Pink and Blue Pixel$: Gender and Economic Disparity in Two Massive Online Games

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Abstract
Information and communication technologies are blurring the boundaries between work and play.
We present the first empirical investigation of gender gaps in virtual game economies. Analysing
big data sets from two major game economies, we find that player gender and character gender
influence virtual wealth in different ways in different games. We conclude that this can be
explained by different returns on female- and male-dominated play activities, that is, *virtual pink
and blue collar occupations*. As the line between work and play increasingly blurs, researchers
should track which occupations get to keep their conventional economic rewards, and which end
up being remunerated in play money.

Keywords
Virtual economy, playbor, prosumer work, online community, online games, digital divide,
gender gap, occupational segregation, avatars, MMO

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Determinants of economic wellbeing have long been investigated from many angles in the social sciences. One prominent angle is the effect that an individual's characteristics, both inherent and acquired, have on income. A key finding that is consistent across economies and time periods is that women tend to earn less income and hold less wealth than men (Drago & Williams 2010; DeNavas-Walt et al. 2010; United Nations Statistical Division 2006). Explanations for this disparity can be found in the different roles that men and women are expected to perform in economy and society, and the structural and behavioral differences that stem from these socially constructed binary gender roles (Kelan 2010; Martin 2003; Reskin 2000; Cotter et al 2001; Borgerson & Rehn 2004; Koenig et al. 2011). Women are paid less than men, work in different occupations, and are more likely to balance career with housework, family, and community activities that fall outside the scope of paid work.

New varieties of work, socializing, creativity, and play that make use of information and communication technologies (ICTs) have led to the blurring of boundaries between paid work and unpaid leisure (Yoo 2010; Fuchs 2010; Ritzer & Jurgenson 2010; Gregg 2011). One area where such blurring is particularly evident is digital gaming. Over half of U.S. adults already play digital games of some kind (Lenhart et al. 2008). On the one hand, games have become more work-like in that they are laborious and can sometimes yield real economic gains (Castronova 2001; Yee 2006b). On the other hand, some work has become more game-like in that it involves the use of virtual points, feedback loops or other game mechanics (Anderson & Rainie 2012; Chatfield 2010; Castronova 2013). Many tasks that were previously carried out by paid workers are now 'crowdsourced' from 'playborers' (Howe 2008; Ritzer & Jurgenson 2010; Kücklich 2005). It is therefore high time to ask how economic disparities appear in returns on

virtual game work. In this article, we address this question with two large data sets from major virtual game economies, *EVE Online* and *EverQuest 2*.

The remainder of the article is structured as follows. We first briefly introduce the impact of ICT adoption on work and organization, focusing on a recent stream of research that examines online activities that display characteristics of both work and leisure. We argue that online gaming is an important area of activity where this ambiguity is particularly strong. We then move on to review the literature on economic gender gaps and the mechanisms that produce them, after which we finish the theoretical discussion by examining what kinds of gender gaps might be present in virtual game economies. In particular, we note that analyses of virtual gender gaps must consider both player gender as well as genders of the virtual characters through which participants interact. We then present such an empirical analysis, drawing from a large sample of online gamers. The article concludes with a discussion of the implications of the results to the larger picture of ICTs and the changing nature of work.

Background

ICTs and the Changing Nature of Work

During the past decades, information and communication technologies (ICTs) have rapidly become an everyday part of working life. The majority of employed adults in the United States use the Internet in one form or another at their job (Madden & Jones 2008). ICT adoption has influenced work and organization on multiple levels. On the one hand, ICT adoption has been accompanied by changes in occupational structures and job characteristics. Some types of jobs have been entirely eliminated, while others have been enhanced with additional responsibilities and skill requirements (Autor et al. 2006; Autor et al. 2002; Liker et al. 1999).

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On the other hand, ICT adoption has also been accompanied by significant changes in the way work is organized. Some of the most studied changes are the rise of teleworking (Huws et al. 1990) and virtual teams (Majchrzak et al. 2000).

An emerging research stream in ICTs and work focuses on the blurring of boundaries between work and play, between production and consumption. Such blurring has become apparent on several levels and in several areas of the economy. At the most general level, the widespread adoption of ICTs, especially mobile devices, in both work and leisure has led to a blurring of temporal and physical boundaries between work and leisure (Yoo 2010; Gregg 2011). Almost half of employed Americans report doing at least some work from home and 18 percent do job-related tasks at home almost daily (Madden & Jones 2008). On a more specific level, many highly popular ICT-enabled leisure activities, such as contributing content to online communities and social media sites, are actually economically productive, so much so that they form the basis of many online business models (Lessig 2004; Benkler 2006; Tapscott & Williams 2006; Fuchs 2010). Internet users also directly contribute to processes of market research, product development, and data processing for for-profit companies through crowdsourcing, microwork, open innovation, and mass collaboration platforms, sometimes replacing conventional workers (Chesbrough 2003; Howe 2008; Lehdonvirta & Ernkvist 2011; Faraj et al. 2011). Some of these activities are paid, while most are not, but many users approach even paid activities as a form of entertainment rather than work (Ipeirotis 2010; Brabham 2008; Brabham 2010). As a result, the conventionally understood boundaries of work as something that produces value and play as something that consumes it are being challenged. Terms adapted and coined to highlight these new ambiguous forms of work include *prosumer work* (Tapscott 1995; Ritzer & Jurgenson 2010), *produsers* (Brun 2007) and *playbor* (Kücklich 2005).

