A cost-benefit analysis of real-money trade in the products of synthetic economies

Edward Castronova

Edward Castronova is an Associate Professor in the Department of Telecommunications, Indiana University, Bloomington, Indiana, USA

Abstract

Purpose – *Macro goals: To alert the telecommunications policy community to the emergence of persistent online worlds as a communications and policy issue. Also to provide game industry decisionmakers with solid economic research on which to base policy decisions. Third, to connect these two communities to each other, for mutual benefit. Micro goals: to conduct a solid cost-benefit analysis of a knotty problem in game economics: what to do about people who break the rules and use real money to buy game items (swords, wands, gold pieces, etc.)*

Design/methodology/approach – *Traditional cost-benefit analysis. Consumer surplus analysis of externality effects, with a parameterized estimate of effects sizes.*

Findings – *Real-money trading acts as a negative externality on the game subscription market. Seems likely to amount to several million dollars per 100,000 users per year.*

Research limitations/implications – *The effects sizes are simulated only. More data from the game industry are needed before one can put a solid dollar estimate on them. Also, much of the material in the paper had to be really elementary in order for the results to make sense for both policy economists and game industry analysts.*

Practical implications – *The analysis indicates a prima facie case for public policy intervention to help shield synthetic worlds from the deleterious effects of the global gold farming industry.*

Originality/value – *Interest in real-money trade in gaming is growing, as indicated by the extent of online discussion by gaming scholars. Despite this, the literature on the economic and policy issues raised by the topic is limited. The article is an original piece of work that takes understanding forward.*

Keywords *Cost benefit analysis, Game theory*

Paper type *Case study*

I. Introduction

This paper provides a basic welfare analysis of a new market that has emerged on the internet. Beginning in about 1987, players of ''MMORPGs'' – massively multiplayer online games, hereafter referred to as synthetic worlds – began to trade items from the games in return for real money[1]. Driven by rapid growth in the online games sector of the entertainment industry, such activity has grown to the point that by 2005, the global level of this real-money trade or RMT exceeds $100m annually and may be many times larger[2]. As RMT has become an integral part of the online gaming experience, it has become controversial. What is innocent person-to-person trading to some is a noxious disruption of the game to others; an otherwise-innocent trade of Boardwalk from Smith to Jones for $US50 can ruin the playing of Monopoly for Miller and Collins, who were not party to the trade but lose the game because of it. The purpose of the paper is to analyze and quantify the potential external damages of RMT within the current online game market.

To understand why the RMT market exists at all, consider the following example. Suppose in a certain game world, a certain key were needed to open the door to a certain dungeon. A dollar-denominated demand for this key might exist because the dungeon might get players involved in some kind of fun activity (dragon-slaying, exploring, solving fun puzzles, or

DOI 10.1108/14636690610707482

acquiring items that look cool on their game characters). The demand would be downward sloping, as usual, because whatever fun the dungeon might provide, players would be more likely to buy the key if the dollar price were lower. A supply curve for the key might exist in dollars too, if the key were scarce. For example, the designers of the game might make the key available only to players who solve a certain puzzle or slay a certain powerful dragon. Or perhaps the key is a ''found'' object in the game, something that appears randomly on the ground but only rarely. Or perhaps the key must be crafted by the players, put together from a difficult recipe that requires the collection of obscure materials from all over the world. In any of these cases, it might take players quite a bit of time, or effort, or ingenuity, or collective action, to produce the key. Any of these factors are sufficient to make these keys scarce, in the sense that it requires scarce resources or talent to produce them. Those resources and talents have values expressed in dollars. Thus there is a dollar-denominated marginal cost to key production, and it slopes upward. Supply slopes up, demand slopes down, and if the curves cross in the positive price-quantity quadrant, a market equilibrium will exist with a positive dollar price. While such markets have existed since 1987, they first became substantial in the late 1990s with games like *Ultima Online* and *EverQuest*, and the first scholarly treatment of them came in late 2001 (Castronova, 2001).

Two aspects of these real-money trade/RMT markets deserve special notice. First, it might seem strange that people are paying real money for what are ostensibly fantasy goods. Some might say the dungeon key above is not ''real'' but rather is part of a fantasy world, so it cannot have a value denominated in dollars. But economics does not recognize any distinction between the ''realness'' or ''fantasy'' of a good when analyzing its equilibrium price in a market. All that matters is that the good is alienable, excludable, rivalrous, and so on. The good ''sex.com'' only has meaning in a large virtual environment called the internet, yet it has positive economic value. Moreover, a dollar-based market price for it doubtlessly exists, and the good itself is doubtlessly worth whatever that price implies. Now consider an analogous good, ''harvard.edu''. It also has economic value, for the same reasons that sex.com does. Unlike sex.com, though, harvard.edu is unlikely to be traded anywhere, and thus its economic value is only implicit. While implicit, though, the point is that the economic value is unquestionably there. By the same arguments, a magic wand or a gold piece that is observed to be traded in a dollar-denominated market unquestionably has economic value, despite being part of a ''fantasy world''. And not only that, but all the wands and gold pieces that are not traded, but remain forever within the ''fantasy'' world, also have economic value[3]. Thus while it may seem strange to discuss the application of welfare analysis in an environment that is ''only a game'', in fact, the label ''game'' properly has no meaning as far as economics is concerned. Economics sees value wherever humans decide that some construct of theirs has utility but is scarce. Synthetic world goods have utility and are scarce; thus they have value that can be measured in terms of real dollars.

The second thing worth noting is that the amount of this trade was already substantial in 2001 and has grown rapidly. According to what little information we have, the global amount of RMT, considering trade from all synthetic worlds together, is at least $100 million annually, and industry insiders claim that it is much more than that, well over $1 billion[4]. These figures are not as incredible as they might seem. There are perhaps as many as 20 million people playing these games today; if each one were to spend $50 annually on in-game items, the total would indeed be $1 billion. And on any given day, anyone can directly observe thousands of thousands of auctions for in-game items at sites like eBay. Category 1654 of eBay in the US, for example, is devoted entirely to trade in internet game items. The typical auction is for game currencies; by buying these gold pieces, players can then use them the in-game economy to obtain the items they want. The transaction happens just the way any other eBay transaction happens:

- The buyer wins the auction and sends the seller a check in terms of dollars.
- The seller takes the check to his bank.
- His bank requests the dollars from the buyer's bank.
- The buyer's bank transfers the dollars to the seller's bank account.

- The seller then ‘‘ships’’ the gold pieces to the buyer.
- The seller loads his character in the game and puts the gold pieces in that character’s inventory.
- The buyer loads his character in the game and sends the seller a message telling him where he is.
- The seller travels through the synthetic world to the buyer’s location.
- The seller and buyer open in the in-game trading interface that allows any two players to exchange items.
- The seller offers to ‘‘trade’’ the gold pieces in return for nothing from the buyer.

They complete the exchange, and close the trade interface; the gold pieces are routed to the inventory of the buyer’s character.

While one might see several points at which the exchange is susceptible to fraud, it is no more susceptible to it than similar exchanges would be for baby dolls and used cars, both of which have successful and largely fraud-free markets on eBay. eBay has a reputation system that has made it the most successful market in human history, with billions of dollars in trade every year. And thus it can be concluded that the RMT auctions one sees on eBay reflect accurately the true market value of the gold pieces being traded. Through these gold piece auctions, one can observe a vibrant foreign-exchange market between game currencies and the dollar. The exchange rate can be tracked; it can also be used, as is done in international comparative research on Earth economies, to put dollar values on the in-game economies (Castronova, 2001). It is in any case a substantial, robust market.

