Das Virtual Capital:

An Economic Perspective on Playing Online Games, Fantastic Scarcity, and Real-Market Trades.

by

Eric Dodson

Submitted to

Oregon State University

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Massively multiplayer role-playing games (MMORPG) are becoming a popular leisure activity world-wide. MMORPG players have created a new kind of market, one for virtual possessions. Some players will buy and sell virtual goods for real-world money. Many game developers oppose this real-market trade because it threatens the control of their intellectual property. These games are inherently social environments where players group together to fulfill quests and meet goals. The value of virtual possessions is a response to a game world's fantastic scarcity, where certain virtual goods and activities raise a player's social rank or further other goals. The game acts like a technological production function that produces virtual goods and capital. Players with high real-world wages will spend less time in games in comparison with low-wage players. Real-market trade allows buyers to shift their real-world wealth into game wealth. However, real-market trade also detracts from the information value of virtual goods, which are act as signals for the amount of time a player has invested and player ability.

Key Words: Massively Multiplayer Online Role-Playing Game, Real-Market Trade, Fantastic Scarcity.

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APPROVED

Mentor, representing Economics

Committee Member, representing Economics

Committee Member, representing MMORPG community

Dean, University Honors College

I understand that my project will become part of the permanent collection of Oregon State University, University Honors College. My signature below authorizes release of my project to any reader upon request.

Eric Dodson, Author

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DEDICATION

To Roscoe and Stacy, with hopes they will be happy together. Many good returns.

Introduction

Online games warrant serious study by economists. Millions of people are living large parts of their lives in these games. They are spending money and time. The wedge of a real-world wealth gap leads to some players trading virtual possessions for money. Because of the inherent social aspect of these games, real-market trades cause harm to other players to some degree. With a growing market for games and an increase in legal discourse surrounding the control of virtual possessions, the efficiency and welfare effects of real-market trade are becoming important issues.

Massively multiplayer online role-playing games (MMORPG) and their progenitors, text-based Multi-User Dungeons, first gained academic attention through sociology and other social sciences. The earliest analysis of MMORPG emergent culture dates back to 1994 (Reid). Contemporary analyses of MMORPG are concerned with much more than the social dimensions of play. In an upcoming book, technology writer Julian Dibbell reports on his yearlong experience playing Ultima Online to make a living. Dibbell is not a professional game player, per se. He did not make his living through any kind of tournament or achievement award. Instead, he became a middleman.

Ultima Online, like many other Massively Multiplayer Online Role-Playing Games (MMORPG) has an active market for trade with real-world currency. Real-market trade takes place through online auction sites such as eBay. Players can buy or sell in-game currency—platinum pieces, in this case—for U.S. dollars. While many of his fellow gamers were killing dragons or learning spells, Dibbell learned how to run a business. In the last month of his experiment, he made $2,000 in profits. The consequences of his income astounded him. He went so far as to ask his accountant if he

needed to report all his gaming as income, as in-game trades could be considered barter. Soon, he asked questions about the economic activity and value of the entire game.

Dibbell is not the only interested party, either. Starting with Castronova (2001), economists have investigated the ramifications of real-market trade to game players, game developers, and society in general. This paper builds on their work to offer more insights to the status of game development, the behavioral decisions of gameplay, and a model of play that includes the effects of real-market trade. These perspectives lead to a better understanding of the implications of real-market trade in regard to economic efficiency and welfare.

MMORPG as Virtual Worlds

Virtual worlds are a dark continent with shores full of recent immigrants from reality. As MMORPG subscribers continue to grow, so does the potential effects of real-market trade. While these worlds are cloaked in fantasy and play, many of their rules follow real-world principles. Trade springs from the nature of MMORPG. Virtual possessions are chimera, but they mirror real-world property.

Virtual worlds are persistent, social environments accessed through computer programs. They feature a representation of the user—the avatar—and sets of interactive objects. This avatar is customizable and can interact with other players' avatars. The virtual space they occupy can be public or private (in terms of access by other avatars). The worlds persist. If an item is left on the ground, it will be there until someone picks it up or a "natural" force moves it. Accordingly, the world does not vanish when the player logs out. Virtual worlds are well suited for the needs of a role-playing game. Players build up their characters over time, buy equipment, and explore a world filled with danger. MMORPG environments display all the characteristics of virtual worlds. They are also the majority of available virtual worlds at this time.

Virtual worlds operate much like the real world because of the conceits of virtual space and avatars. Most resources follow the rules of private property, starting with the avatar itself. When a player creates "Grog the Barbarian," she understands no one else can play as Grog at the same time. Grog is a rival good. Grog is also excludable because of password protection and other methods of player verification. The features of private property also apply to virtual possessions. If Grog has a sword, helmet, a diamond, or a beachfront property, no other avatar can use that particular object at the same time, nor

could they use it without "his" permission. Without these rules, the player would not have any reason to invest his time and money into Grog, nor would he bother to collect virtual possessions.

Ultima Online was the first commercially successful MMORPG and set many of the standards for the genre. In 1999 it attracted over 100,000 subscribers who paid for the

