An Empirical Study of Online Penny Auctions

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Abstract

We investigate why QuiBids has survived a string of bankruptcies and closings of penny auction sites over the past two years. We find that although inherently profitable on an auction by auction basis, penny auction sites have problems retaining users. In order to alleviate this problem, many sites implemented a Buy-Now system, where bidders could contribute money already lost in an auction towards the purchase of the auctioned item at a slightly inflated price. First we use empirical data to look at why QuiBids' implementation of this feature allowed it to remain profitable while others failed. We find that one reason QuiBids survived is because it properly increased its bidder-to-auction ratio. Additionally we find that QuiBids cleverly implemented a system of voucher bids (additional bids that users can win through auctions) that allows the bidder-retaining effects of Buy-Now to remain while lessening its effects on QuiBids' profits. Next, we attempt to calculate the real effects of these policies on QuiBids' profit. We find that the Buy-Now feature does appear to be increasing the retention of users and that QuiBids can make a profit with the current system. We also find that users behave irrationally when bidding on voucher bids and that without this system, QuiBids might no longer make a profit.

1 Introduction

Most past empirical studies of penny auctions (e.g. Augenblick [1], Hinnosaar [2], Wang et al. [4]) have shown that penny auctions cause users to radically overbid in aggregate. This has earned them the title "the evil stepchild of game theory and behavioral economics" from the Washington Post[1]. This overbidding also means that this model should be extremely profitable for the sellers using them because bidders must pay for each bid they submit. Augenblick estimates that Swoopo, one of the larger pre-QuiBids penny auction sites, generated profits of just under $24 million over four years and that each auction generated average revenues of 150% of the good's value [1]. This means that Swoopo had approximately a 33%

[1] http://www.washingtonpost.com/wp-dyn/content/article/2009/07/11/AR2009071100684.html

profit margin. According to Fortune magazine, the most profitable sector of the retail economy in 2009 was department stores with a 3.2% average profit margin[2]. Needless to say this pales in comparison to the order-of-magnitude larger margins supposedly being made by Swoopo.

1.1 Customer Retention Problems

Unfortunately, the fact that many auctions generate huge amounts of profit for the seller means that many of the buyers are taking huge losses, and everyone but the winner is taking at least a small loss. Many studies have also shown that customer retention suffers substantially because the chances of making money on many of these auctions are so small. Wang et al. claim that "the vast majorities of new bidders who join the website on a given day play in only a few auctions, place a small number of bids, lose some money, and then permanently leave the site within a week or so" [4]. Augenblick further supports this observation with empirical data. According to Augenblick, 75% of bidders leave the website forever before placing 50 bids, and 86% stop before placing 100 bids [1]. This is a problem because, as suggested by Wang et al., the majority of Swoopo's profit was coming from this "revolving door" of inexperienced bidders: a large number of new, inexperienced bidders who would soon leave the website never to return [4]. This is a long term problem with penny auctions because as soon as the supply of new inexperienced bidders runs out, the majority of these websites' income would evaporate. Indeed, Zeng et al. spend their entire paper addressing win limits, an attempt to increase consumer retention rates that we will discuss later [5].

The root of the consumer retention problem, according to Wang et al. was that the penny auction model "offers immediate outcome (win or lose) feedback to bidders so that losing bidders can quickly learn to stop participating" [4]. Prior to the introduction of Buy-Now in late 2009, most sites had already introduced a number of measures in an attempt to alleviate this problem [5].

1.2 Potential Solutions

As we already mentioned in section 1.1, the majority of penny auction sites introduced win limits, where the number of auctions a single bidder could win per month was limited to some small amount (12 for QuiBids). This was designed to directly alleviate bidder attrition, where a few people would win most items, and most people would never win an item. When there are more unique winners, it becomes more likely that new bidders will win an auction, and therefore more likely that they will return to the site repeatedly and become an experienced bidder, reducing sites' reliance on inexperienced bidders for profit.

Many penny auction sites also introduced beginner auctions. Bidders are only allowed to participate in beginner auctions if they have never won an auction before. Beginner auctions tend to be numerous and are usually for inexpensive items; however they attempt to get every new user a win early in their bidding career. As we have already stated, these early wins make it more likely that a bidder will become more committed to the site.