As RMT has emerged and grown, it has spawned discussion among industry experts, academics, and game designers about whether it has a net negative or positive impact on the games themselves[5]. From the standpoint of welfare analysis, one’s initial position must be that the emergence of this market, like any other, must have positive implications for welfare. If supply and demand for item exist and intersect in the positive price-quantity quadrant, the market creates net consumer and producer surplus and hence raises welfare. If some players are relatively well-endowed with gold pieces while others are relatively well-endowed with dollars, then the exchange of gold pieces for dollars raises well-being for both. In practical terms, this is often what drives the market. Some players have a lot of time and little (dollar) money; others have a lot of dollar money and little time. The former use their time to acquire items and powers which they transmute to gold pieces using the in-game economy. The latter bypass these time barriers by using their relatively rich stock of dollars to buy gold pieces, so that they can then acquire the desired game items and powers right away. The time-abundant receive money for their gameplay time, which raises their effective wage rate. The time-scarce are able to use real money to get around in-game hurdles, and so are able to experience the best parts of the game for less time cost. Absent any market failures, then, RMT must raise overall social well being.

There is, however, a failure in the RMT market, because some welfare effects of the trade fall on others. To see this clearly, imagine playing a game like Monopoly where two of the other players engage in a side deal using their real dollars. Player A is losing to Player C, but owns Park Place. Player B is also losing but owns Boardwalk. A pays B $US50 for Boardwalk; with this monopoly, A wins the game. Doubtless, A and B are better off – A now wins the game, and B, who was losing anyway, has $US50. Yet players C and D, who were not party to the transaction, are worse off. First, Player C would have won had the trade not happened. Second, and both C and D experienced a degradation in the nature of the game itself; it became less fun. This loss of fun, more broadly, can be seen as an externally-imposed disturbance of the game, a perturbation away from the gameplay as intended by the designers. The costs are borne both by users, who get less utility from the product, and by the designers, who realize fewer revenues from the sales of games. In this, RMT is like a pollution of a service that the designers are attempting to provide to their customers. Such uncompensated interdependencies can be clearly recognized as market failures potentially worthy of some sort of policy response[6].

The direction of any such policy can be illustrated with an example. Suppose the bees from my commercial flower-growing operation keep flying over to my neighbor's pastry restaurant, driving away his customers. According to the economics of externalities, the price of my flowers does not reflect the social costs they impose, specifically my neighbor's costs in lost revenue from customers annoyed by pesky bees. The price of flowers is too low, and the sales volume of flowers is too high. Good policy will seek to restrict the sales volume of flowers, ideally by raising the price of flowers so that it matches the true social cost of flower production.

By analogous argument, we can say that the price of gold pieces does not reflect the social costs of RMT. It reflects only the cost of providing gold pieces to the market, and not the cost that comes from RMT's negative effects on the game experience[7]. Because of this externality, the sales volume of gold pieces is too high from the standpoint of social optimality.

The purpose of this paper is to analyze the welfare economics of RMT and identify the surplus areas associated with the RMT market and the externalities it creates. These issues are potentially of interest to a hybrid audience: economists interested in new markets emerging in cyberspace, and game industry experts interested in the economic analysis of RMT. Because these two populations know very little about one another's business, it will at times be necessary to go over material that will seem very elementary to one or the other. Thus, the preceding introduction covers material already well-known within the game industry, but not yet understood by most economists. Similarly, Sections II and III of the paper will provide first-principles market analyses that are at a quite fundamental level for economists, but not for game industry experts. The goal is to bring both economists and game industry experts to an understanding of what the RMT market is, how it operates, and what effects it may have.

Section II describes the elements of the subscriptions market: the market for access to these synthetic world games. Section III then describes a simplified gold market, the RMT market itself, and illustrates in the abstract what the welfare effects of RMT are. Section IV uses current information from these markets to make a rough estimate of the external costs of RMT, that will hopefully be of interest to both populations. Section V concludes.

II. The subscriptions market

Synthetic worlds are built at some cost by the developers; then users are invited to access the world in return for a monthly subscription fee. For most games, users who want to enter a world must first buy client software, which typically goes for prices comparable to other PC software titles; most game clients can be purchased for $20-$30 a few months after release. Players then load this client on their home machine and use it to connect to the service. The service then usually signs them up for a free month, after which subscription fees are assessed to their credit cards monthly. At intervals, the company may develop and release ''expansion packs'' which also must be purchased separately. If we amortize these periodic one-time costs, we can view the market for these online games as basically a market for monthly access, at the cost of a monthly subscription. Producers rely on the quasi-rent (i.e. producer surplus) from the monthly subscription market to cover their fixed costs from building the world initially. Fixed costs include payments on debts and loans, and returns distributed to investors and publishers. Assuming a perfectly competitive industry, the fixed development cost will be exactly covered by the discounted present value of the stream of monthly quasi-rents in the subscription market[8].

In practice, development costs can range from as low as $2m-$5m to as much as a major Hollywood film, over $100m. Monthly subscriptions, along with the amortized costs of software upgrades, are typically $10-$15. Thus profitability for firms in the synthetic world industry depend critically on attracting and securing a large number of subscribers. At $15 per person, a world developed at a cost of $50m needs to maintain a player base of 278,000 users for an entire year, just to break even, assuming zero operation costs. Yet ongoing operations costs, while much less than development, are themselves substantial. A primary cost is customer service; maintaining order and civility in a space being used in common by

278,000 strangers is a difficult job and requires a specialized, expensive labor force. Additional operations costs include bandwidth, server maintenance and repair, bug fixing (''patches''), and new content development. These costs, of course, only increase the number of subscribers needed to cover the development cost. On the whole, under the current business model, the profitability of most synthetic worlds seems to depend quite critically on the flow of subscriptions. Any decisions that game companies make will have their main effect on subscriptions in the short run, so this market represents the immediate choice environment for the companies.

For users, similarly, the subscription market is the immediate marginal choice environment. Once we amortize the one-time cost of client software, the decision that most players face in the short run is simply whether to continue playing the game for another month, given the subscription cost. If we adopt a short run analysis (with the number of games fixed), we can capture the welfare effects of small policy changes in the subscription market by looking at consumer and producer surplus there.

Figure 1 illustrates the subscription market in the abstract. There is no evidence of price controls, quantity controls, or non-competitive practices in this market (even though some quite large firms participate, such as Sony). Hence the basic competitive supply and demand model should be applied as a start. Supply is upward sloping because the marginal cost of operating games, involving things like bandwidth, rises as the number of subscribers rises. Demand is downward sloping for the usual reasons. The equilibrium price and quantity of subscriptions are indicated by P_s and Q_s, respectively.

In terms of welfare, we will follow established practice in applied welfare economics and estimate well-being using the concept of surplus, by which one identifies well-being with areas on supply-demand graphs like that in Figure 1[9]. Accordingly, the region ABC in the graph is the total value of online games to society, while region C is the total cost. The surplus earned by users is the region A, the value of games to them that is above and beyond the price they paid for access. The surplus earned by producers is the region B, the difference between the subscription price they were able to charge and the marginal cost of providing the service in the short run. Region B is the quasi-rent from running the world; overall profitability of the synthetic world requires that the stream of monthly region B values must be sufficient in present discounted value to cover the initial costs of world development.

III. The gold market

As described in the introduction, the existence of scarcities in online games has generated a market among players, where one player trades game items to another player in return for dollars. Because the vast majority of this trading is in terms of game currencies, usually gold pieces, we can usefully approximate the welfare consequences of all RMT by analyzing a market for virtual gold. Such a market is depicted in Figure 2.