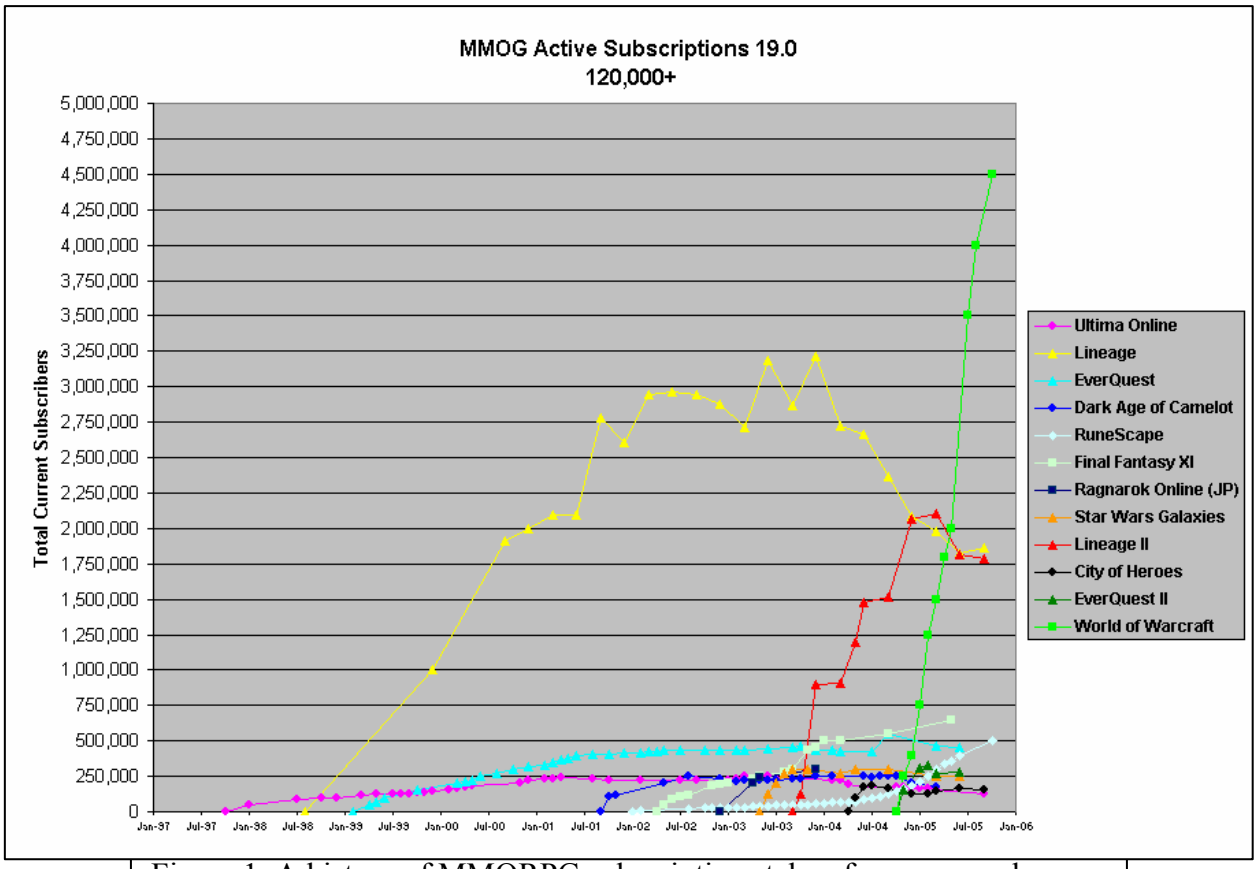

Figure 1: A history of MMORPG subscriptions taken from press releases, private disclosures, and news sources compiled by Woodcock.

boxed game and monthly access. That figure is now considered the make-or-break point for a game's first year (Bartle). The concept of a continual revenue stream from a video game got the industry's attention. After a few lonely years at the top, Ultima Online was joined by competitors. New game worlds ranged from more fantasy, science fiction, medieval times, and established works of fiction such as Star Wars (a Pirates of the

Caribbean MMORPG is on the way). Ultima Online's graphics are now considered sub-par, but it attracts a few long-time subscribers. Waves of large games passed through until Blizzard Entertainment released World of WarCraft in 2004. As of winter 2006, Blizzard claims over six million subscriptions worldwide (Blizzard Entertainment).

MMORPG subscribers play and socialize together. Gameplay focuses on avatar advancement through gaining experience, armor, weapons, and other items. Group formation, both short and long-term, is a necessary element of progressing through quests and dangerous areas. An avatar's abilities determine its treatment by other players. As characters advance, they gain respect from other players, join highly organized player guilds, and access more entertaining gameplay. Most MMORPG have a maximum character level where the avatar can gain no more experience. This point is inevitable, though it takes several months even for determined players. Once the avatar is leveled out, the search for better weapons and higher social rank continues. Advanced game content typically requires large, dedicated groups (up to 50 players, in WarCraft).

MMORPG represent the majority of virtual world real-market trading. One notable exception is SecondLife, a virtual world that ranges between "game" and social interaction program. The striking difference in SecondLife is that all content, other than terrain, is created by players. Participants have access to object creation and animation, allowing them to create buildings, games, or other items. All intellectual property rights are held by the user-creator, in an effort to encourage business and content creation. The game is free, but players who want to purchase land must pay a monthly subscription on top of their virtual real estate buy-in. The operators also make money from trading SecondLife currency with dollars. For all these reasons, SecondLife has attracted artists,

programmers, and other eccentrics. It also presents the most liberal intellectual property scheme of a popular virtual world.

In MMORPG, we are not truly dealing with orcs or barbarians or ewoks. The only real inhabitant of these worlds is Homo Economicus, the profit and satisfaction seeker. Players who want to advance through the game without spending as much time can use real-world money on online auction sites for virtual possessions. The most common trades are currency exchanges (dollars for gold, yen for pieces of eight, etc) on online auctions or private trading sites. Less frequently, players will sell their avatar itself, allowing a new consumer to skip straight to more advanced standing. In both cases, a cottage industry of professional players has sprung up, mostly from developing countries in Southeast Asia. These "Asian Farmers" will locate quests, areas, or monsters with the biggest treasure payoff and play to earn their living.

Not all companies allow trading. Right now, games fall under contract and copyright law, though they have not been tested on the battleground of court. Outrageous claims are made by players, player groups, and developers in regard to the negative effects of treating game possessions as legal property. The number of MMORPG players continues to increase. China and South Korea have national laws that protect virtual possessions, classifying them as virtual property (Fairfield). Modern countries have colonized these worlds. Today, they have begun to legally recognize them.

Developing and Operating MMORPG

Since the advent of large-scale (100,000 players or more) MMORPG after 1997, numerous companies have entered the field, creating a competitive marketplace. Ongoing subscriptions make MMORPG developers significantly different from traditional video game companies. The games themselves display qualities different from other games or intellectual property (for a digression on MMORPG as club goods, see appendix 1). Companies that oppose real-market trade see the practice as a threat their intellectual property rights and control of the game.