One significant area of ICT-mediated interaction where the ambiguities of work and play are particularly strong is digital gaming. Over half of U.S. adults play digital games of some kind, whether on a computer, mobile phone, tablet, or other device (Lenhart et al. 2008). Gaming often involves social and creative activities that, like other forms of prosumerism, can be highly productive and contribute to game companies' economic success (Sotamaa 2007). On a very concrete level, some gamers create new objects, landscapes, storylines, and even new functionalities to some games (Kücklich 2005). On a more intangible level, every multiplayer game is to some extent co-created by the game's developers and players, as the game experience consists of the interplay of code and creative human practice (Potts et al. 2008). To the framework provided by the developers, each gamer contributes their own unique expressions, ultimately resulting in a cultural product that the company is able to charge money for. Thus we can go so far as to say that simply playing an online game is a rudimentary form of cultural production, or cultural work. It is noteworthy here that highly original or skillful players can attract thousands of spectators on online video sharing sites.

The functions that gaming serves in everyday life are also to some extent becoming confused with functions associated with work. Even though gaming typically does not offer monetary rewards, gaming can be a significant source of self-esteem, identity, and even social status, especially when played in online social contexts (Steinkuehler & Williams 2006; Lehdonvirta & Räsänen 2011). Sociologists such as Bauman (2005) note that individuals turn to alternative sources of identity development, such as consumption and play, when working life becomes too precarious to support a stable and esteem-enhancing identity. Perhaps for this reason, online gaming is often pursued even when it becomes laborious and repetitive rather than fun and entertaining (Steinkuehler & Williams 2006; Yee 2006b). Playbor is thus not simply

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entertainment, but for some an attempt to participate in wider society in a meaningful way. Serious online gamers speak of duty, service, and contributions to the community, and occasionally suffer from burnout (Williams et al. 2006).

As in many other cultural contexts, identity and social recognition in online games is to varying extents tied with artificially scarce markers that one must acquire and display (Lehdonvirta et al. 2009). In other contexts these markers might be called status goods; in online games they are a variety of 'virtual goods'. Players consider virtual goods valuable because of their symbolic values, but also because they can be useful within the context of the game, and thus assist in the acquisition of further goods (Lehdonvirta 2009). Access to this virtual wealth is structured by a 'virtual economy' that links players' time and effort to economic outputs (Castronova 2001; Lehtiniemi 2009). A typical virtual economy is loosely modeled after a simple market economy, where players produce some goods from the environment and acquire other goods via trade with other players (Lehdonvirta & Castronova 2014).

Because of their scarcity and perceived value, players sometimes buy virtual goods from each other for real money (Castronova 2001; Lehdonvirta & Ernkvist 2011). Lehdonvirta and Ernkvist (2011) estimated that players traded approximately 3.0 billion U.S. dollars' worth of virtual goods between each other for real money in 2009. In some cases, play can thus have a very tangible impact on a person's earnings and wealth. For the most part, though, the benefits of virtual wealth remain locked to specific online contexts and communities. The significance of these virtual economies in the context of ICTs and the changing nature of work lies in the fact that virtual wealth, in its many forms, is the currency in which much (prosumer) work today is compensated. Publishers deliberately use virtual rewards as a way to elicit productive user behaviors. While critically questioning this state of affairs like Fuchs (2010), we should also

begin to subject the resulting economies to similar analyses as we do our conventional systems of recompense allocation, including analyses of gender equality.

Gender and Economic Disparity

In this article, we theoretically situate gender – feminine and masculine – as a social construct, not an innate biological feature that accompanies being female or male. We contextualize gender and gender roles as a socially created binary set of characteristics, behaviors, and social roles, that are assigned to accompany biological sex, itself a binary construction. Gender constitutes a set of practices and processes that are embedded into our daily lives, which ultimately works as a system of social stratification between women and men (Lorber 1994). In this section we discuss these practices and processes within the sphere of work and the economy.

Since before the ICT era, both paid and unpaid work have typically involved significant disparities between women and men. In the paid workplace, structural inequalities, such as discriminatory practices (glass ceilings), occupational segregation (pink collar jobs), and devaluing women's skills and performance, contribute to lower incomes than men (Kanter 1977; Reskin et al. 1999; Kay & Hagan 1998; Reskin & McBrier 2000; Bielby & Baron 1986; Milkman 1987). In the unpaid workplace – the domestic sphere – women are still largely responsible for domestic chores and are primary caregivers to children. Because women's careers are structured by familial obligations, they are more likely to have interruptions during their career and work part-time jobs, therefore earning less (Baker & Lero 1996; Heymann 2001).