Figure 1 Subscription market

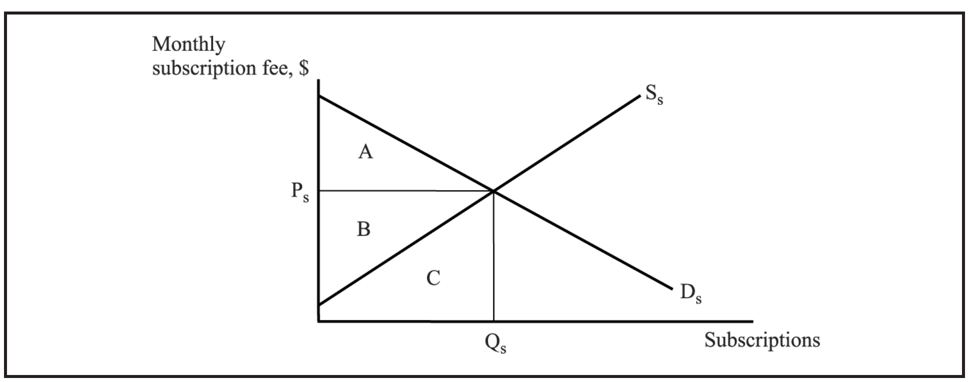
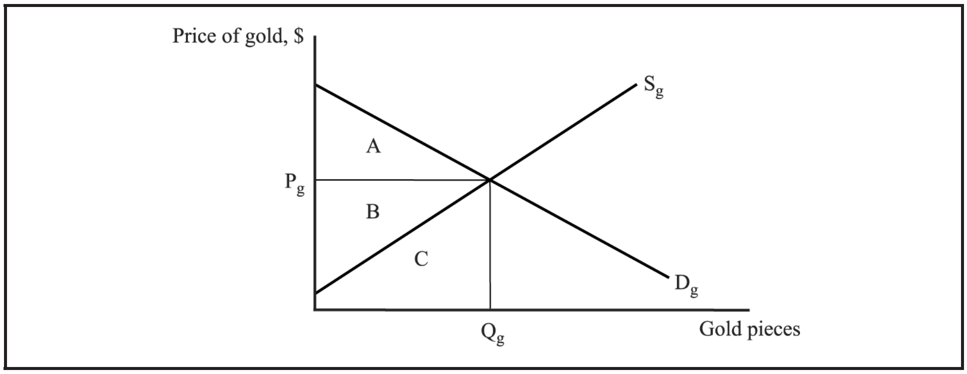


Figure 2 Gold market



Again, though some large firms participate in this market, their activity is not obviously anti-competitive enough to invalidate using the competitive model as an initial approach to market analysis. For reasons described in the introduction, we expect the supply and demand curves to have the usual slope. The existence of the equilibrium price (P_g) and quantity (Q_g) of gold pieces sold per month follows from these slopes and the assumption of competition. The price P_g should be thought of as the exchange rate between game currency and the dollar.

So far, the welfare consequences of the gold market are as follows: The total value of the gold market to society is area ABC. Area A is the consumer surplus, the value of gold to the buyers above and beyond the price that they paid for it. Area B is the producer surplus, the profit on ongoing gold sales. Area C is the short-run operating cost of providing gold, the total variable cost.

However, the welfare analysis is incomplete thus far, in that the gold market degrades gameplay for players who do not participate in it. Anecdotal evidence suggests that while about one-third of the player base pursues RMT as part of their game play, just as many players actively desire that RMT be curtailed or completely eliminated[10]. Players who want RMT to be restricted usually put forth a single reason for their opposition (although there are others, which we will discuss in a moment). The main reason cited is that RMT disturbs the game's atmosphere; it is said to be ''wrong'' and ''against the rules''. These opinions probably stem from the idea that because these are fantasy worlds, real-world money ought not to play a role in how people do in them. From a broader perspective, we might conjecture that the quality of the service that a game provides depends on intangible factors like ''feel'' and ''immersion'', and these intangibles are damaged by the intrusion of real-world money and monetary considerations. Generally, the utility of a game world derives from the fact that it is a game world, and not the real world. When real-world money begins to affect the game world, the utility of the game world *qua* game world is reduced. Hence the service being provided is damaged. To use a metaphor, dreams are punctured when the sleeper is awakened. Here, dreams are being provided for a price, by a for-profit company. Acts that poison the dream with real-world troubles are damaging in an economic sense to both the sleeper and the dream-maker.

There is considerable debate among players as to whether the effects of RMT significantly degrade the game experience of all players. One argument holds that the real-money trade between two players is something of a hidden act, one that can have very little impact on the game experience of others. This argument seems reasonable on its face. At small levels, RMT probably bothers no one. If a player gives a friend 100 gold pieces for $5 so that he can get started in the game, or if a student sells his account so he can buy textbooks, there would not be a significant negative effect on the dreamworld of others. As with many pollutants, RMT can be absorbed by the game atmosphere so long as it remains a minor irritant.

Problems begin to arise when the volume of a pollutant gets so large that it changes the atmosphere. With RMT, direct observation suggests that it has reached a sufficient scale to change the atmosphere of a game[11]. In most games today, for example, one cannot visit a fan site related to the game without seeing multiple banner ads for gold sales, and all casual conversation about the game, both inside and out, presumes that gold sales are a way of life. It has become normal within the culture of most games that there is a subgame involving commercial transactions with third parties. At such levels of presence, it may seem normal to most new players that one uses RMT in order to advance in the game. Rather than appearing to be a violation of the rules of the game – which it is, under the terms of service – RMT appears to be a normal part of game play. At large scales, RMT changes what the game *is*, and damages the game experience generally[12].

To accurately assess these damages, though, we must be careful to keep in mind the proper counterfactual: a game without RMT. This counterfactual is one that will be hard for most players to construct in their minds. The vast majority of players have never experienced what their game worlds would be like without RMT, and this throws some doubt about the validity of industry assessment that ''only'' one-third of players object to the presence of RMT in their games. In the literature on welfare economics, this kind of casual hypothetical survey has been roundly dismissed as a valid way of measuring welfare consequences. Freeman's welfare measurement text (1993, Chapter 6), for example, stresses the importance of carefully specifying hypothetical policies and all their effects, including benefits and costs that the respondent may not have known about. To cite just one informational problem, it seems unlikely that most players realize that the inflation in their games (see below) may be accelerated by RMT. Another problem would be the fact that a survey of current players will not include responses from those who have left the game because of gold farming and its effects. On the whole, it seems that while one-third of current players may express dissatisfaction with RMT, more than one-third would actually have a better game experience were RMT curtailed.

RMT's effect on the game experience generally is the main reason cited for opposing it, but the practice has other damaging effects as well: RMT has a direct effect on important game mechanisms. First, there is reason to believe that gold sales accelerate the forces of inflation in the game world. It is not clear that inflation is as much of a problem in synthetic worlds as it is in the real world, but it in any case it is certainly disruptive to some degree to the economic planning and management activities of the players and the developers alike. Games are designed so that the currency enters by a number of ''faucets'' and then leaves by a number of ''drains''. If the inflow greatly exceeds the outflow, inflation will occur. One of the primary drains is the exit of players: when a player quits and cancels his account, his gold is effectively destroyed and removed from the system. If instead he sells this gold before quitting, it stays in the system. By partially plugging this money drain, gold sales may accelerate inflation.