While the number of MMORPG players reaches towards tens of millions, the pool of developers is fairly small due to the high cost of production. Another possible damper is the technological network effect. Once a group of people have adopted a certain game to live out their online lives, they are not as likely to switch worlds and leave their hard work behind. In the long run, this effect is balanced by the eventual turnover—or slush—of players, which some research claims is around 14 months (Bartle 2003).

A startup company could decide to make a MMORPG right off the bat, but most developers have a few "normal" video game releases under their belts. An investment in a MMORPG is not necessarily a safe bet, especially for virgin developers. No computer program is flawless in its first edition, but MMORPG that do not work well due to coding problems with code or server connections during their premier lose the first wave of players and never fully recoup. Anarchy Online is the standard example for this problem. While the game is now functional, the first group of buyers balked at the persistent bugs

and unfinished areas of the game. The world lost its first core group of players and never fully recovered in population. (Castronova 2005).

The lure of hundreds of thousands of people willing to pay a one time fee of $30-50 and a continuing subscription of $10-15 a month has the attention of dozens of game companies that have more experience and can field the inherent risks. A commercially competitive MMORPG requires a large investment up front. Like any video game, a whole production team of artists, programmers, and engineers spend months designing every aspect of the game. Successive levels of testing must be done before a finished product can be released. Advertising campaigns and marketing agreements must be worked out simultaneously, if not before the production. A network infrastructure of servers and their support staff must be purchased. These costs add to an initial investment in the range of millions (Bartle 2003). A typical video game has between 20-40 hours of in-game content. Some offer much higher game time given different options on replay. A MMORPG developer wants to entertain for a much longer period of time, or even indefinitely.

MMORPG are ongoing services, rather than typical video games. Standard video game developers must trust in intellectual property law to prevent pirating and game manipulation. MMORPG players must buy a computer program that allows them to interact with the virtual world (the *client* program) and then pay a subscription to connect to the online server (the *host* program). This system allows thousands of players to interact with the world and each other simultaneously; it also allows MMORPG developers complete legal and technical control over their games. Because they own and control the host code, MMORPG developers act like virtual world governments.

If MMORPG are governments, then real-world trade are their most controversial policy issue. Developers are not directly hindered by real-market trades. Some, such as Sony, have embraced the practice and have created verified trading institutions. They may have reasons to ban or accept trading because of effects on players, as addressed in the next section. However, current actions taken against trade indicate developers are trying to avoid a risk to their control over their intellectual property.

The current situation towards real-market trade is defined by End-User License Agreements (EULA) and weak enforcement. EULA are contracts that players must agree to if they want to play a MMORPG. They allow any number of rights for players or developers, and make it clear that players pay a fee to obtain a license to use the developer's product and are limited by that license. In some cases, the restrictions are so exhaustive that the user signs away their rights to intellectual property they create inside the game, including catch phrases, content ideas, or their private conversations (*World of WarCraft Forums*). At the same time, developers do not fully enforce the EULAs. Anti-trade developers have stopped the sales of virtual goods on eBay (Taylor), but have not gone after any other aftermarket firms. If the network server support detects obvious trading or automatic "bots," they occasionally do ban or suspend players. This poses only a temporary inconvenience to gold farmers, the most likely targets because of their high trade volumes.

Developers claim so many rights in EULA for primarily economic decisions. First, they claim rights because they can. EULA have not been tested directly in the U.S. Courts, though some legal scholars claim they do not constitute legal contracts because they are agreed to after the product purchase (McManis). If they can wrest ownership of

potentially commercially valuable in-game content or ideas, they will. Secondly, the EULA also defends against spurious lawsuits from players who feel their ideas were implemented in the game without compensation. The issue of players owning their virtual possessions raises a new set of potentially non-spurious lawsuits and enforcement costs.

This scheme is most likely temporary. As the market develops, RMT will continue to grow. Players will become more invested in the game. Developers will devise better technology to track those who break their rules, allowing lower enforcement costs. Legal counsel for developers may begin to worry about silent consent for real market trade. Some day, EULAs and trade will collide in court. These variables will force a new set of institutions regarding real-market trade.

Playing Online Games

Real-market trade occurs because virtual possessions are valuable to players. The value of in-game objects is based on players' reasons for spending time in MMORPG in the first place. The main goal of a player in a MMORPG is to fulfill a role in society and move upwards. A player accepts the *fantastic scarcity* of a game, in which different actions and resources have different returns to social standing. Gameplay decisions, including buying items on real-world markets, are a response to that scarcity.

Once a consumer makes his choice and becomes a player, he either pays the subscription to continue playing or he drops out. Subscriptions are a fixed cost for access to the game world. Obviously, the worlds must be rewarding enough to cover these costs plus the player's private opportunity cost of time. That tradeoff is crucial to understanding the demand for MMORPG and the effects of real-market trade. First, the basic goals of playing games should be analyzed.

MMORPG add a direct social element to video games. This changes the essence of gaming. Most Western books, cinema, and video games rely on a dramatic buildup towards an ending. MMORPG have story elements in quests throughout the game where a player saves princes(ses), rights wrongs, and saves a kingdom. However, the long-term game denies an explicit winning condition. Instead, it provides a highly competitive setting for the most dedicated players to have a fleeting chance at a high status among peers. Social advancement is hard-wired into the game's framework, as a player's level and experience are highly visible pieces of information. Also, most MMORPG have

mechanics that encourage players to group together and cooperate, making social status directly useful.

A consumer may pick up the MMORPG in order to fulfill his psychological need to belong to a group and interact with real people. Anonymity allows consumers an extra degree of freedom in expression. In the context of the game, one-time group members who work well together may form long-lasting associations via guilds and grow in membership, until the guild itself is a competitive social microcosm. Ability and performance garners respect. Even the most advanced single player video game does not offer this feature, as computer character facades are rather thin.

Real-life social connections give another reason to start playing. A friend who plays a MMORPG may convey a trusted positive review. That friend is even more likely to encourage the consumer to play in order to spend time online together. This effect is similar to the adoption of compatible technologies, per network externality theory (Liebowitz and Margolis). If one agent uses a VCR instead of BetaMax, their recordings can only be lent to friends who also have VCRs. This is very similar to the above ideas, but uses the social nature of these games to explain a variation on word-of-mouth buzz.