[2]http://money.cnn.com/magazines/fortune/fortune500/2009/performers/industries/profits/

1.3 The Introduction of Buy-Now

As of early 2009, many sites appeared to still be grappling with the bidder retention problem despite implementing these features. As a result, many Penny Auction sites implemented the Buy-Now feature by late 2009 (Swoopo[3], BidHere, RockyBid, BigDeal, BidBlink, Bidazzled, PennyLord, Winno, and JungleCents to name a few[4]). This allows bidders to contribute money they have spent in a lost auction towards the *value price* of that item, and buy the item for the remaining amount. The value price of an item on a penny auction site is a price marked up from the retail value of that item. Despite the inflated price, this feature still provides an extra sense of security to the bidder. Effectively, the worst outcome for a bidder is now that they buy the item at a slightly less than optimal price. This limits a bidder's loss to the difference between the auction site's value price of an item and the retail price of that item. The Buy-Now feature approach also cleverly deals with the problem Wang et al. mention of providing immediate outcome (win or lose) to bidders [4]. Because bidders can now choose to utilize the Buy-Now option, which is an almost neutral option, they never have to lose a lot of money in an auction, and are less likely to get discouraged quickly.

Between late 2009 and early 2011, almost 150 penny auction sites shut down inexplicably or went bankrupt[5]. This included such penny auction giants as BigDeal and Swoopo. This is even more surprising when we consider Augenblick's empirically supported claims that Swoopo was making a profit of almost $24 million over the four years preceding 2009 [1]. Notably absent from the bankruptcy list is QuiBids, who has become one of the biggest auctioneers in the penny auction scene since 2009. The obvious question is then why did QuiBids survive and sites such as Swoopo fail so quickly when both implemented the Buy-Now option. It seems each sites implementation of Buy-Now, the only notable change to many penny auction sites in late 2009, may have played a part in Swoopo's demise.

1.4 Overview

In this work we will first investigate both QuiBids and Swoopo in our attempt to determine how QuiBids flourished while Swoopo went bankrupt after introducing Buy-Now. We find that the two main contributors to successfully implementing Buy-Now appear to be actively maintaining a proper bidder-to-auction ratio, and properly implementing a system of voucher bids that lessens the negative effects of the Buy-Now option on revenue.

Second, we will estimate if QuiBids is successful in maintaining profits after implementing the Buy-Now feature. In determining these profits, we will also look at if QuiBids has been able to solve the reliance of penny auction sites on inexperienced bidders. We find in a variety of scenarios that QuiBids is still able to maintain a profit unless users stop bidding on voucher bid auctions (auctions where the bidders are bidding for more bids). Additionally we find that the majority of QuiBids' profits do appear to come from experienced bidders, and can therefore infer that Buy-Now does increase consumer retention.

The paper is organized as follows: Section 2 defines penny auctions and describes their

[3]http://techcrunch.com/2009/06/26/unique-auction-site-swoopo-expands-to-canada-testing-buy-it-now/

[4]http://tomuse.com/penny-auctions-entertainment-shopping-sites-review-compare/

[5]http://www.pennyauctionwatch.com/2011/04/over-150-closed-penny-auction-sites-is-the-model-sustainable/

implementation on QuiBids. Section 3 describes our data and collection methods. Section 4 investigates evidence supporting our findings that the bidder-auction ratio and voucher bids are the reason QuiBids survived while Swoopo failed. Section 5 investigates the long term profitability of QuiBids under a variety of scenarios. We look at how various policies affect QuiBids profit, and what we expect QuiBids profits to be depending on the fraction of the bidders that correctly use Buy-Now. Finally, Section 6 concludes and offers directions for future research.

2 QuiBids' Penny Auction Rules

Penny auctions start at an initial price of \$0. Bidders may then increment the price by \$0.01 by submitting a bid. In order to submit a bid, the bidder must pay a bid fee of \$0.60. These bid fees are not returned to the losing bidders, thus penny auctions are often considered a form of all-pay auction [3]. The auction timer counts down to zero seconds from about 16 hours. If a bid is submitted in the last 20 seconds of an auction, the countdown timer is reset to 20 seconds, extending the duration of the auction. While this reset time starts at 20 seconds, the reset time may decrease to 15 or 10 seconds if the auction extends past a time threshold. The auction ends when the auction timer reaches 0; therefore each bid is effectively a bet that no other bidder will bid in the time it takes for the auction timer to reach zero after being reset. When the auction ends, the last bidder pays the auction end price of the item and the shipping cost. All of the losing bidders incur costs equal to the number of bids they submitted multiplied by the bid fee, \$0.60.

QuiBids is the sole seller of all products on its site. Members are only allowed to bid on items and are not allowed to start auctions selling their own items. For this reason QuiBids is more of a quirky online retailer that uses auctions to sell items instead of simply listing a price.