Second, gold sales encourage misuse of the game's resources. It is not uncommon within games now to encounter and be harassed by ''gold farmers'' – low-wage workers who have been hired to obtain gold from the system by for-profit businesses established for just this purpose. Gold farms are typically organized either as sweatshops are as cottage industries. In sweatshop organization, a company fills a large workspace with computers that have access accounts to a game. Workers are hired to play the game and are given a quota of gold pieces to earn during their shift. In most games, it is possible to discover more or less rote formulas for obtaining the currency, such as the following fictional, yet typical, gold-farming system:

- In the Brown County region of the game *World of Hoosiers*, one can find many Angry Bears.
- Each bear, when killed, yields 20 silver pieces and the item ''Rough Bear Fur''.
- When a bear is killed, the system replaces it with a new bear[13].
- The merchant Aimee Boggins in the village of Smithville buys Rough Bear Fur in unlimited quantities for 5 silver each.

- Therefore each bear kill is worth 25 silver.
- Therefore 4 Angry Bear kills makes a gold (100S = 1G).
- It takes 30 seconds for a character to kill an Angry Bear.
- A worker can kill 120 bears per hour, earning 30 gold.
- 30 Gold can be sold for $8 on eBay.
- Workers can be hired in a certain country for $1 per hour.

Company profits are $7 per hour per worker, minus hardware and software costs, internet access fees, taxes, and auction sales fees.

In cottage industry organization, conversely, companies do not establish and maintain gold-farming sweatshops. Instead, they leave individual players to do the gold farming on their own, and only provide delivery services. The gold farming players sell gold to the company by using the company's website, and the company then immediately picks up the gold from the player in-game. The company sells the gold on its website at a much higher price to gold-buying players, and again agrees to deliver the gold immediately in-game. By providing immediately delivery services in-game and immediate payment services on its website, a cottage industry company can impose a significant buy-sell spread on its gold. The buy-sell spread generates the company's profit margin.

Whether through sweatshops or cottage industry operations, the gold farming industry has become directly involved in the play of the game. Anecdotal evidence suggests that the most resource-rich areas of several games have effectively been seized by gold-farming players[14]. Regular players who attempt to enter the area are harassed and, if the game code allows it, killed. Gold delivery operations create a significant system resource load, such that certain heavily-trafficked areas can become impossible for regular players to navigate. When large number of game characters congregate (which face-to-face delivery operations require), video performance and server-to-client communication performance seriously degrade for all players in the area. Framerates can drop to zero, and client-server connections can simply self-terminate, booting the player from the world. Since gold delivery operations will be most efficient if they are centered on places where players congregate anyway, they tend to set up in, and hence overload, areas that are of most use to players, such as nodes for transportation, storage, mailing systems, and group formation. By degrading the ability of players to efficiently use these areas, and by occupying resource-rich regions of the virtual territory, gold farming operations have a direct impact on player experience of important game mechanisms.

The gold farming industry also interferes with the game's communications systems, because it can use in-game communication channels to advertise. Here is the text of a message received by the author on December 6, 2005, in the game *World of Warcraft*:

> Adifdkd whispers: Hi, pls visit www.itembay.ca The low Price: $8.99 = 100G, $16.99 = 200G $40.99 = 500G $75.99 = 1000G. First Come, First Serve.

The message is a ''whisper'', a direct person-to-person message. It is an ad for a gold-selling site based in Canada, offering 100 gold pieces for $US8.99, an exchange rate of 11 gold to the dollar (the Yen is about 120 to the dollar). It is from a character named Adifdkd (probably randomly generated), who in all likelihood had been created a few moments before on a temporary account. A software program had been written that caused the character to search the world for active characters of other users, and then send them this message. Thus, the character Adifdkd was effectively an ad-spamming robot. It almost goes without saying that such junk messaging can be a serious problem in digital communication systems. It is also an egregious violation of the fantasy atmosphere the game is designed (and advertised) to reproduce.

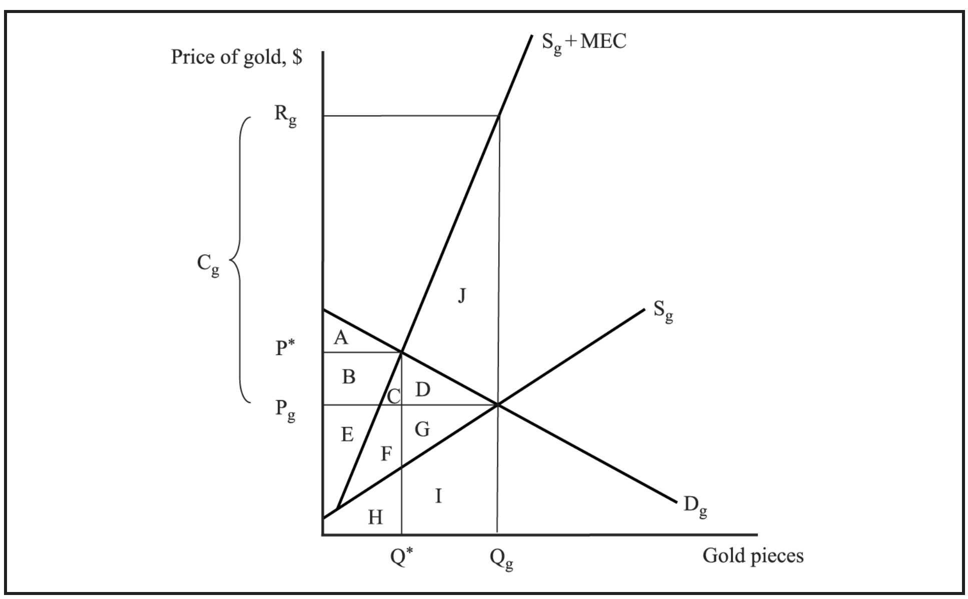
While the preceding four effects fall primarily on players, a fifth effect of large-scale RMT is customer service. Industry representatives report that a significant portion of their customer service costs are related to RMT and its effects. Although the trade is technically against the rules, players feel that the game company is the court of last resort for RMT-related disputes[15]. In addition, gold-farming creates direct in-game conflict between the farmers and regular users, and in-game conflicts often result in customer service calls. Policing the use of communications channels for advertising is also a customer service cost burden. The game company must devote resources to determining whether such-and-such an activity at such-and-such a time was legitimate use of geographic or communication space, or was rather gold farming or ad-spamming. In all, RMT seems to add significantly to customer service costs.

These five effects suggest that RMT produces tangible external welfare losses on two groups: it reduces the value of the game to players; and it increases the developer's cost of providing the game. Considering both the anecdotal evidence and the preceding conceptual discussion, it is reasonable to assume that the RMT externality has the following features:

- At low levels of RMT, the externality is $0.
- At current levels of RMT, the externality is substantial.
- The incidence of the externality falls partly on current game players and partly on game developers.
- For current game players, the externality can be measured as the decline in the value of the game to them, relative to a hypothetical counterfactual game in which RMT did not happen.
- RMT disrupts the game's fantasy atmosphere.
- RMT causes inflation.
- RMT induces gold farmers to occupy territory and system resources.
- RMT induces gold farmers to appropriate game communications systems for advertisement.
- For developers, the externality can be measured as an increase in service provision costs, relative to the costs of a hypothetical counterfactual game in which RMT did not happen.

Figure 3 illustrates the resulting pattern for the external costs of RMT trade. The curve labeled "S_g + MEC" is the true social cost of the selling of gold pieces. It includes the marginal cost of operating gold-selling firms (S_g), plus the external cost of gold sales on

Figure 3 Gold market with RMT externality



others (MEC). At the current equilibrium quantity Q_g, the total marginal social cost of selling gold is R_g, which equals the marginal private cost to gold-selling firm (P_g) plus the marginal external cost imposed on other players and the game company (C_g).

At the status quo equilibrium, (P_g, Q_g), welfare effects are as follows:

- gold-buying game players receive consumer surplus of ABCD;
- gold sellers receive producer surplus EFG; and
- the external cost imposed by gold sales is CDFGJ.