One hour spent in a MMORPG will not bring the player one hour closer to the end of the game. Instead, that hour improves their avatar. Perhaps this feature of marginal benefit alone attracts social scientists and economists to analyze these worlds. The player's goal is to improve their character together with peers. Of course, that improvement is fun and doesn't resemble real world work—in this respect, the player is subjected to *fantasy*.

A beginning character starts at the bottom and aims to get to the top of the heap, at the limitation of the player's ambition. Status is a limited resource that must be wrested from other players and the mechanics of the game itself. This *fantastic scarcity* is accepted by every continuing player to some degree and drives in-game decisions.

Fantastic scarcity, my own term for this phenomenon, applies somewhat to all games and sports, and corresponds to the concept of "the magic circle," the illusion that must be created and supported to give games a sense of meaning (Huizinga). The magic circle applies to the formation of a new set of rules in a divergent reality, whereas fantastic scarcity describes the effect of the rules on decision criteria. *Monopoly* players, for example, collectively agree to treat plastic houses as valuable objects in the context of winning. However, *Monopoly* players could agree to a change in the rules—the magic circle in this case is small and flexible. MMORPG players accept the given fantastic scarcity (or accept but complain) part and parcel with the game. Not all players will fully accept the value of social advancement, but they are still bound by their personal goals and the fantastic rules governing their world. According to one highly-involved player (over 50 playing hours a week), the fantasy can become highly competitive with reality. Discussing shopping for her avatar in World of Warcraft, she says "It was great—I didn't even have to go to Nordstrom's anymore." (Jones)

Fantastic scarcities in MMORPG center on combat resource allocation. Value is placed on attack, defense, speed, and other battle related abilities. An avatar with higher levels of these characteristics is more useful for player-vs-player battles, for instance. Given a choice between two potential groupmates, a player will pick the one with higher statistics before heading into a high-level dungeon. Group selection presents another form

of allocation, but for avatar types. A certain quest may require a mix of hearty melee fighters, ranged attackers, and even healing avatars. Whether for limited group sizes or massive (50 or more member) campaigns, individual characteristics and classes are vital to advancement.

Characters gain abilities through varied game mechanisms. Players can pour their time into killing monsters, fulfilling quests, playing the in-game auctions, working at an in-game profession, or idly chatting. Killing monsters (*grinding)* and fulfilling quests earns experience points, which allow characters to gain levels and powers. Weapons, and armor augment a character's attacks and defense. A wide variety of one-use items allow for temporary gains to vital statistics. Gold is a reward for killing enemies and also performs the role of real-world money. Possessions can be bought and sold between players or between a player and an automated non-player character. Because it is created through completing tasks and very seldom taken directly away from players or the in-game market, the level of money in most online games is always growing. Most games feature avatar professions. Characters can develop skills in blacksmithing, ore mining, jewelcrafting, and other value-added abilities. In Ultima Online, for example, one could improve the blacksmithing skill by gathering ore, moving back and forth between the forge and anvil, hammering out the prescribed item, and repeating the whole process hundreds of times. Finally, some games allow virtual real estate. Aside from benefits of storage, these properties are mostly aesthetic. Castle properties are a key feature in Lineage 2, and their control is regularly decided through sieges.

We can imagine a general case of fantastic scarcity and avatar ability mechanics quite simply. In the world of Academenon, Grog has almost nothing to begin with. There

are very few resources he can gather that are lying around, though he may later learn to mine or collect herbs. Grog's scant starting possessions include a sword. He uses the sword to kill some monsters. The monsters leave Grog their exclusive property (*loot)*, objects that help Grog kill more monsters or that have in-game trade value. Each kill also gives Grog more experience. Eventually, he gains enough experience he advances a level, giving him bonuses to strength and overall-ability-to-kill-things. After trading off objects that do not help him kill monsters, Grog can buy a bigger sword that kills the same monsters faster or that allows him to kill tougher monsters that have more gold. Time passes, and Grog branches out. Grog makes gold by performing quests for non-player-characters—he retrieves specific items or kills certain monsters. Every activity he engages in—earning gold, experience, or items—increases his marginal return to labor. The more gold he gets, the more items he can buy, the better he can kill, the better he can earn gold. At some point his experience levels out, forcing Grog to rely solely on better items and non-in-game-experience-related ability to increase his rewards. And so he climbs.

Avatar progress is given with time, not necessarily skill. Many games refine combat to a point and click affair, though they allow room for advanced strategies as well. Hardcore players develop strategies for everything from combat to selecting professions and maximizing the rate of increase to their characters' abilities. They maximize the impact of player time on character development, but the chief input is still time. Most players, given enough time, can rise to high levels in the game. Thus is the problem of challenge level balanced with a variety of player skill levels solved. In-game time increases the value of the character, but that value is in response to the fantastic

scarcity that limits the player herself. Without the context of in-game advancement, nothing is created. Players subject themselves to scarcity and pay Blizzard for it. Then they spend hours of clawing up the ranks of scarcity they paid for. The game gives social structure and a production function for upward mobility.

Some of the products of the time input are transferable. Without a real-market trade option, players can still receive goods from a friend or from their own advanced characters. The latter option, known by players as *twinking,* can be limited by technical restrictions. For example, powerful weapons can have level requirements to prevent low level characters from using them. With these non-purist options gone, only the player's time can drive her towards her goals. She spends time in character, grinding, making strategic decisions for development, engaging in auctions, questing, and jobbing.

Modeling Player Decisions

Given the mechanics of gameplay and fantastic scarcity, MMORPG can be described through economic models. Existing models for MMORPG in economic literature do not accurately and concisely capture the decision to play. I argue for a broad model that describes MMORPG as technological production functions for virtual possessions and capital. This model also explains the fundamental reasons for real-market trade. It also describes a potentially large cost of trade due to the signaling effect of virtual capital.