These workplace inequalities are often considered the result of biological sex differences between females and males, but in fact are mostly perpetuated by structures and expectations that

deem certain behaviors as appropriately feminine or masculine. In the case of pink-collar jobs, for example, women are considered suitable in occupations such as nurse, teacher, secretary, housekeeper, and so forth, because women are thought to possess an abundance of 'feminine' characteristics: caring, emotion, nurturing, and sociality (Armstrong & Armstrong 1993; Morgan 1998). These characteristics and occupations are associated with womens' traditional role in the home and the domestic division of labour (Hochschild 1989; Shelton & John 1996). These occupations were and still are considered less important than the kinds of work men do (Britton 2000), and the feminine characteristics that women are said to inherently posses are seen to be suited to some kinds of work – typically not the jobs that men do (Steinberg 1990). In some workplaces, the presence of women in non-traditional occupations creates tensions. In particular sexual harassment or ostracizing behaviors create toxic work environments that can lead low job performance and high employee turnovers (Cohn 2000; Reskin & Padavic 1994). Conversely, for men working in non-male-traditional occupations, hostile work environments are produced when notions of masculine identity are challenged or threatened (Cross & Bagilhole 2002). But other research also points to advantages men can gain in non-traditional jobs, such as expedited promotions, referred to as the glass escalator (Budig 2002; Evans 1997; Maume Jr 1999).

As women's participation in the labor force increased in the 1970s, more women entered non-traditional occupations, showing that women possessed the skills and intellect to succeed at what was deemed 'men's work'. Scholars have observed that gender roles surrounding the kinds of work that women and men can do are perpetuated by socially constructed characteristics and behaviors of femininity and masculinity (Acker 1990; Steinberg 1990). The ideology of gender that is prevalent throughout social institutions frames what is expected, allowed, and valued in women and men. This ideology is expressed in what women and men do (roles), how women

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and men relate to each other (relationships), and how women and men perceive themselves (identities; Walby 1986; Goldin 1994). In other words, gendered scripts are different for women and men. They are reinforced throughout the family, education system, workplace, media, and so forth. Both feminine and masculine behaviors can be practiced or performed by both women and men, which separates these scripts from biological sex (West & Fenstermaker 1995).

The occupational and organizational changes associated with ICT adoption have involved significant gender dimensions (Cockburn & Ormrod 1993; Menzies 1982; Huws 1982; Game & Pringle 1983). The elimination of some jobs and the enhancement of others has had uneven impact on male and female dominated occupations (Webster 1996). For example, many pink-collar clerical jobs, such as typists, have been eliminated. Other pink-collar jobs have been enhanced, but in the process gained a more masculine technological image that influences their gender makeup. Organizational changes, particularly the adoption of teleworking and virtual teams, have provided new opportunities for combining work and family (Gregg 2011), and thus either helped women cope with the expectations they face, or further institutionalized the female housework script, depending on perspective. In terms of concrete outcomes from these changes, gender gaps in earnings and career trajectories remain common in ICT-related work (Webster 1996; Gregg 2011).

Gender dimensions in the most recent ICT-related transformations in work and organization remain understudied. This applies in particular to playbor and virtual economies. Several studies have examined gender in games and virtual environments (e.g., Yee 2006a; Hussain & Griffiths 2008; Williams et al. 2008; Huh & Williams 2010; Lehdonvirta et al. 2011; Lehdonvirta et al. 2012), but none of the studies have examined gender in relation to virtual work. In particular, no study has investigated concrete economic outcomes, such as gender gaps, that

gender-related processes could generate in virtual economies. Existing research on virtual economies approaches wealth from the perspective of macroeconomic indicators (Castronova 2001; Castronova et al. 2009; Lehtiniemi 2009) or deviant economic practices by certain groups (such as 'gold farmers'; Heeks 2009; Keegan et al. 2011; Lehdonvirta & Ernkvist 2011). There is no research about economic disparities in game worlds and where the wealth actually resides within the demographic structures of the players and characters. This is likely because prior research has not been able to marry real-world variables with virtual-world behaviors. The present study aims to address this gap. In the next section we assess potential micro-level mechanisms through which gender disparities could form in a virtual economy, and then discuss our research questions.

Gender in Virtual Economies

Drawing from analyses of game economies (Castronova 2001; Lehtiniemi 2009; Lehdonvirta et al. 2009; Castronova et al. 2009; Lehdonvirta & Castronova 2014), it is possible to argue that virtual economic institutions are indifferent towards gender. For example, there are no salary or wage differences per se in game economies, no glass ceilings, and no pink-collar jobs, at least at the outset. Wealth in game economies is for the most part meritocratic – one works to earn wealth by levelling, questing, and acquiring experience and skill points. The player's actions and performance (and time spent playing the game) leads to increased wealth regardless of sex or gender. This meritocracy is institutionalized by code, so there is no room for discrimination by other people.