Net social benefit of the industry is (ABCD) + (EFG) − CDFGJ = ABE − J

The analysis indicates that gold sales are occurring at a level higher than socially optimal. If gold sales were constrained to the level of Q^*, market forces would drive the price up to P^*. Gold selling would not be eliminated, but rather reduced. This is a consequence of counting not just the costs that RMT imposes on regular players, but also the benefits it creates for gold buyers and sellers. The analysis in the diagram takes the well being of all parties into consideration, and suggests that the optimal level of RMT from a social perspective is Q^*, less than Q_g. If gold sales were indeed reduced to this level, the following welfare effects would obtain:

- consumer surplus would be A; gold-buying players lose BCD;
- producer surplus would be BCEF; gold-sellers lose G but gain BC;
- external costs would be CF; external costs fall by DGJ; and
- net social benefits would be A + BCEF − CF = ABE; an increase of J.

Looking at this from a broad social perspective, the controls on gold sales end up raising the price, transferring BC from gold buyers to gold farmers. Setting aside this transfer, there are surplus losses, D for buyers and G for farmers. However, from a social perspective, both of these are compensated by equivalent declines (D and G) in the external cost of RMT. Thus the net social effect is that society gains J: a gain from reducing the external cost of RMT that is not offset by any losses elsewhere.

Another relevant way to interpret the diagram is to focus not on social effects as a whole but on the groups that bear the changes. When RMT is controlled, the players who engage in RMT as buyers lose BCD. The gold sellers lose G but gain BC. And the players who do not engage in RMT gain the area DGJ. Thus, among those who engage in RMT as buyers or sellers, total losses from the restriction of gold sales are DG, while the gains for those who do not engage in RMT are DGJ. It follows that restricting gold sales takes DG from the gold farming industry and gives DGJ to the regular players. It is a transfer that gives more to those who gain than it takes away from those who lose. Public policy generally looks on such transfers positively because they increase the overall amount of material well-being (the gains are greater than the losses). Furthermore, the merits of the two groups would also need to be taken into account. With RMT, the fact that gold buyers and sellers are receiving their economic surplus in contravention of the game's terms of service might be a relevant consideration. Not only would a reduction in the gold market create more benefits than costs; it would impose the costs on rule-breakers and deliver the benefits to rule-followers. On grounds of both benefit-cost analysis and merit analysis, some restrictions on the gold market seem warranted.

IV. Estimates of the external cost

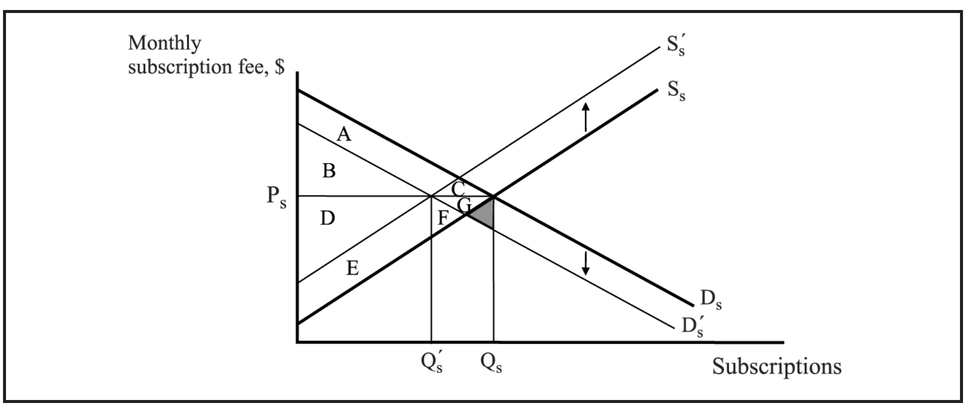
Section III provided an analytical assessment that a reduction of RMT from current levels would generate benefits for ordinary game players that would exceed the costs for gold sellers and buyers. Still, it does not follow that these welfare effects would be significant in a practical sense. To estimate the rough size of these external effects, a thought experiment will be useful. The past eight years have seen a steady growth in the extent of real-money trade and its impact on these fantasy gaming worlds. Suppose we are in a situation where we anticipate a further one percent growth in RMT from its current levels. How much additional social cost will be produced? By moving from the global analysis of Section III to a marginal one, we can take advantage of common sense assumptions about the response of consumers and producers to changes in market conditions. Using these assumptions, we can generate some baseline estimates of marginal changes in the externality from marginal changes in RMT. Then we can vary the assumptions to see how sensitive these rough estimates are to the assumptions.

The thought experiment, then, is that RMT rises by 1 percent from its current level. This increase will lower the value of the game for regular players, and raise the costs of providing the game for the game's owners. Each of these effects can be depicted in the subscription market (Figure 1). Figure 4 illustrates.

When RMT decreases the value of the game for regular players, their willingness to pay for a subscription falls. A decline in willingness to pay for a good is the same thing as a vertical decline in the good's demand, depicted here as a drop from D_S to D'_S[16]. When RMT imposes additional costs on game providers, their marginal costs rise. A rise in the overall marginal cost of production is the same thing as a vertical increase in the supply curve, depicted here as a rise from S_S to S'_S. Both effects will reduce the quantity of subscriptions, which now fall to Q'_S. But since the demand effect lowers market price, while the supply effect raises it, we cannot predict how prices will change. As a baseline, the diagram is drawn under the assumption that subscription prices remain unchanged; the demand effect cancels the supply effect[17].

The impact of the marginal RMT increase on the well-being of regular players can here be seen as a loss in consumer surplus, in the amount AC. Its effect on production costs is visible here as the loss in producer surplus, in the amount EFG. It would be an overestimate, but one could approximate the consumer surplus loss as the decline in willingness to pay (the vertical shift in demand) times the current number of subscribers Q_S. Similarly, a near overestimate of the producer surplus loss would be the number of subscribers times the increase in provision costs (the vertical shift in supply). While these are both overestimates of the effects, the overage will be negligible for small changes to the system. To see this, note that the grey triangle on the diagram is the amount of overestimate implied for consumer surplus. When Q_S is very large relative to Q_S-Q'_S, the area of this triangle will be negligible relative to the area A, which is the lion's share of the proposed consumer surplus loss estimate. We know that Q_S is numbered in the millions, yet because the demand and supply shifts under consideration are fractions of a cent (as will be seen below), we would not expect the resulting changes in the quantity of subscriptions to approach 1 million or more. Thus it is safe to assume that the gray triangle (and its analog on the supply side) is negligible in practice. Correspondingly, we will proceed by estimating consumer and surplus loss as the change in demand and supply, respectively, times the current subscriber base. Adding these two costs produces an estimate of the marginal external cost, or MEC, of RMT: this is the change in total external costs caused by a 1 percent increase in RMT.

Figure 4 Subscription market with marginal RMT effects



To move from this marginal effect to an estimate of the total external costs of RMT, we need to make some assumptions about how the subscription market responds to RMT. There are two critical responsiveness parameters. The first is the *RMT elasticity of subscriptions*, denoted e_{rs}, defined as the percentage change in subscription demand and supply in response to a given percentage change in RMT. If $e_{rs} = 0.2$, then a 10 percent increase in RMT causes a 2 percent decrease in players' willingness to pay (demand) for game subscriptions and a 2 percent increase in the developers' marginal cost (supply) of subscriptions. In principal one would want to separate the response of subscription demand to RMT from the response of supply, but given that we have no credible information on which to base any such distinctions, the only reasonable initial assumption is that both curves are roughly equally responsive to RMT changes. The response of both supply and demand with thus be captured in the parameter e_{rs}.