Castronova (2002) puts forward a proposed model of player utility that incorporates fantastic scarcity, reward, and time management. No other economists have challenged his model in publications, though Yamaguchi (2004) uses it as a foundation for further work. His "puzzle model" makes some questionable assumptions, but gives an explanation for real-market trades. In Castronova's model, a player divides his time between N games in order to maximize utility. Castronova starts with a model for games or puzzles:

$$S = (\alpha)(R) - (\beta)(C-\Omega)^2$$

where satisfaction of completing a puzzle is a function of the reward (R) and challenge level (C). Omega is an ideal level of challenge for the individual player—that is, we do not expect it to be the same for all players, though that aspect does not come into play directly. A small deviation from the ideal challenge level results in large losses to satisfaction. A more complete model would include a mechanism for challenges that exceed the player's ability, though this effect is captured somewhat through high levels of challenge that negate all reward.

The basic puzzle model needs work, but only after seeing the rest of Castronova's arguments. It plays into his next steps only in a general sense. If games feature a level of challenge and rewards for playing, the following still works. Castronova plants his satisfaction functions into a utility function for online games—the model also fits other phenomena, too. If we consider work as one game (money is one form of reward) we can model the utility function based on the amount of work time (H_A) and play time (H_B).

$$U(H_A, H_B) = S_A\ln(H_A) + S_B\ln(H_B)$$

and

$$T = H_A + H_B$$

These models give insight to the issue of real market trade in MMORPG. One is U-shaped demand in regard to wages (Castronova). The high level of reward in return for time attracts those who have a low real-life satisfaction of work or those whose wages are high enough to follow their favorite leisure world. Mid-range wage earners have rates of pay that come into competition with game worlds. While technology adoption rates play a part, this is one explanation for the large amounts of high school and college student players. The explosive growth of online games in Southeast Asia can be explained by their lower wages. This outlook gives valuable information about the demand curve for MMORPG.

Secondly, the models give very salient information about two divisions of players, the low-wage and middle-to-high wage groups. As noted above, player advancement is mostly a matter of time spent with a character. A player who spends more time in the game will have a more advanced character than someone who spends less time there. The models, along with basic stipulations about wages and value of time, predict that the

more advanced character belongs to a low-wage player. Conversely, a player who has higher real-life wages will have a less advanced character, holding the personal game satisfaction parameters equal (Yamaguchi).

Given the social nature of MMORPG, these players will eventually meet and communicate about their preferences—though they may connect outside of the game, through third party sites. Player one would prefer to stay in the game if not for money concerns. Player two also likes the game, but isn't as far along because of less time devoted to the game. This presents a chance for both parties to gain from trade, if real-market trading systems are allowed either de jure or de facto. Player one uses his game advantage to meet his real world needs, where Player two uses her real world advantage to further her gaming wants. Real market trades allow this gain from trade. These gains must be measured to track the effects of virtual possession policy on efficiency.

Castronova models the core elements of real-market trade, but all based on the problematic puzzle function, which is a threefold mistake. First, it introduces satisfaction as game output. Nothing resists an empirical analysis quite like human satisfaction. Ironically, Castronova makes a note in the same paper reminding the reader that utility functions do not necessarily reflect individual well-being but a decision-making criteria. Secondly, the player's relationship to the variables is unknown. For that matter, there is no explanation for how any of the variables are formed. Finally, Castronova fails to articulate his assumption that constraints in games directly raise utility and demand. By separating reward and challenge, he leaves us wondering why the consumer doesn't pick a leisure activity that has greater reward, such as watching television. Even assuming that higher challenges result in higher possible rewards (which acts like risk aversion),

challenge itself is a subjective factor. He conflates *challenge* with *perceived challenge*. For example, one might derive great satisfaction from beating a grandmaster in an honest game of chess. However, one would gain the same satisfaction if the grandmaster secretly lost the game on purpose. People like to overcome challenges to get a reward, but they would rather have the reward with less challenge.

A new model is needed to iron out the wrinkles in the puzzle theory's economic assumptions of human behavior. The replacement function should not yield "satisfaction," but some output as a function of time. Based on the analysis of game activities in the last chapter, the model should resemble a technological production function based on time inputs, given several factors discussed above. Serendipitously, Castronova starts on this track in a later work. He proposes that the aggregate output of gameplay is a function of player time, given human capital, avatar capital, physical capital, and the resources available in the virtual world. Human capital is the player's aptitude for gameplay or skill level. Avatar capital is the measure of avatar abilities and statistics. Physical capital includes transferable possessions that augment abilities, including items with trade value. Lastly, the resources available inside the world are limited, including overall content to explore (Castronova 2005).

This new model can be strengthened by removing the resource variable, adding social capital as a variable, describing a parallel payoff function, and recognizing the dynamic nature of all the variables.

The inclusion of fixed in-game resources is unnecessary. Castronova includes the variable to make a point about diminishing marginal returns to time. In the model, "resources" act like a fixed set of subsidiary inputs. It suggests the avatar's ability to

gather loot and kill monsters will exceed the amount of loot and monsters to kill. In a broader sense, it refers to the limits of content. However, most successful games continue to develop more difficult challenges throughout the game's lifespan. A player may suffer if a specific area is highly congested, but it does not seem reasonable to get that specific in the foundational model. At this stage, we can assume the player can always find content somewhere in the virtual world.

Social capital can be described as social rank or appeal to other players. MMORPG are inherently social, and part of the reason for play is to increase one's social standing. The aggregate output captures that portion of social relationships. But relationships are also useful in response to fantastic scarcity. In this sense, social capital attracts groupmates and affects overall attitudes towards the player. Social capital can be measured through guild affiliations, "buddy lists" of regular partners, reputation rankings, and purely aesthetic choices. The latter characteristic includes virtual property in some games, avatar appearance, avatar sex, and trophy items that have no value in regard to avatar ability. These characteristics and institutions allow the player to attract and group with other players. Players use social capital as an indicator of the benefit of grouping with another avatar. Given a risk-averse player and two potential partners, the player will choose a partner she has played with before, given their other characteristics are equal.

The output of gameplay is hard to measure fully, but can fit into an objective payoff function easily. To put it simply,

$$\Pi = (Y)(\lambda) - C(T, M)$$

Where y is the game output, lambda a preference vector, and C(T,M) the opportunity cost of time and money. Money represents subscription and bandwidth fees and also allows for the possibility of expenditures for in-game items.