As previously mentioned in section 1.2, QuiBids contains beginner auctions where only bidders who have not won any auctions may bid. QuiBids has also implemented the following win limits on each bidder:

- Each bidder may only win 12 items over a 28 day period.
- Each bidder may not win more than one of the same item valued over \$285 in a 28 day period.
- Each bidder may only win one item valued over \$999.99 in a 28 day period.
- Voucher bid auctions are not subject to any of these restrictions and are only subject to a maximum of 12 wins per day limit.

Voucher bids are actually an auction item on QuiBids. Sold in packages, voucher bid auctions allow users to bid in an attempt to win more bids for use on other auctions. Voucher bids are auctioned off using the same penny auction system as other products on QuiBids. This means that a user who wins a voucher bid pack auction on QuiBids gets a predetermined number of voucher bids. The only difference between purchased bids and voucher bids is that voucher bids are not eligible to contribute their cost to the Buy-Now feature.

The *Buy-Now* feature allows a bidder who has lost an auction to count the cost of the bids that user has submitted for that particular item towards the purchase of that item at the value price. QuiBids' value price is always at least the retail price of the item on similar websites, and is often significantly more. Henceforth we will refer to the difference between QuiBids' value price and the retail price as the *value price markup*. For an example of the usefulness of Buy-Now, let's take a scenario where a bidder submits 550 purchased bids towards a $600 value price laptop (retail $500) and loses the auction. The price of the bids the bidder has used is $550 \times \$0.60 = \$330$. Therefore the bidder can use the buy-now option to purchase the laptop for $\$600 - \$330 = \$270$ in addition to the $330 the bidder already spent on bids. In this case, with the buy-now option the bidder has spent $600 total for a $500 dollar laptop ($100 loss) instead of spending $330 for nothing ($330 loss). This example demonstrates that the Buy-Now feature effectively serves as a loss limiting measure for the bidder, where the maximum loss is the value price markup. Additionally, because Buy-Now limits the bidder's losses to the value price markup, we can define rational use of the Buy-Now option as using the buy now option whenever a bidder loses an auction and has spent bids whose total value is over the value price markup. The value price markup in the previous example is $\$600 - \$500 = \$100$. The minimum number of bids required to use the Buy-Now option in the above example is therefore $\$100/\$0.60 = 167$ bids. Because Buy-Now limits the per-auction loss of any bidder who appropriately uses Buy-Now, it also limits the per-auction profit that QuiBids can make from any such bidder. Without the Buy-Now option, QuiBids would have made $330 from the previously mentioned bidder; however with rational Buy-Now use, the most revenue QuiBids' can generate from that bidder is the value price markup ($100).

Finally, QuiBids offers a feature called the *BidOMatic*. A bidder can set this tool automatically submit a user determined value between 3 and 25 bids on the bidders behalf (QuiBids frames this tool as a bathroom break tool). Each BidOMatic bid is placed at a random time between the reset time and zero seconds. A bidder cannot leave for a long time without refilling the BidOMatic. At a maximum, the BidOMatic lasts every other bid for 50 bids (because a bidder cannot bid against themselves). With a maximum of 20 seconds between each bid, we find that the BidOMatic lasts $50 \times 20s = 1000s =$ about 16 minutes at maximum.

3 Data Collection

In order to collect auction data that approximates the number of bidders on QuiBids, we use Alexa web traffic data[6]. In order to collect data from QuiBids, we created two ruby scripts using the Watir gem[7].

3.1 Auction End Data

The first script was responsible for capturing all available data for each ending auction. A major challenge in attempting to collect this end-of-auction data was QuiBids' page rate limit

[6]http://www.alexa.com/

[7]http://watir.com/

which will stop delivering page requests if the user goes over a certain click rate. Despite this limit, the script was able to collect the ending statistics of all 37,233 auctions which ended during the seven days following November 15th. For each auction, the following information was collected:

- Auction ID - a unique auction number
- Item Name - A brief item description
- Auction End Price - The final price of the item
- Date - Day the auction ended (EST)
- Time - Time the auction ended (EST)
- Value Price - The value of the item as assigned by QuiBids
- Winner - The bidder ID of the winning bidder
- Bid-O-Winner - Whether or not the auction was won by a BidOMatic
- Distinct Bidders - The number of distinct bidders in the last 10 bids
- Distinct Bid-Os - The number of distinct bidders using BidOMatics in the last 10 bids
- Last Ten Bidders - The bidder IDs of the last ten bidders