The second critical parameter is the same responsiveness concept applied to the total external cost; e_{rc} is the *RMT elasticity of total external costs*, defined as the percentage change in the total external costs of RMT in response to a given percent change in RMT levels. Thus if gold sales rise by 10 percent in a given year, and $e_{rc} = 2.0$, it follows that the total external cost of those sales rose by 20 percent.

We have no estimates of these response parameters as such, but their definitions make them amenable to intuitive, common-sense reasoning. For example, it might seem a reasonable first approach to assume that e_{rc} is about 1.0, while e_{rs} is lower than that. In words, this would be to assume that the external costs of RMT rise at about the same rate as RMT itself does; if RMT doubles, its costs double. Such a value for e_{rc} makes intuitive sense. At the same time, we would not find it intuitively sensible to assume e_{rs} is 1.0, for this would be to expect a doubling of RMT to halve the demand for game subscriptions and double the marginal costs of providing games. Those effects are probably too large; while RMT certainly has some effect on the subscription market, the effect is probably not that strong. By this kind of reasoning, the reader can look over various calculations and determine which seem most sensible.

With these responsiveness parameters, we are now in a position to calculate the effect of a 1 percent increase in RMT on RMT's external costs. Let's assume, to begin with, that $e_{rs} = 0.05$. This would imply that a 1 percent increase in gold sales would reduce subscription demand and increase subscription supply by one-twentieth of a percent. Currently, the typical subscription fee for a large online game is about $15 per month. Since this is the current equilibrium price in the market (P_S), it indicates both the willingness to pay of the marginal subscriber, as well as the marginal cost of supplying the marginal subscription to him. A 0.05 percent decline in demand can therefore be quantified at the currently equilibrium as a shift of $(-0.0005) \times (15) = -0.0075$, or three quarters of a cent. Similarly, a 0.05 percent increase in supply at the equilibrium becomes $(0.0005) \times (15) = 0.0075$. Although they are small, marginal effects in this magnitude – i.e. a three quarter penny decrease in the willingness to pay for the game, and a similar increase in customer service cost per customer – seem reasonable as a minor market response to a minor increase in gold farming and sales.

To estimate consumer and producer surplus losses in the subscription market, we would multiply these shift amounts times the total number of subscribers. For sake of simplifying analysis, we will restrict attention to the US. One US game, *World of Warcraft* has several million subscribers all by itself, though many of those subscribers are in Asia and Europe. There are several other US games with 200,000-500,000 subscribers, so an estimate of 5 million US subscribers would be reasonably conservative. Thus a rough estimate of annual consumer surplus losses from a 1 percent increase in RMT would be:

$$(5\,\text{million subscribers}) \times (\$0.0075\,\text{cost per month}) \times (12\,\text{months}) = \$450,000$$

Similarly, a rough estimate of annual producer surplus losses would be:

$$(5\,\text{million subscribers}) \times (\$0.0075\,\text{cost per month}) \times (12\,\text{months}) = \$450,000$$

Adding these two, we can estimate that a one percent increase in the gold farming industry from current levels would impose an additional $900,000 in costs annually on regular players and the companies that produce the games. This would be the *marginal external cost* of RMT – the change in total external costs from a 1 percent change in RMT. Under these assumptions, the MEC is $900,000.

Now we move from the marginal external cost to an implied estimate of total external cost at current levels of RMT. For this we use the second responsiveness parameter, e_{rc}. If we make the sensible assumption that each percentage increase in RMT causes an equal percent increase in RMT's costs, we will be giving e_{rc} the value 1.0. For this exercise, we have assumed that RMT increases by 1 percent, and we found that its costs increase by $900,000. With $e_{rc} = 1.0$, it follows that $900,000 must amount to 1 percent of the total external cost. Thus, the total external cost of RMT comes to $90 million. With 5m subscribers, this implies about $18 in external costs per user, per year, or about $1.50 per user, per month. In other words, this baseline finds that RMT causes each subscriber to view the game as 75 cents less valuable on a monthly basis, while customer service costs are 75 cents higher, so that the total cost of RMT on a per user, per month basis are $1.50. A game with 100,000 subscribers would bear $1.8m annually external costs as a result of RMT.

Having provided an illustrative calculation above, we can now show how these figures are affected by the assumed parameters. Table I shows how the estimates of external RMT costs depend on the two response parameters, e_{rs} and e_{rc}.

The scenarios show that a wide range of cost estimates is possible, and that they do depend on the assumed responsiveness parameters. If we include the most extreme assumptions, annual RMT costs range from $100,000 to $29 million per 100,000 users. The smallest number comes from assuming that a 1 percent increase in RMT has only a one-hundredth of a percent effect on the subscription market, even though RMT's costs go up five times as rapidly as RMT does. On the other hand, the largest number comes from assuming that each percent increase in RMT has a one-fifth percent impact on the subscriptions market, though it only increases the costs of RMT by one-quarter of one percent. It seems unreasonable to assume, as in this last case, that RMT growth has a small effect on the associated external costs while having a large effect on the subscription market. The opposite assumption pair, from the previous case, also seems implausible; a huge cost effect ought not to have a tiny subscription effect. As we move toward the middle of the table, the assumptions are not quite so implausible; RMT's costs go up at a reasonable pace relative to the overall amount of RMT growth, and RMT has a reasonably moderate impact on the subscription market. Under assumptions like these, the estimated annual cost of RMT ranges from $400,000 to $7.2 million per 100,000 users. These figures, while still a wide range, are probably an accurate assessment of the range of actual external costs of RMT. The baseline estimate of $1.8 million per 100,000 users is the result of choosing mid-range assumptions.

To put this figure in perspective, return to Figure 3. What we have just estimated is the total externality cost of RMT under current conditions. This is the area CDFGJ in the figure. A comprehensive welfare analysis of the gold market would require estimates of the consumer and producer surplus effects, that is, the benefits that accrue to buyers and sellers of gold.

Table I Sensitivity of external cost estimates to variations in responsiveness parameters

			e_{rs}		
e_{rc}	*Almost no response (0.01)*	*Small response (0.02)*	*Baseline response (0.05)*	*One-tenth response (0.1)*	*One-fifth response (0.2)*
Very small response (0.25)	1.4	2.9	7.2	14.4	28.8
Small response (0.50)	0.7	1.4	3.6	7.2	14.4
Baseline response (1.00)	0.4	0.7	1.8	3.6	7.2
Double response (2.00)	0.2	0.4	0.9	1.8	3.6
Five-times response (5.00)	0.1	0.1	0.4	0.7	1.4

Notes: All figures in millions of $US; cell entries are the total external costs per year imposed by real-money trade per 100,000 users of a game. e_{rs} is the percent change of the subscription market in response to a percent change in RMT. e_{rc} is the percent change in RMT's external cost in response to a percent change in RMT. Example: the ''Five-times response'' value for e_{rc} assumes that a 1 percent increase in RMT causes a 5 percent increase in RMT's external costs

This would require measurement of areas A, B, and E. However, we know very little about the gold market. We do not even know the total annual sales, and estimates cover a huge range (from $100,000 to over $1 billion). We are fortunate that CDFGJ can be estimated to some degree, simply because we do have data from the subscriptions market. But until better data are available, estimating A, B, and E would be quite difficult. Nonetheless, we can still make some very firm judgments about the total welfare situation in the gold market, based on the simple analytics of externalities. Simply: when there is an externality, the benefits of reducing it exceed the costs. In other words, economic theory tells us with certainty that a policy to reduce RMT would benefit ordinary players more than it would hurt gold sellers and buyers. Looked at another way, standard economic theory tells us whatever benefits a marginal increase in RMT might provide to gold sellers and buyers, the externality costs must be greater still. In this section we have measured those costs, on the margin and in toto. And what the figures reveal is that these theoretical considerations are descriptively significant. Thus, we know from Section III that that RMT's costs theoretically exceed its benefits, and now we know from Section IV that this excess is meaningful in a practical sense. RMT is neither beneficial for games (on net), nor is it trivial.