Parts of the returns of player time are expressed as increases to in-game capital. The exact breakdown of the returns is complicated. The important aspect is that Y is valued by the player and also increases the amount of Y in the next time period. The amount of literature in game forums written about optimal combinations of armor, race, class, magic, and playing style suggest a number of people care passionately about maximizing the destructive or defensive ability of their avatar. As discussed above, gold is interchangeable with items, experience, skills, and other forms of avatar capital. Reward can be divided between virtual goods and actual avatar capital. Additions in avatar capital act like increases in human capital in a labor market. For the metaphysically squeamish, avatar capital improves the technological constraints of the production function. Because this capital increases the returns of the next time period, the model should describe this learning by doing aspect. While time and money allocation are made in period *t*, virtual capital is determined in period *t-1*. Even if we assume a flat learning curve, the player's ability to allocate avatar resources and actions (H, the human capital component) will increase through time.

Altogether, the new model can be described by:

$$\Pi_t = (Y_t)(\lambda) - C(T_t, M_t)$$

Subject to

$$Y_t = F(T_t, M_t; H_{t-1}, A_{t-1}, K_{t-1}, S_{t-1})$$

Where H is human capital, A is avatar capital, K is (virtual) physical capital, and S is social capital. If money is allowed to represent both subscription costs and the ability to purchase virtual capital, the outcomes of Castronova's first model still occur. In this model, the substitution of money for time through real-market trade takes place as a cost minimization in the payoff function. The opportunity cost of a highly paid player's time is higher than the player with low wages and large amounts of virtual capital.

The reward for playing as expressed in Y can be in-game satisfaction, real world wage, or compensation for virtual goods through RMT. The player receives the feeling of reward insofar as his preferences are in line with his avatar's success. If Grog gets 100 gold for killing a squad of lesser undead dingoes, Grog's player may be indifferent to the reward, depending on his level of commitment to the game. If he plans on playing for exactly one hour and never again, that 100 gold may not be as interesting as exploring different areas or other non-linear features. If he plans on maxing Grog out no matter the time requirements, the 100 gold is valued by the metric of how much closer it can bring him to his goal. Avatar capital becomes a measurable good produced in MMORPG, like wages in the real world. This is strikingly different than labeling the formula as *satisfaction*—as in Castronova's work, a strange term to find thrown in without much justification. The satisfaction in gaining avatar capital doesn't need to be addressed directly, as it is a preference for a good. The player indifference curve or utility function assumed in lambda covers that aspect.

The ability to trade has wider ramifications than gains shared between two players. Social capital is defined above as the leftover characteristics that determine a player's appeal and social rank. In the broader sense, all forms of virtual capital

determine a player's appeal to potential groupmates. A high aggregate capital signals several things to other players, as long as real-market trades are banned. It signals a minimum total time a player has put in the game. Though the human capital accumulation form is not elucidated, the amount of time corresponds with higher player ability. If the player has had the avatar for a short while but it is fairly advanced, the player must have an even larger human capital advantage. If the player has simply put a consistently high amount of time into the avatar, it shows their dedication and relative experience using the character. All these make the player a better candidate for grouping or guilding.

Real-market trade corrupts the signal, explaining one reason some players speak out against real-market trades. A player may have to choose between two possible partners for an instance. Both prospective partners have roughly the same statistics, reputation, and gear. In turn, the deciding player judges both players as equally capable. However, if one of the potential partners bought his gear through real-market trade, he will have lower human capital and actually be a worse partner. The worst-case scenario is a parvenu who buys a high level character but does not even know how to play the game. In either case, the benefits of that partner are lower and chances of death or failure are higher.

In the bigger picture, the amount of time invested into the game is a badge of honor and a likely indicator of ability. Moving up amongst peers is one of the crucial goals of MMORPG, and these same signals of time investment apply to the social hierarchy. Some players label real-market trades as cheating because buyers move up without putting in the effort to do so. The payoffs of the "cheaters" do not have to affect

these players. Instead, the knowledge alone of the deception is enough to trigger a social disapproval mechanism (Camerer).

This function produces several goods, each subject to its own indifference curve. The game acts as a bundle of goods, as we might expect. As discussed above, the player involved in strict gameplay will accrue marginal avatar capital and virtual possessions with every hour in the game at a rate determined by their level of avatar capital and real-world skill. Their performance increases their reputation with other players. Finally, some chunk of games is an entertainment value, possibly from breathtaking graphics, satisfying mechanics, or an unfolding story.

The puzzle satisfaction formula is highly individualized and suspect in regard to economic theory. Instead, we should consider game time as moving towards the goals of avatar ability and social standing. The consideration of avatar as an extension of the consumer fits the role of technology in a fantastic scarcity. Instead of wages, the avatar gives the player a production function for virtual goods. Real-market trades emerge as a response to asymmetric levels of wealth between real-world and virtual-world specialists. The

Implications and Conclusion

The largest unsettled question regarding virtual worlds is the ownership of virtual possessions and allowance of real-market trades. Economists, lawyers, players, and game designers all have their arguments, but jurisprudence and empirical analysis have both remained outside the dispute. The models above give testable propositions, so we can draw some conclusions about them. The study of online behavior and MMORPG is so nascent the scale of the conclusions face a wide probable range. Still, the general effects of different trade institutions should follow from the basic predictions of the models. Institutions to consider include a gray real-market trade, a real-market ban, virtual property rights, and variations within the three.

The current scheme silent consent works well for developers. High-wage players continue playing because they can buy items with currency and gold farmers contribute to subscriptions and in-game activity, and everyone benefits at the slight cost of corrupting the reputation and ability signal. The developer takes action against large-scale farmers but does not otherwise intervene. As discussed in the developer section, this scheme is likely to change. Furthermore, the corruption of overall social status may drive players away and lower the value of play for those who stay.

A total real-market ban will result in a “pure” game. Together with restrictions on gifting, the social status signal would be a much stronger indicator of human capital and accomplishment. However, the high-real-wage players will lose the gains from trade, as will gold farmers. Consequently, if the benefit of the social signal is relatively low, this

set of rules will result in a deadweight loss. Players who would trade in other scenarios will play less or not at all, resulting in a loss to the developers.