3.2 Full Auction Bid Histories

When attempting to collect complete auction bid histories, we found that QuiBids only allows a user to watch four auctions at once. Because of this limit, we have just over 50 complete auction bid histories. The following data was collected for each bid in each auction where the auction clock is at or below its reset time:

- Auction ID - uniquely identifies each auction
- Bidder Username - uniquely identifies each bidder (persists between auctions)
- Bid Price - The new price of the item after this bid
- BidOMatic? - Whether or not this bid was placed by a BidOMatic or placed manually
- Bidders in Last 5 - The number of bidders in the last five minutes
- Auction Clock - The time on the auction clock when this bid was placed
- AC Reset - The time the auction clock resets to every time a new bid is placed (this starts at 20 seconds, and eventually reduces to 15 seconds and then 10 seconds)
- Date - The date this bid was placed on (EST)
- Time - The time this bid was placed on (EST)

4 Evidence

4.1 Bidder-to-Auction Ratio

It is generally understood that having more bidders in an auction tends to lead to higher profits. Zheng et al. support this claim and say "due to the competitive nature of penny auctions, the number of bidders is even more critical for generating larger profits" than in other auction types [5]. However, this does not mean that bidding sites managing multiple auctions at the same time should attempt to maximize the number of bidders per auction. If this were the case, we would expect to see only very few auctions running at a time. Instead, having more auctions increases the number of opportunities penny auction sites have to make money. For example, a penny auction site running only one auction at a time would probably make more money by adding a second auction because many of the sites' bidders would probably bid in both auctions. Having more bidders increases the per-auction profit of a penny auction site. Having more auctions increases the number of times the penny auction site receives that per-auction profit. Therefore there is some optimal bidder-to-auction ratio which maximizes total short-term profits for penny auction sites. Penny auction sites can adjust this ratio by increasing or decreasing the supply of auctions. Augenblick claims that Swoopo determined the optimal ratio (prior to the introduction of Buy-Now) to be one active auction for each 42 active bidders, and rigorously maintained this ratio, acheiving 98.6% of potential profit [1].

Maintaining this ratio so that it stays correctly optimized for the short term is not enough. Penny auction sites also need to make sure that they can maintain this same proportion of bidders-to-auctions into the future, ideally without having to decrease the number of auctions. This means that they also have to consider consumer retention rates when deciding on the optimal ratio. Penny auction sites want the number of bidders per auction to be high enough to generate a significant profit; however if this ratio is too high, the proportion of winners will be too small. New bidders would then quickly "learn to stop participating" [4] due to repeated losses before they have an opportunity to win an auction. When there are no more new bidders to replace the bidders that are being driven away by the low win rates, the bidder-to-auction ratio would not be maintainable because there would be a shortage of buyers. Therefore in considering an appropriate ratio, and assuming there is not an infinite supply of new bidders, penny auction sites must also consider the effects of the bidder-to-auction ratio on the "revolving door" of new bidders. Given that a lower bidder-to-auction ratio implies that new bidders are more likely to win auctions, and therefore stay for the long term, we would expect the optimal long-term ratio of bidders-to-auctions to be lower than the short-term profit optimizing ratio.

The introduction of the Buy-Now feature also changes the optimal bidder-to-auction ratio. As mentioned in section 2, Buy-Now limits the amount of money an auction site can make per bidder, and therefore decreases overall profits. This means penny auction sites would be inclined to increase their bidder-to-auction ratio to help regain some of those lost profits. Additionally, the Buy-Now option theoretically improves consumer retention rates. This occurs because Buy-Now limits bidders' losses, and therefore offers new bidders a better alternative to large losses. This increases the chances that new users will use the site more than once, and eventually win something, which would hopefully secure the bidder's long-

term loyalty. Because the Buy-Now option improves consumer retention rates, we would expect the optimal bidder-to-auction ratio to be even higher. A higher bidder-to-auction ratio would be expected because penny auction sites have to worry less about a high bidder-to-auction ratio driving new bidders away. The combination of lower profits and better bidder retention that Buy-Now provides means that we would expect to see a significant increase in the optimal bidder-to-auction ratio with the introduction of Buy-Now. Indeed, when we attempt to calculate QuiBids' Buy-Now influenced bidder-to-auction ratio (based on our full bid history data), we find that there are on average 347 bidders in each auction. As expected, this is significantly larger than the ratio of 42 bidders per auction that was optimal for Swoopo prior to the introduction of Buy-Now. If Swoopo failed to properly increase its bidder-to-auction ratio with the introduction of Buy-Now, we would expect its profits to suffer. Therefore this might have been a contributing factor to Swoopo's eventual bankruptcy.