V. Conclusions and policy responses

This paper has attempted to identify analytically the incidence of the welfare effects of the gold farming industry in massively-multiplayer games. It found that these effects could be modeled as a negative externality, with identifiable marginal and total external costs. It was shown that gold buyers and sellers benefit from this real-money trade, but that other players and the companies who develop and own the games are the primary bearers of the externality cost. A simulation exercise showed that the total cost of RMT-related externalities in the current market may be substantial. A figure of $1.8 million per 100,000 users per annum was identified as a baseline estimate of RMT's cost. Absent more information, it is hard to say whether this is a conservative figure. It assumes that a one percent increase in RMT would only have a one twentieth of a percent impact on the demand for subscriptions, and a one twentieth of a percent impact on customer service costs. Perhaps the effects of RMT on the demand for subscriptions and on customer service would be greater than this, which would of course raise the cost. The figure also assumes that a one percent increase in RMT causes a 1 percent increase in RMT's costs. Perhaps at RMT's current scale, however, the damages are largely in place, so that growth in RMT has a smaller effect on the growth of the aggregate cost. Here again, this would indicate that a given marginal cost number translated into a larger total cost number (a fixed number being a smaller percent of an unknown whole implies that the whole is larger). In any case, the baseline assumptions do imply that the current cost of RMT is about $1.50 per user, per month, which aggregates to $1.8 million per 100,000 users per year.

A full welfare analysis would have to balance this external cost figure against the benefits of gold sales received by those who buy virtual gold for real money, and by the industry that sells it. The theory of externalities demonstrates mathematically that, at current levels, each additional gold piece sold will impose costs on regular players and the developers that exceed the benefits received by the gold buyer and the seller. The optimal level of gold selling can be shown to be greater than zero but less than the current level. Future research should focus on estimating the parameters on the external cost simulations presented here, and quantifying welfare-relevant areas other than the external costs. The success of that research will depend to a great degree on increased access to data that we do not now have, such as the demand for game subscriptions, costumer service costs, and so on.

Regardless of what such research may show, however, the analysis and calculations in the paper together form a solid case for some policy intervention with respect to RMT in these large games. What we have is a clearly identifiable negative externality. Analytically, we know that its costs to society exceed its benefits. Moreover, the activity that produces the externality is done in contravention to explicit rules to which all parties have agreed ex ante. In this, the situation is akin to, say, doctors selling prescription pain-killers over the counter. Both doctor and patient have signed contracts with insurance companies in which they state that they will not do that. If an economic analysis discovered that such sales were a negative externality, that is, imposing costs on other members of society, there would be two grounds for trying to restrict the sales. First, because the sales are a negative externality, the benefits of reducing them will exceed the costs; there is a benefit-cost justification. Second, because the people engaging in the sales are breaking promises, they have relatively little standing in terms of justice; thus there is a merit justification as well. On both grounds, a policy that reduces the sales is warranted.

Any such policy would have to pass its own benefit-cost test, of course. Those who administer the games have apparently not found cost-effective means for controlling gold sales, since the sales are fairly rampant. Yet some innovation appears to be happening. One company, Sony Online Entertainment (SOE), now (as of 2005) offers players different versions of their game worlds. In one version, RMT is against the rules as usual. In another version, RMT is sanctioned and even administered by the company itself. Players who choose RMT-enabled games are free to engage in RMT as much as they wish, and the company handles the transactions. In doing so, SOE cuts out the 3rd-party firms operating on the cottage industry model; on RMT-enabled servers, gold farmers can simply sell their gold through the SOE website, and the company directly transfers the gold through its databases – no delivery characters are needed. Whatever this means for profits of all involved, we can presume that it reduces the externality effects of RMT. It seems reasonable that, only players who do not find RMT noxious will play on an RMT-enabled server. Furthermore, theoretically, this should draw RMT activity away from non-RMT servers, leaving the atmosphere there less affected by RMT. In a sense, the individuals most interested in polluting the game atmosphere are given a territory that they can pollute at will, in the hopes of drawing them away from other individuals who are harmed by the activity. This kind of sorting can achieve the full social optimum: if not RMT happens on non-RMT servers, and all those who dislike RMT play only there, then there is no external effect, and hence no external social cost. The market failure is eliminated by sorting alone. No studies have been done on the effectiveness of this sorting policy in practice, however.

Other policy options can be drawn from the standard menu of externality management tools developed in economics. They include:

- *Regulation by courts*: players or companies may sue to have RMT damages restored to them by gold buyers and sellers.
- *Regulation by government*: real-world governments may assist game companies in finding and prosecuting those who violate the terms of service. Governments may impose ''Pigovian'' taxes on gold sales.
- *Self-regulation by small, empowered communities*: groups of players may be given quasi-governmental powers to control RMT within the player community.

Each of these options has its own cost and benefit structure, which would have to be explored specifically in future research.

Notes

1. According to Richard Bartle and Jessica Mulligan, two industry veterans, RMT first emerged in shared online spaces as early as 1987 or 1988 if not earlier. See Hunter (2006).
2. NPD Group reports that in 2005, sales of video game software and hardware reached an all-time high at $10.5 billion. In 2004, DFC Intelligence forecast that revenues from online video games would rise five-fold from $1.9 billion in 2003 to $9.8 billion in 2009. See http://msnbc.msn.com/id/10842897/ and www.dfcint.com/game_article/june04article.html
3. For decades, the literature on welfare economics analysis has operated under the basic premise that intangible, unmarketed items nonetheless have a real material value that should, if at all possible, be quantified in terms of real money and included in any cost-benefit analysis. Following this premise, scholars have rigorously established the economic value of numerous intangibles. For example, Viscusi (1993) devotes an entire essay in one of the leading journals in economics to a review of the many studies estimating the monetary value of a single human life, a good that is not traded on markets but whose value is important for assessing policies that affect the risks of death. Textbooks by Freeman (1993) and Boardman *et al.* (1996) contain multiple chapters justifying and

explaining the monetary valuation of intangibles, including such untraded goods as air pollution, occupational safety, and job training.