Virtual property rights and corresponding legalization of all forms of trade introduces even more complexity. If the game is introduced with full real-market trade, then all players must agree with the dual inputs of time and money. Social rank is still subverted by money, but those who play are those more likely to want to spend money in real markets. One way to preserve the connection between time and social status is to limit the amount of money spent on an avatar. If players can spend only so much in a given period of time, then virtual capital will stay closer to human capital. For example, instead of buying a maxed out character, a player could be allowed to buy a marginal increase in avatar statistics for every 8 hours they spend in active gameplay. This ensures that human capital rises along with the avatar's status.

The largest problem from a developer's perspective is becoming a police power and government. If virtual property becomes legally protected, the developer is responsible for returning stolen property and compensating those they damage. The latter poses a serious issue related to ongoing changes in games. In most MMORPG, players complain—albeit for free—every time developers make changes to fantastic scarcity. Developers revise in order to balance fun, fairness, new technology, and glitches. If the balancing is successful, the virtual society benefits as a whole. Individuals can experience benefits or drawbacks. Some attributes may get a boost in a rewrite—a power bonus for Barbarians is an automatic boon for an advanced Barbarian character. An item that loses relative usefulness is "nerfed." (originating from the Nerf brand spongy foam toys). The

additional problem of virtual property is that items with high market values can be nerfed into worthlessness.

If your character is your virtual property, then Blizzard might take part of its value away in a rewrite. In a worst-case, your level 60 character becomes a ridiculous combination to play. Nerfing could affect markets like government regulations do in the real world. In virtual worlds with a virtual property rights underpinning, the pseudo-government of the developer does not enjoy the doctrine of eminent domain. The legal likelihood of lawsuits stemming from nerfing is the prime reason listed by analysts who argue against virtual property rights (Bartle 2004). It seems that while they compare developers to governments, they forgot to compare them to their other analog—God.

If I sue the government for regulatory takings because ESA critical habitat designation makes my private forest harvest impossible, the government has two responses. They can allow me to harvest, or they can compensate me for the loss of my investment. Nerfing affects investment in a different fashion, almost by striking down the market for the investment good. The effect of a nerf regulation is to fundamentally lower the usefulness of a good or character class. Players still have complete ownership of the good, but the good's relation to all other goods has been changed. Depending on game dynamics, the old owners of the nerfed good could petition to keep the old version, making the change purely prospective. This may work, depending on the quantity of the good, useful lifespan in the game, and inalienability.

As for compensation, developer advocates recoil in horror at the idea of lawsuits and huge payouts for irate nerfed players. In our ESA example, the government gives the logger financial compensation because it is the preferred medium of trade. The logger

could conceivably invest it into a new forest all over again. In fact, the only reason the government doesn't trade the logger another forest is the corresponding complexity of making an equal trade. But that would be the first move they'd make, if they could. Game developers are like unto gods of virtual worlds. They can effortlessly duplicate code and create virtual property. If a sword gets nerfed, the victims can be compensated with virtual property and should be before they receive any dollar payments.

While nerf compensation through virtual possessions presents no cost to developers, it could effect the market value of non-nerfed items. If good X is nerfed, developers could compensate the loss of value by giving players good Y. Those who hold good Y will oppose the handout, and the cost of nerfing is not avoided. However, this is not necessarily the case and could always be thwarted by special rules attached to the new goods. A dramatic increase in good Y will lower its value on in-game or real-world markets, but it may balance out with a price increase from X's devaluation. If the goods are substitutes, the payoff might make a dramatic change but quickly readjust to X's loss in usefulness. In a two-good virtual economy, a holder in Y only will benefit from the income effect of a price drop of X. Secondly, the developers could compensate with good Y'. Y' acts like good Y but has restrictions on alienability. If the value stays with the character and does not spread immediately, the compensation behaves like a takings buyout. The sticking point is that nerfed items are selected because they are overpowered. When the item is an investment of sorts, the property owner may deserve compensation, but should not retain an unfair or imbalanced advantage in the same nature of the nerfed item.

Non-gameplay decisions also have implications for virtual property owners. Pulling the plug on the server would destroy every piece of virtual property in the game. While often used as a virulent objection to a liberal property scheme, it does not necessarily translate to debilitating property destruction. If the players have a large financial interest in the world, then they also have an incentive to keep it going. If an old game began to lose money, the operator could raise the subscription price. If the game stayed in the red and was discontinued, how much could the aggregate virtual property be worth? It seems the argument is built on an augmented labor theory of value. When a competitive game or real life takes players out of game A, we assume that real-market trade for A also declines. With less competition for social rank, in-game resources become less scarce. On a large scale, demand for virtual possessions is destroyed through depopulation, and virtual property values plummet. A world on the brink of collapse is unlikely to have much worth protecting in it. Finally, any virtual property that retains value but is "stuck" in a dying world could be transferred to another world belonging to the same developer, even if the real world if code or art cannot be transferred.

Finally, developers themselves could help adjust players' risk assessment of game closure, nerfing, or potential crashes. If they try to maximize subscription quantity and duration, however, they will not take an action that lessens the present value of gameplay. They might take action if the threat of virtual property lawsuits grows, but even then their warnings will come later than earlier.

All these implications are based on the understanding of economic efficiency in MMORPG given in this project. A starting point for future research is to test the model of player decision-making empirically. The implications of this paper draw short of

recommending a policy option because of the lack of information about the virtual capital signal and overall market volume. A case study, experimental study, or statistical analysis could answer the question of the virtual capital signal. As for the overall goals of playing, rigorous surveys could confirm the goals of play and attitudes toward real-market trade. One additional area to investigate is the agglomeration and value-added benefit from marginal players. Club theory does not provide a clear framework for a multiple-producer club, but MMORPG could spawn an addition.

MMORPG are not as frivolous or harmless as they seem. While they provide a fantasy, the personal investment of millions is very real. That investment has launched online games into a fast-developing sector of the software industry, but it has also led to emergent markets for treasure, magical objects, and dragon-slayers. However, as the internet develops, it may very well begin to look like these virtual worlds. We would do well to pay attention to them and understand the rationale behind their citizens and governors.