It is also possible to develop an opposite argument. Although economic institutions enforced by program code are in principle blind to gender, race and other personal characteristics,

a common feminist criticism of both conventional economic institutions and digital environments is that they embrace certain values and privilege some interests over others by design (Nakamura 2002; Kendall 2002; Webster 1996). The game industry is notorious for being highly male-dominated. Males typically also play more online games than females (Williams et al. 2008). Game economies are thus arguably designed from a male perspective. What could such built-in gender bias mean in practice? A concrete manifestation of this bias might be found in structures that reward masculine game activities more than activities that are deemed feminine. For example, one study suggests that in accordance with prevalent gender scripts, male players are drawn more towards achievement-oriented activities, while female players are more interested in socializing and immersion (Yee 2006c). Many games are designed in such a way that socializing yields no virtual earnings, while adventuring does. Still, not all games are like this – different games cater to different tastes. Moreover, players have also been found to act in ways that run counter to prevalent gender scripts (Huh & Williams 2010; Lehdonvirta et al. 2011). Lehdonvirta et al. (2011) suggest that to some extent, each player population develops its own understanding of what is considered masculine and feminine in the context of their particular game.

Economic outcomes in multiplayer games also depend on other players, not just on program code. Player-run institutions that have appeared in virtual economies include informal friend groups, guilds, clans, corporations, and even some attempts at banks and stock exchanges (Lehdonvirta & Castronova 2014). These player-run institutions provide a vector for conventional gender role-based disparity mechanisms to enter virtual economies. One concrete example that can be found in earlier games literature is cross-gender effects in virtual gift-giving. Some male players court attention from group members thought to be female by showering them

with virtual gifts and favors (MacCallum-Stewart 2008). In a Japanese online game, an opposite effect was observed: females showering males with gifts and free work (Lehdonvirta et al. 2011). Gendered institutionalized economic flows such as these could conceivably be reflected as disparities in overall economic outcomes.

Other earlier research suggests that player-run institutions in game economies can in fact challenge gendered game spaces. For example, Steinkuehler and Williams (2006) found online games to be relatively level social playing fields where personal characteristics did not influence social interactions in the same way as they do offline. Players recognize and use this characteristic of game environments to their benefit, sometimes intentionally masking cues that could otherwise lead to differential treatment (Hartmann et al. 2010). A controlled field experiment in an online game found that the removal of voice cues, for which humans readily encode gender information (Nass & Gong 2000), reduced discrimination among players, while the introduction of such cues increases discrimination (Williams et al. 2007). Further, gender may be a more salient factor in smaller groups of trusted others (e.g., guildmates) than with strangers that make up most of the population (Ratan et al. 2010).

In summary, earlier research proposes a variety of reasons why constructed gender categories may or may not influence virtual economic outcomes. In this study, we rise above these individual mechanisms to look at the big picture, overall economic outcomes on the level of sociodemographic structures, which our data uniquely allows us to address:

RQ1: Are female players in a virtual economy richer, poorer or as wealthy as male players?

Experience from national economies suggests that women would tend to end up being economically disadvantaged, while the previous research reviewed above also provided reasons

to expect that female and male players would be approximately equally well off. Answering this question is important enough in itself, but answering it in the context of different virtual economies will hopefully also allow us to begin to unpack some of the underlying mechanisms, with implications for gender and playbor more generally.

Next we consider another gender-related high-level factor with potentially systemic effects on virtual economic outcomes: character gender. In online games and virtual environments, players typically interact through avatars: characters that represent them in the virtual space. While participants typically draw on their self-image when constructing an avatar, it is also common to exaggerate or even reverse these qualities, especially when the context is perceived as playful rather than serious (Vasalou & Joinson 2009; Yee & Bailenson 2007). This sets participants free to assume characteristics and roles that differ from their ordinary social and physical identities, although the choices available when creating an avatar also constrain the range of identities that can be feasibly assumed (Yee & Bailenson 2007). For example, it is typically necessary to choose from either a male or a female avatar (Kolko 1999), which reinforces gender binaries. The player's physical identity is never completely erased, though, as language and self-presentation necessarily reveal some hints about one's nationality, education, gender, race and other sociodemographic factors (Kendall 1998; Nakamura 2002).

With respect to gender cues, gender is a performance, something we actively 'do' continuously on our own and with our interactions with others (West & Zimmerman 1987; West & Fenstermaker 1995). As such, gender should be understood as existing as on a continuum of expression and performance; our behaviors, actions and characteristics do not always fit neatly into the rigid categories of feminine and masculine (Butler 1990), and some virtual spaces can

allow players to actively express and perform different aspects of their physical identity or identities.

