (see Section 2).
Source: American Time Use Survey, 2003-2013, own calculations.

Column 3 of Table 7 reports results of estimating model 2, which is intended to analyze the direct relationship between time spent playing videogames and labor market earnings. The coefficient is slightly larger, suggesting that there is a direct association between playing videogames on labor market earnings that is not simply being picked up by less time spent on productive activities such as the amount of hours worked. That is to say, even after controlling for time spent on such productive activities (or any other activity), there is still a clear negative association between playing videogames and labor market earnings. The coefficient is -24.29 – representing a reduction of about 3% from average earnings.

While this result does suggest that playing videogames directly reduces productivity, seemingly at odds with the findings from Suziedelyte (2015) and Cummings and Vandewater (2007) that videogames can increase cognitive ability or productivity, a causal effect cannot be established from these findings. More importantly, as we will see now, there is strong evidence to argue that a more accurate description of the relationship between videogames and earnings is nonlinear.

This evidence is reported in Table 8. Table 8 shows the estimated coefficients from adding a $Gaming^2$ variable to model 1. I use both earnings and labor supply (work hours) as dependent variables. All coefficients are reported for the baseline model (model 1) with demographic and regional controls. Controlling for the nonlinear effects of these activities while allowing for substitution between different activities is clearly very important in the earnings regressions, with coefficients for both gaming and TV being positive and significant. The results for the labor supply regressions are mixed, with coefficients for gaming and TV again positive but only the latter being significant.

Consider the weekly earnings regressions for Table 8: the association between gaming and weekly earnings rises in magnitude from -$21.50 per week to -$41.24 per week. However, the coefficient on the squared term is positive and significant (3.557), suggesting that the association between playing videogames and weekly earnings grows weaker with higher amounts of daily play. The cumulative partial effect in dollars is -41.24 + 7.114**Gaming*, so that over increasing amounts of play for person *i* the association diminishes (recall that the average gamer spends about 2.14 hours playing games, which corresponds to a partial effect of about -$26 per week). These findings suggest that while there may be some differences that can be discerned between gamers and non-gamers, these effects do not amplify with longer gameplay – indeed, after 5-6 hours per day of play, the association becomes close to zero.

Table 8
Linear and quadratic coefficients

Variable	Coefficient, Earnings Regressions	Coefficient, Labor Supply Regressions
TV	-18.841***	-0.761***
TV2	0.672***	0.038***
Gaming	-41.236***	-0.674***
Gaming2	3.557***	0.002

Notes: * p<0.1, ** p<0.05, *** p<0.01. This table adds quadratic transformations of time spent watching TV and playing games to the regressions reported in Column 5 of Tables 9 and 10 and reports the coefficients. Regressions are weighted to produce estimates of daily time use (see Section 2).
Source: American Time Use Survey, 2003-2013, own calculations.

In summary, there is no question that there are some significant differences between those who play videogames and those who do not, in terms of educational and economic outcomes. The results from the direct effects (Column 3 of Table 7) show that it is indeed the case that holding other activities constant – including work time – more time spent playing videogames is associated with fewer earnings. But the fact that the negative association with earnings (accounting for substitution of time between activities such as work time) does not amplify with more time spent playing videogames – and, in fact, seems to diminish in magnitude – is the strongest evidence against a negative effect of videogames on economic outcomes. While not a confirmation of the argument that videogames can have a positive impact on productivity, these results support the view that videogames do not significantly affect labor market outcomes. In the final set of results, Tables 9 and 10 shed light on the labor supply decision.

Table 9
Relationship between time spent on media and labor supply, 2003-2013 (dependent variable: work hours)

	(1)	**(2)**
Gaming	-0.550***	
	(0.03)	
Watching TV		-0.656***
		(0.01)
Age	0.190***	0.209***
	(0.01)	(0.01)
Age^2	-0.002***	-0.002***
	(0.000)	(0.000)
Minority	0.313***	0.352***
	(0.07)	(0.06)
Male	0.836***	1.056***
	(0.04)	(0.04)
Married	-0.119***	-0.197***
	(0.04)	(0.04)
Constant	1.438***	2.674***
	(0.38)	(0.36)
R^2	0.045	0.149
Observations	82,380	82,380

Notes: * p<0.1, ** p<0.05, *** p<0.01. All regressions control for occupation, industry, and state. Standard errors (in parentheses) corrected for heteroscedasticity. Regressions are weighted to produce estimates of daily time use (see Section 2). Source: American Time Use Survey, 2003-2013, own calculations.