Appendix: MMORPG as Club Goods and Superior Copyrights

Apart from considering the effects real-market trade, virtual worlds are interesting from a club good theory perspective. This digression explores the implications of club good theory in regard to MMORPG. They exhibit the excludable, non-rival nature of club goods. That non-rivalrousness extends only so far before congestion affects player enjoyment through lag. Finally, the reliance on developer servers gives these firms a superior copyright that maintains their control over MMORPG as intellectual property.

MMORPG are excludable as long as the operator has a technological monopoly on the game server. Club good theory offers a model for excludable, semi-rival goods such as MMORPG (Buchanan). They act as non-rival at low use rates, but become competitive in use when used more frequently or by a larger population. These goods are similar to public goods except users can be excluded; in the case of MMORPG this process is due to the control developers exhibit over their servers. This rids us of the free-rider problem of pure public goods. A group—at the moment, developers—can provide a good at a cost distributed across all club members, such that each one pays the average cost. MMORPG subscriptions are more than the average cost, but due to the specialized nature of the technology and a market that shows signs of positive economic profit. People will join until the last member's utility of membership is equal to the average price of the good.

Games display varying degrees of rivalrousness. As with most forms of intellectual property, the developed game is non-rivalrous. The dispute arises in regard to the distribution and access of the good. You and I could read *Tropic of Cancer* at the exact same time, but we wouldn't read the same copy. Similarly, we could both play

Lineage II at the same time, but through different ports on the network server. Our access is dependent first on a broadband connection which we are responsible for buying from a third party—another cost of playing online games. The player's client program connects through that connection with the network server and world database. The server updates the world database given non-player programs (physics, mobs, etc) and the actions of every player connected at that time. The mechanics of network servers and the increasing complexity inherent of thousands of connections results in an effective upper limit of population size. How should we consider this in light of rivalrousness?

In a model of developer cost versus number of players with server numbers considered an exogenous factor, marginal cost is determined by the account creation of each additional player. All initial development costs are considered fixed or nil, as an endowment from the development period. The marginal player also requires more technical and customer support, but these marginal costs are constant until servers reach their optimal level. Past that point, costs rise until the servers cannot take on another player. With servers as an exogenous variable, no more players are possible and costs just stop. This model doesn't show the loss of players at beyond-optimal server loads, either. Because the function becomes rather turbid when the marginal player affects the number of players, a congestion model is more appropriate.

MMORPG feature rivalrousness only when accessed by "too many" players. At lower population levels, virtual worlds exhibit very low or no rivalrousness, as the virtual world resembles in many aspects a real-world commons. It follows that that space is subject to the same rules that govern crowding in the real world. In real life, no two people can stand on space X, Y, Z. Most games allow players to run through each other

to combat this, though too many avatars in the same space limits efficient interaction and sorting. At higher populations, some content can be crowded by high numbers of competing players. Cities and staging areas are one thing, but crowded gameplay areas foil the player's enjoyment. One gameplay tool to skirt this issue is the "instance." An instance is a portal from the commons virtual world to an area where only the player and her group are allowed in. Basically, the game creates a copy of a dungeon and its monsters for the player and excludes everyone else from entry.

At a yet higher population, the mechanics of the server itself become congested, causing *lag*. Lag is a reference to the slack of time between the client and server. It can be a problem from poor connection speed, or it can be caused by server bog. Most times, the client will not receive information from the server, even though it is still sending the player's inputs. When the time difference is pulled taut, items, monsters, and other players will instantly jump to their real-time location. Any effects on the player during the time slack will appear to happen at once. In effect, lag could cause a player to inadvertently walk into (or out of) a group of monsters. Damage could accrue without the player being able to react to it. Other problems arise in foreseeable fashion.

For most population ranges, the marginal player does not take away another's enjoyment from playing the game. Furthermore, it stands to reason that the marginal player adds enjoyment to the game through social interaction and grouping. Traffic and congestion are effects of the marginal player. The effect is not to take away the total enjoyment of the game for another player, but a portion of the enjoyment.

The club good nature of MMORPG make them superior to other copyrighted works or intellectual property. While the client application is costless to duplicate, no one

but the developer has access to the server code. Without a server, the easily duplicated client program is worthless. Hollywood studios and publishers would turn green if they realized the ease of an internally enforced copyright. Of course, the server technology must also be able to discriminate between paying and non-paying users, a function best served by security code. Concerns over cheating are likely greater than for non-paying users. A non-paying hacker must develop or find an exploit in the server. If they play very much, they face the possibility of the developer finding them and bringing the hammer down. Griefers—players who seek to harass or annoy other players—may break in to harass others or combine exploits, but are typically content to "grief" through a subscription account.

Even if the server application is duplicated on a compatible physical network, cost factors and overall quality limit rogue servers. For a time, Ultima Online players could find "shards" (UO's term for a server) hosted by individuals for free. These shards were inferior to the subscription worlds, as the host had far less resources to enforce player behavior, server crashes, or game exploits. These problems apply to possible rogue servers for other games. Rogue providers must have some sense of pride to take on the economically inefficient task of providing for freeriders. It is doubtful that they will be able to provide any glitch control or player assistance. Some players will exploit the rogue server and topple the fantastic scarcity. Furthermore, it is even more unlikely that the rogue server will host new content, unless they find a way to continually steal from the developer. Lastly, a free resource will be over-used and congested to no end. Conceivably, a small group of dedicated players could provide their own high-standard server from their own pocket, but it would lack new content and could still be killed by

the copyright holder at any moment. Given all these drawbacks plus the developer's incentive to enforce access to their content, we can safely label MMORPG as intellectual property that has been translated into an excludable good.

The club good nature and superior copyright of MMORPG affect the decisions of developers and players alike through traffic and control of intellectual property. Given enough "clubs" of games, MMORPG subscription costs should decline to the game's average cost. Hourly fees or price discrimination could be used to battle lag, just as road tolls are used in traffic congestion. Finally, other video games and intellectual property may try to duplicate the success of MMORPG in excluding non-paying users.