While previous research has found that most players choose characters that match their own gender, presumably for reasons of identity consistency (Hussain & Griffiths 2008; Huh & Williams 2010), many players also choose opposite-gendered characters. Such gender 'swapping' is a common form of identity play in some online environments. Arguably, this is not swapping per se, but simply players expressing (or performing) different aspects of their identity. In one of the first studies to address this topic, 40 percent of participants in a virtual environment were found to use an avatar of the opposite gender (Roberts & Parks 1999). In a more recent study, 57 percent of respondents reported cross-gender play in virtual spaces (Hussain & Griffiths 2008). This suggests that empirical investigations of virtual gender gaps should be structured in terms of two distinct layers: "being female" (offline gender identity) and also "appearing female" (character gender). Some gender-related virtual economic institutions, particularly cross-gender gift-giving, should be expected to hinge more on character appearance than offline identity (MacCallum-Stewart 2008). Our second research question therefore is:

RQ2: Are female characters richer, poorer or as wealthy as male characters?

Some women use male avatars to circumvent negativity and prejudice towards women, as well as unwanted courting behavior or sexual advances, in male-dominated virtual environments (Roberts & Parks 1999; Yee 2008). In other types of computer-mediated spaces, early Internet research found a high prevalence of this type of negative interactions, such as unwelcome questions about one's physical appearance, invitations for cybersex, threatening and hostile messages, harassment, and cyberstalking (Tannen 1994; Fallon 1998; Spender 1997; Ellison & Akdeniz 1998; Herring 1999; Ferganchick-Neufang 1998). More recent research has

examined women's experiences within digital game spaces and virtual worlds (Kennedy 2009; 2011; Braithewaite 2013), reflecting similar patterns of harassment and abuse that positions some gaming spaces as a male terrain – or a 'boy's club'. Given the past experiences of women in computer-mediated spaces, it is not surprising that women might choose male characters to avoid this kind of negativity. On the other hand, some men are reported to be using female avatars to enjoy gendered benefits, such as attention and gifts lavished by other males (MacCallum-Stewart 2008), although voyeuristic motivations are also common (Hussain & Griffiths 2008; Yee 2008). It is thus not immediately obvious whether female avatars are on par, disadvantaged, or advantaged in virtual economic outcomes. Our data again allows us to provide a unique overall picture of the outcome.

Data and Methods

To address the two research questions put forth above, we analysed economic data from two large-scale virtual economies, *EVE Online (EVE)* and *EverQuest II (EQII)*. This study is possible because the publishers of both games, CCP Games and Sony Online Entertainment, respectively, provided privacy-protected and anonymized server-log data to the researchers. Both data sets represent a form of unobtrusive observation, which has the benefit that the subjects are not influenced by the researcher's presence (Webb et al. 1981). Most previous studies of gender in online games, such as Hussain and Griffiths (2008), Yee (2008), and Yee (2006c), rely on self-reported data, which is problematic, because male and female players have been found to underreport their behaviors in systematically different ways (Kahn et al. 2010; Williams et al. 2009).

The virtual environments and types of activities in these two games are quite different, yet at the same time, they both contain a virtual economy with broadly comparable concepts such as virtual wealth. Next we describe the games in more detail, and then follow with descriptions of the populations, measures and analysis methods used.

Background on Sample Games

EVE was launched in 2003 by Iceland-based game company CCP Games, and currently has over 500,000 active subscriptions (Drain 2013). It is a space-themed massively-multiplayer online game (MMO) where players pilot starships in a universe of approximately 7,500 star systems. The majority of players are from North America and Europe. Players are represented to others by upper-body avatar portraits or the spaceships they are piloting. Players are organized into corporations and can specialize in activities such as mining, hauling, industrial management, trading, and security. Compared to other online games, *EVE* has a very detailed virtual economy and many game-play activities revolve around the production, distribution, and marketing of spaceship parts, raw materials, and other virtual commodities.

EQII, the sequel to *EverQuest*, was launched by American company Sony Online Entertainment in 2004 and attracted several hundred thousand players (Schiesel 2007). Like *World of Warcraft*, which is currently the most popular Western MMO, *EQII* is set in a fantasy world and players use magical characters to complete quests, acquire equipment, kill monsters, and socialize with other players. The game includes various classes and races of characters, each of which offers unique abilities within the game world. As is common in the genre, players accomplish more when they work together in groups, and thus the social interaction component of the game is important. Like most fantasy MMOs, *EQII* has an economic component in that

players must manage their finances to buy the most suitable equipment and maintain housing and storage. However, it is not the focal point of game play as it is in *EVE*; while some players enjoy the financial aspect of the game, many ignore it entirely.

Thus, these two MMOs share some general similarities but also some differences. Both offer persistent "always-on" virtual environments that guide player activities and within which players socialize and compete with each other. *EQII* represents the most typical genre of MMO games, the role-play game (RPG) rooted in Tolkien-esque fantasy fiction, which accounts for over 85% of MMO subscriptions (Van Geel 2012). *EVE* is less about killing monsters and going on heroic quests. Instead, the game focuses on finance, trade, and resource management. War between player factions is common, but its outcome hinges at least as much on economic strength and logistics as it does on martial prowess. Many players use complex spreadsheets to calculate the necessary amounts of materials, time investment, and expected profit from the production of goods and other activities. This is not typical of most MMOs. Instead, activities in *EVE* bear a resemblance to entrepreneurial activities and corporate business practices when it comes to achieving success. Our exploration of these two MMOs that differ so greatly in the emphasis that they place on the economy offers a high level of generalizability and breadth in interpreting the results.