Refer first to Table 9. An additional hour of playing videogames is associated with a reduction in labor supply of about 0.56 hour, compared to a 0.66 hour reduction in labor supply in the case of time spent watching TV. These results are very similar to the ones for education, suggesting that when time spent playing videogames increases, there is substitution out of productive activities. The other coefficients have the expected signs, with age showing an inverse-U relationship with labor supply over the lifecycle, a positive effect of male and minority status on labor supply, and a negative effect of marital status on labor supply.

Finally, in Table 10 (similar to Table 5), there is variation in the substitution out of labor supply activities over the course of a week, with the strongest associations between time spent playing videogames and labor supply occurring on Wednesdays and Thursdays. The week negative association of time spent playing videogames with labor supply shows that the substitution effects between playing videogames and productive labor are significant.

Table 10
Daily estimates of relationship between time spent on video games and labor supply

Day	Coefficient
Monday	-0.586***
Tuesday	-0.588***
Wednesday	-0.755***
Thursday	-0.727***
Friday	-0.384***
Saturday	-0.274***
Sunday	-0.183***

Notes: * p<0.1, ** p<0.05, *** p<0.01. [4]
Source: American Time Use Survey, 2003-2013, own calculations.

5 Discussion and conclusion

Recent studies have contributed to various parts of a research program intended to analyze the social and economic effects of time spent playing videogames. This paper represents two contributions to this program. First, I add to the existing research on new media and time allocation decisions using a nationally representative time use survey spanning 11 years (2003 to 2013) with over 140,000 observations. My findings are consistent with previous studies of children that have found that playing videogames induces a substitution out of educational time. The second contribution comes from the fact that the ATUS allows one to study work-

[4] Standard errors (not reported) corrected for heteroscedasticity. Coefficients derived from estimating an unweighted model of the labor supply-gaming relationship that includes individual-level and regional controls (similar to Column 2 of Table 4) for each interview day separately. Regressions are weighted to produce estimates of daily time use (see Section 2).

ing individuals who play videogames – a not insignificant portion of all people who play videogames today. For this sample, I find that playing games is not associated with job search, but is negatively associated with work time and labor market earnings, though the effects are small after controlling for demographic, occupational, and regional factors.

These results should be seriously considered in debates over the effects of playing videogames on economic outcomes, though there are a few caveats to keep in mind. First, I am not able to impose an exogenous variation in playing videogames, making it impossible to draw causal claims from my findings. Second and more importantly, a growing body of evidence has shown that while playing games does lead to less time spent on educational activities, this is not necessarily unproductive time, since playing videogames can improve certain cognitive abilities, unlike (for example) watching TV. This point should be considered in the context of both children and adults, who, although at a glance may be taking part in "unproductive leisure", are actively using their minds in a way that improves various human capital measures and economics performance.

This point, in the context of adults, brings a third caveat to keep in mind: the findings regarding the quadratic form of the earnings-gaming relationship in the previous section. My results offer further evidence regarding the potential benefits of playing videogames because while the coefficient on the linear term is negative, the coefficient on the squared term is positive, meaning that the negative effects of playing games on earnings disappear for longer play times – by around 6 hours per day the partial effect becomes zero. This result is encouraging since it suggests that those who are more likely to make a hobby out of playing videogames – arguably an important subsample for analyzing the effects on more permanent features like cognitive ability or productivity – have a lower partial effect of their time on earnings.

Future research in this area should clearly address the causal effects of playing videogames on both earnings and productivity. Given that some of the more recent psychological evidence on the positive effects of gaming is supported by my findings, an experimental study whereby the effects of short "breaks" of playing videogames are evaluated, or a longer-term study that captures the long-run effects of playing games into adulthood, would prove useful. More analysis of the reasons why games do not significantly reduce earnings among working-age individuals should also be explored from an economic standpoint: do games provide a more productive outlet than watching TV, making gamers mentally healthier workers and therefore more productive? Or is it a self-selection issue, whereby those individuals with higher-than-average computer skills naturally gravitate toward these games, so that the positive account is mainly due to a biased coefficient on "games played"? While panel data may help to control for these possibilities, it appears that the most fruitful work may lie in experiments that try to estimate the impacts of playing videogames on a worker's attention to a task and overall motivation and creativity. Nevertheless, it is hoped that the results in this paper are a significant first step and contribution to our understanding of the role that new media plays in our economy.

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