4. No statistics on RMT are published by state agencies or private consulting firms. The CEO of a gold-selling firm (Steve Salyer of IGE) stated at the State of Play Conference in October 2004 that the industry annual sales volume was $887 million at that time. Until early 2004, I was able to track volume in RMT at the US eBay site, estimating the size of that part of the market at $30 million annually and growing rapidly. Trade in Asia is much larger. An uncorroborated Newsweek International report from 2004 placed the volume of trade in Asia as between $83 and $417 million. Nicholas Yee (2005), in unpublished survey data from 1,923 players of the game EverQuest, found that 22 percent of players had purchased virtual gold, and among them, the average lifetime expenditure was $135. That would imply average per-user RMT expenditures of $29.70 over a lifetime. If the typical respondent has played for three years, it would come to about $10 per year per user. If there are 20 million users of these spaces globally, that would be $200m per year. Putting the pieces together, a fair guess as to the size of Asian, US, and European markets combined, including growth into 2006, would be at least $100 million, more likely closer to $200 million, and quite possibly over $1 billion if industry figures are to be followed.
5. Much of this discussion has occurred at the blog Terra Nova, terranova.blogs.com. I am indebted to the Terra Nova community of authors and commenters for their thoughts on this issue.
6. See Varian (1984), pp. 259-276 or Cornes and Sandler (1986), pp. 29-47 for general theoretical analyses showing that uncompensated interdependencies result in pareto-inefficient outcomes.
7. An objection that may come to mind here is: ''But RMT does not have only negative effects on game experience – it also has positive effects, in allowing frustrated players to advance in the games using their real-world money instead of their time.'' This is true. However, this positive effect is already captured in the demand curve for gold. The point of the externality argument is that it identifies the effects of a trade on persons who are not party to the trade. RMT's positive and negative effects on those who buy and sell gold are already fully captured in the demand and supply curves for gold. What we are discussing in this section are RMT's effects on those who do not buy and sell gold. Those are largely negative.
8. This cost and revenue structure also explains one of the quirks of the industry, which is that most worlds continue to operate even though they are not profitable. Most of the cost is fixed up front, and ongoing revenues from subscriptions almost always exceed ongoing costs of operation. In other words, average revenue exceeds average variable cost but is below average total cost. The firm is losing money, yet would lose more money by shutting down.
9. The concept of surplus, also known as consumer surplus, occupies a standard section in introductory economics textbooks, e.g. Hall and Lieberman (2003), pp. 436-437. It is known to be an approximation to well-being, albeit one widely accepted by the profession. Strictly speaking, the measurement of well-being in terms of dollars is provided by the expenditure function, defined as the level of income necessary to purchase a given level of utility at given prices. Changes in expenditure functions are best approximated by changes in consumer surplus when policy changes are small and when the material effect of those changes are a small component of individual income. The policy changes considered later in this paper involve marginal changes in real-money trade. RMT is undeniably an element of decisions in the subscription market, but it is by no means a dominant element. Marginal changes in RMT policy could not be considered dramatic changes in policy, nor would their effects have a dramatic impact on consumer or producer incomes. Thus consumer surplus analysis is an appropriate technique. The use of consumer surplus in general is defended in a classic paper by Arnold C. Harberger (1971). Most practical welfare analysts argue that there are as many or more problems involved with using expenditure functions as there are with using consumer surplus – they are complex, have heavy data requirements, and are subject to function-specification issues. Consumer surplus is to be preferred because of its clarity and ease of explication, on top of its near-equivalent accuracy.
10. This assessment has been casually mentioned among industry executives from several different firms, who have evidently surveyed players about their attitudes toward RMT.
11. No formal statistics exist on the fraction of game play that is affected by RMT, so only anecdotal and observational evidence is available. Most of it points toward the conclusion that RMT has become large. The major gaming magazine PCGamer, following protests from its readers, decided to drop all ads from gold sales firms. In justifying this move, the editors reprinted this message that they

received from a gamer identifying himself as Rushlight: ''Lately, in my beloved World of Warcraft, I've had to put up with an influx of farmers. They've driven me out of the end-game areas, stolen my crafting nodes, undercut me at auction houses, and tricked in-game monsters into attacking me so that they can meet their quotas. The biggest ad-sponsored WoW fan sites are bombarded with banners for gold and account sales. Even in-game, I get emails and whispers from spammers telling me the addresses of gold sellers. And now I crack open my new issue of PCG, only to be slapped in the face with even MORE gold ads? C'mon, guys! Have a heart for a poor besieged troll. Drop the gold advertisements, won't you please?'' (from www.next-gen.biz/index.php?option=com_content&task=view&id=2058&Itemid=2).

12. This overlooks the effect of RMT on rule-following behavior. Since RMT is against the rules, the fact that so many players engage in it must erode respect for the rules more generally. That in itself also degrades game play more generally.
13. System resources respawn in this fashion to enable ordinary players to have animals, monsters, mines, plants, etc., to interact with. Player A goes through an area, encountering the animals and creatures and non-player characters and so on, killing some, driving others away, befriending some and taking them with him, and so on. If the system did not respawn and reset these resources, Player B, when she comes through, would have nothing to play with. Thus almost every resource in these worlds is on a ''spawn timer'' that restocks things when they get low. Under intense gold farming, of course, the in-world stock is always low. The spigot of spawns is perpetually on; each time a resource is spawned, it is immediately harvested by the worker who is waiting for it, and the system is induced to spawn another one in the minimum time allowed by the timer.
14. Steinkuehler (2005) relates several anecdotes about in-game territorial violence between players and ''adena farmers'', workers harvesting the currency adena from the game Lineage II.
15. All RMT activity as such is expressly forbidden in the terms of service agreed to by all users of the service on entry. Enforcement is not trivial, but space does not permit a full discussion of the companies' efforts to enforce these terms. See Lastowka and Hunter (2004) for an analysis of virtual worlds and the law.
16. An objection might be made here, that because some players prefer to use RMT to enhance their play experience, the increase in RMT should also have a demand-increasing effect in the subscription market. This is undoubtedly true, yet its welfare effects must be ignored – they are already captured in the consumer surplus area in the gold market. To move the demand upwards in the subscription market and add the resulting welfare increase would be double-counting the welfare increase created in the gold market when the RMT level rose there. Not only that, but the exercise in question here involves only the measurement of the external effects of RMT. The positive effects of RMT for buyers and sellers are not relevant for that question. If they were to be measured, though, the proper place to measure them is not in the subscription market, but in the market where they first appear, the gold market. See Boardman *et al.* (1996), pp. 82-88, for an explanation of why the observation of welfare effects in one market (here, the gold market) makes redundant the welfare consequences of correlated changes in a second market (here, the subscription market).
17. Variations on this assumption would not affect the overall cost calculations, but would affect whether game developers or game players bear the greater burden of RMT's costs.

References

Boardman, A.E., Greenberg, D.H., Vining, A.R. and Weimer, D.L. (1996), *Cost-Benefit Analysis: Concepts and Practice*, Prentice-Hall, Upper Saddle River, NJ.

Castronova, E. (2001), ''Virtual worlds: a first-hand account of market and society on the cyberian frontier'', CESifo Working Paper Series No. 618, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=294828

Cornes, R. and Sandler, T. (1986), *The Theory of Externalities, Public Goods, and Club Goods*, Cambridge University Press, Cambridge.

Freeman, A.M. III (1993), *The Measurement of Environmental and Resource Values*, Resources for the Future, Washington, DC.

Hall, R.E. and Lieberman, M. (2003), *Microeconomics: Principles and Applications 2/e*, Thomson Southwestern, Mason, OH.

Harberger, A.C. (1971), ''Three basic postulates for applied welfare economics: an interpretive essay'', *Journal of Economic Literature*, Vol. 9 No. 3, pp. 785-97.

Hunter, D. (2006), *The Early History of Real Money Trades*, Terra Nova, available at: http://terranova.blogs.com/terra_nova/2006/01/the_early_histo.html (accessed January 13).

Lastowka, F.G. and Hunter, D. (2004), ''The laws of the virtual worlds'', *California Law Review*, Vol. 92 No. 1, pp. 1-74.

Steinkuehler, C.A. (2005), ''The mangle of play'', paper presented at the Games, Learning, & Society (GLS) Conference, Madison, WI, June 23-24.

Varian, H.R. (1984), *Microeconomic Analysis (2e)*, Norton, New York, NY.

Viscusi, W.K. (1993), ''The value of risks to life and health'', *Journal of Economic Literature*, Vol. 31 No. 4, pp. 1912-46.

Yee, N. (2005), *Buying Gold, The Daedalus Project*, available at: www.nickyee.com/daedalus/archives/001469.php?page=1

Corresponding author

Edward Castronova can be contacted at: castro@indiana.edu

To purchase reprints of this article please e-mail: **reprints@emeraldinsight.com**
Or visit our web site for further details: **www.emeraldinsight.com/reprints**

Reproduced with permission of copyright owner. Further reproduction prohibited without permission.

للاستشارات المنارة

www.manaraa.com