Populations

In both games, players can use multiple characters. In the current study, the unit of analysis is a single player's main character, defined in *EVE* as the character with the most skill points, and in *EQII* as the character with the most playing time. Only active and paying players are considered. Active players are those who have not quit or been expelled from the game.

Paying players are those using regular, not trial accounts. These limits were defined at the time of data extraction, July 17, 2007 for the *EVE* sample and September 11, 2006 for the *EQII* sample. For *EVE*, the sample begins on November 1, 2005, when the logs for all relevant variables became available. For *EQII*, the range begins on January 1, 2006.

The analysis was not performed on the whole population of either game, but instead on sub-samples. The *EVE* sample was assembled from a stratified random sample in which an even number of males and females were selected. This method was used because the gender distribution of *EVE* players is highly asymmetrical, with only about five percent of active players being female. After removing outlier players (those with only deleted characters or main characters with negative account balances and negative skills) from an initial sample of 8,000, the remaining sample consisted of 3,904 males and 3,806 females, resulting in a total of 7,710 players. The mean age of this population was 29 (*SD* = 7.41).

The *EQII* analysis was conducted on a similarly stratified random sample also because of a skew toward male players (87%). After removing cases with incomplete data from an initial sample of 10,000, the remaining sample consisted of 3,086 males and 3,075 females, resulting in a total of 6,161 players. The mean age of this population was 31 (*SD* = 9.33). Overall, the current paper utilizes a total *n* of 13,871.

Measures

Both game operators provided the researchers with demographic information about players as well as behavioral server-log data, all of which was privacy protected and anonymized. The demographic information included the player's age (calculated from date of birth) and sex as entered when they first signed up for the game. The behavioral server-log data included the

player's main character gender, amount of time logged onto the game with that character, skill level of the character, and total wealth accumulated by the character. Measures of player age, time spent, and skill level were used as controls in the analysis. Age has been found to affect MMO play behavior (Williams et al. 2008; Yee 2006c) and thus could influence wealth accumulation in systematic ways, while familiarity with MMO design suggests that time spent playing and character skill level are the biggest direct contributors to wealth accumulation in MMOs: playing more, just like working more, tends to lead to more activity and expertise, and thus more earnings and wealth.

All of these variables are straightforward and similarly defined in both games except for skill level and wealth accumulation, which require further explanation. In *EVE*, character skill level is defined as the number of skill points that a character has accumulated. These points are awarded when players assign their avatars to 'train' specific skills that fall into broader categories, such as mining or combat. In *EQII*, character skill level, referred to simply as character level, is based on the amount of experience points (XP) a character accumulates. These points are awarded for various in-game activities, such as killing monsters or completing quests. This system is typical of the RPG genre. Both variables fulfill the same function in the present analyses: to control for the effect of the character's prowess on wealth accumulation.

Player wealth, in *EVE*, is defined as the sum of virtual currency the main character possesses and the market value of all items the character possesses. The market value of an item was obtained by computing the average price of all market transactions of the item in the month prior to data collection.

In *EQII*, wealth is defined as the earned sum of platinum, gold, silver, and copper, which are all different units of measurement for the same currency used in the game. Unlike in *EVE*,

this value is based on the amount accumulated and is not affected by the amount spent. Thus, there was no need to calculate the market value of items possessed as an indication of wealth.

Analysis method

A regression analysis was used to examine the potential effects of player gender (RQ1) and character gender (RQ2) on virtual wealth. As is typical in studies on gender gaps, the dependent variable was log-transformed (Marini & Fan 1997; Albrecht et al. 2003). This normalizes the otherwise highly skewed wealth distribution and allows the coefficients in the regression model to be interpreted as percentage changes, an approximation that holds for small changes in the variable (Stock & Watson 2007). The independent variables playtime and character prowess were also log-transformed, because we know from the design of the games that their effect on wealth is exponential rather than linear – thus resulting in log-log regression. The independent variables player gender, character gender, and player age were not transformed, thus log-linear regression.

In log-linear regression, the coefficient indicates how many percent the dependent variable changes in response to a one-unit change in the independent variable. In log-log regression, the coefficient indicates how many percent the dependent variable changes in response to a one-percent change in the independent variable. This method is commonly used in econometrics, because many relationships are naturally expressed in terms of percentages (Stock & Watson 2007).

Due to the large number of cases and the use of highly accurate observational data rather than self-reported data, the study bears more similarity to so-called Big Data research than to more conventional social science research designs (Mayer-Schonberger & Cukier 2013). This

means that we must place more emphasis on assessing the practical significance of any observed effects rather than simply relying on statistical significance as an indicator of importance. After all, with a sufficiently large data set, any relationship is statistically significant. Thus for each independent variable in the model, we calculate the effect size variable Cohen's D as a rough measure of practical significance.

Results

Two models were constructed for each of the data sets to distinguish the effect of the gender variables. Model 1 contained only player age, character skill level, and play time – our control variables. Model 2 also included player gender and character gender – the variables in which we are most interested (see Table 1 and 2).

[Table 1 about here]

[Table 2 about here]

Model 1 for both games shows that there are large wealth disparities in both MMOs that appear to be driven by time played. In *EVE*, character skill level also plays a large role, while in *EQII,* the effect of age is also significant but small. Specifically, in *EVE*, a one percent increase in skill level or time played is associated with a .51 percent or .64 percent increase in wealth, respectively. In *EQII*, a one percent increase in time played or age is associated with a 1.17 percent increase or .01 percent decrease in wealth, respectively.

As for Model 2, in *EVE*, both player gender (RQ1) and character gender (RQ2) were found to be statistically significant predictors of wealth. Male players are on average approximately 11 percent wealthier than female players, while male characters in the sample are on average approximately seven percent wealthier than female characters. However, the R^2 of

Table 1. *Regression Models on Wealth in EVE*

	Model 1				Model 2			
	B	*t*	Cohen's d	size†	B	*t*	Cohen's d	size†
Player Age	0	0.094	ns		0	0.32	ns	
Skill Level	0.51	43.05 ***	0.98	large	0.51	43.12 ***	0.98	large
Time Played	0.64	55.23 ***	1.26	large	0.64	55.11 ***	1.26	large
Player Gender (0M, 1F)					-0.11	3.27 ***	0.07	small
Character Gender (0M, 1F)					-0.07	2.29 **	0.05	small
df	7,707				7,704			
R^2	0.66				0.66			

*Note: *p < .05, **p < .01, ***p < .001*

† >0.8 considered large, >0.2 medium, <0.2 small

Table 2. *Regression Models on Wealth in EQII*

	Model 1				Model 2			
	B	t		Cohen's d	size†	B	t		Cohen's d	size†
Player Age	-0.01	-2.77	**	-0.06	small	-0.01	-2.89	**	-0.06	small
Skill Level	-0.04	-2.24	ns			-0.04	-2.22	ns		
Time Played	1.17	81.77	***	1.71	large	1.17	81.04	***	1.70	large
Player Gender (0M, 1F)						-0.10	-1.23	ns		
Character Gender (0M, 1F)						0.27	3.47	**	0.07	small
df	5,591					5,589				
R²	0.58					0.58				

*Note: * p < .05, ** p < .01, *** p < .001*

† >0.8 considered large, >0.2 medium, <0.2 small

Model 2 is not improved over Model 1, implying that in practice, the gender variables do not influence the dependent variable greatly. This is further confirmed by the effect size measure, Cohen's D, which is much smaller for player gender (.07) and character gender (.09) than for skill level (.98) and time played (1.26). In other words, the analysis shows that there is a statistically observable gender wealth gap in favor of males in *EVE*, in terms of both player gender and character gender, but in practice this gap is minuscule in relation to the very large wealth disparities that occur in the game due to other reasons.

For *EQII*, only character gender in Model 2 is a significant predictor of wealth. Interestingly, the direction of the effect is opposite to *EVE*: female characters in the sample are on average 27 percent wealthier than male characters. However, as with *EVE*, the R^2 of Model 2 is not improved over Model 1, implying that this variable has little practical effect on the dependent variable. This is also confirmed by Cohen's D, which is much smaller for character gender (.07) than for time played (1.7). We conclude that in the analyses pertaining to both *EVE and EQII*, gender seems to play little practical role in determining player wealth in these virtual economies. However, the results are not unambiguous and raise additional questions, which will be discussed below.

Discussion and Conclusions

Virtual economies should be of interest to scholars of work and organization, because they represent an extreme example of the blurring of boundaries between work and play. Since much (prosumer) work today is being paid for with virtual markers instead of national currencies, it makes sense to subject these virtual systems of allocation to similar critical scrutiny as we do more conventional economies. The present study focused on gender disparities in virtual game

economies. Data from two large virtual game economies, *EVE* and *EQII*, was used to show that the effect of player gender and character gender on virtual wealth accumulation is in practice very small. There were, however, large differences in wealth as a function of time spent playing and skill level of the characters, indicating that these factors drive the variance in wealth. Insofar as women and men have different amounts of time available to spend on playing due to gendered structures of everyday life outside the game, they will accumulate different amounts of virtual wealth. But once within the game – the focus of this study – gender seemed to have little effect on economic outcomes (i.e., "equal pay for equal work"). These findings were mostly consistent across the two games, suggesting that they may be quite generalizable to virtual game economies.

However, our results concerning gender and virtual wealth are not unambiguous. In a conventional economy, an 11 percent difference between genders would normally be judged as practically very significant. Yet statistical measures of effect size suggested that here the effect is practically insignificant. The reason behind this apparent contradiction is that overall wealth inequality in these virtual economies is orders of magnitude greater than in any national economy. An 11 percent gap is minuscule compared to gaps of tens of thousands of percent stemming from differences in character skill levels and amounts of time spent playing. The gap is lost in the noise, becomes practically insignificant. That said, further research could examine whether this assessment corresponds with players' subjective experiences, that is, whether players perceive a gender gap themselves.

This may well be the situation in other online sites where work and play are blurred as well. The economic differences between groups such as leisure users and semi-professionals are likely to be so large as to obscure the effects of conventional sociodemographic structures like gender (Lehdonvirta & Räsänen 2011). The implication to further research is that we must

examine how such groups could be effectively distinguished in the data, or whether playbor and prosumer work in fact point toward a need to develop new groupings or conceptualizations that no longer depend on the old economic dichotomy of work versus play.

Virtual blue and pink collar occupations

A second ambiguity in our results is that the small gender gaps that were observed in the two MMOs were in the opposite directions to each other. This finding highlights the importance of comparative research; had the study used only one data set, the risk of drawing unwarranted generalizations would have been great. The data at hand does not permit us to dive deeper into the possible reasons behind this difference empirically, but we can instead offer theoretical interpretations based on mechanisms identified earlier in the article. One mechanism that would explain this result is that different MMOs reward different kinds of activities: some provide a better economic return on fighting and exploring, while some favor trading, social interaction, and forming social networks, for example. If there are gender differences in play styles, that is, differences between men and women in what play activities they favor (Yee 2006c; Heeter et al. 2009), then this would be reflected as a gender economic gap that varies in size and even direction between different MMOs. In *EVE*, earning wealth is one of the most obvious goals of the game. Players are constantly reminded of how much money they have and wealth is frequently compared between players. Achievement is thus strongly associated with the accumulation of wealth, and so those conforming to a masculine gender role are perhaps more drawn towards accumulating wealth in *EVE*. In *EQII*, achievement is associated with a wider variety of measures, such as experience points and achievement points. While such activities do generate wealth, there are other activities in the game that generate wealth more directly, such as

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crafting and trading. These activities are associated more with socialization than achievement, and thus likely to appeal more to players who conform to a feminine gender role (Yee 2006c; but for a contrary observation, see Hayes 2007). The observed differences in gender gaps in these two games would thus result from an interaction of 1) gender disparities in the popularities of various activities and 2) uneven economic rewards from different activities between games.

We can generalize the above idea to the broader picture of ICTs and the changing nature of work. Gender differences in online behaviors (traceable back to gender roles) and reward structures built into online environments (likewise socially constructed) interact to create *virtual pink and blue collar occupations*. These virtual occupations are gendered patterns of behavior that can result in systematically different virtual economic outcomes for different genders. As our results from *EQII* demonstrate, these differences are not always numerically to women's detriment. In playbor and prosumer work, workers are consumers who either indirectly or directly *pay* for the ability to work. This results in very different power dynamics compared to conventional wage negotiations. Designers of online games and social networking services who wish to attract business from female customers have a need to ensure that virtual pink-collar activities are virtually rewarding. Indeed, some of the most influential online games and services in recent years, such as *FarmVille* and *Pinterest,* were designed and operated particularly with (a certain conception of) female users in mind. Users demonstrating feminine-typical behaviors were rewarded generously for their contributions, with virtual objects, coins, and 'likes' from other users.

In the past, ICTs enhanced some jobs while relegating other jobs to the category of unpaid labor (Autor et al. 2006; Liker et al. 1999; Webster 1996). The rise of playbor and prosumer work is likewise changing occupational structures. Instead of eliminating jobs or

turning them into unpaid labor, it is transforming some jobs into virtual labor, paid for with virtual rewards. Virtual rewards are not quite the same thing as conventional pay. Some virtual currencies can be readily converted into dollars and euros, but most virtual rewards do not translate to conventional economic benefits at all, although they may still be perceived as valuable in other ways. As the boundaries between work and play become increasingly blurred, researchers would do well to keep a keen eye on who gets to keep the conventional rewards, whose work ends up being remunerated in play money, and what that play money is worth in terms of actual power and social status.

Limitations and further directions for research

We must recognize some inherent limitations in the empirical part of this study. First, the external validity of our results is naturally limited by our focus on MMO players, who may not be representative of other populations. For example, female MMO players may differ from an average female Internet user in terms of what kind of gender roles they perform (Williams et al. 2009). This issue is exacerbated by the relative dearth of women in both games examined. Further, the women who play *EQII* may differ in these characteristics from those who play *EVE*, thus limiting our ability to generalize to MMOs as a whole and potentially contributing to the inconsistencies in findings between the two games (Greenberg et al. 2010). Future research could address these limitations by examining gendered returns on virtual work in a wider range of online platforms, with specific emphasis on those that appeal to more general populations.

Acknowledgements

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