In order to show that QuiBids is actively maintaining this ratio, we must show that QuiBids adjusts the supply of auctions when there is a noticable change in the number of bidders on QuiBids. While collecting data during November and December 2011, we noticed that there was a huge increase in the number of auctions on Black Friday (November 25th, 2011). If QuiBids were adjusting the number of auctions to intentionally maintain their optimal bidder-to-auction ratio, we would expect to see the number of visitors to QuiBids increase almost proportionally to the number of auctions. In 24 hours of data we collected between November 27th and 28th, we counted a total of 12,623 ended auctions. In our week of data collection the week of November 15th (prior to Black Friday) we collected 37,233 auctions, or an average of 5319 auctions per day. That means QuiBids intentionally increased the number of auction per day by about a factor of about 2.37. Using our data from Alexa in Figure 1, we clearly see an increase in the number of visitors to QuiBids by a factor of slightly over 2 from before to after Black Friday 2011. This suggests that QuiBids was intentionally increasing the number of auctions to maintain the bidder-to-auction ratio appropriately, and supports the hypothesis that proper regulation of this ratio was a contributing factor to QuiBids' survival of the introduction of Buy-Now.

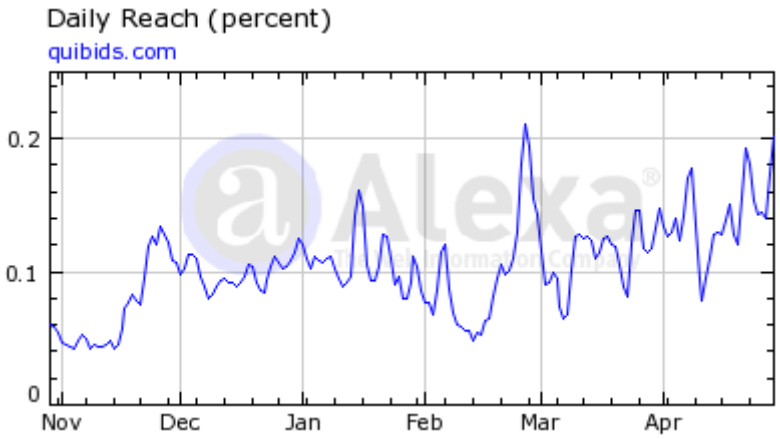

Figure 1: Estimated percentage of global internet users who visit QuiBids.com from November 2011 to April 2012. (From http://www.alexa.com/siteinfo/QuiBids.com)

4.2 Voucher Bids

The most noticeable difference between QuiBids' set of rules and Swoopo's set of rules was how each treats voucher bids. While QuiBids' rules state that voucher bids contribute nothing towards the Buy-Now feature, Swoopo allowed voucher bids to be counted towards the Buy-Now feature at a value of 70% of a purchased bid (hereafter referred to as the 70% policy). This difference is a natural place to look for answers to our questions surrounding the survival of QuiBids and death of Swoopo.

Of the 37,233 auctions occurring during the week of November 15th, 18,742 of them (slightly over 50%) were for voucher bid packs. By summing the auction end prices for all of these auctions, and multiplying by 100, we can calculate the number of bids submitted in aggregate to these voucher bid auctions. We find that 1,688,459 bids were submitted over the course of that week. Interestingly, if we sum over the number of bids contained in each bid pack, we find that only a total of 561,035 bids were given out to the winners of these auctions. This means that if voucher bids were worth the same amount as purchased bids, QuiBids would be making a profit of $(1,688,459 - 561,035) \times \$0.60 = \$676,454.40$ on bid vouchers alone. If we include the \$1 transaction fee that QuiBids takes on each bid voucher auction, this amount increases to $\$676,454.40 + 18,742 \times \$1 = \$695,196.40$. This huge profit is likely because there is more fierce competition for bid vouchers because they are not included in bidders' monthly win limit.

Bidders appear to be overbidding dramatically for these voucher bids when they are valued evenly to purchased bids. This overbidding is even more dramatic when we consider that the true value of these voucher bids is far less than \$0.60 because these bids cannot contribute to the Buy-Now option. We can calculate the true value of each bid based on the fraction of total bids used by the winners of an auction, versus the fraction used by losers. When used by a winner of an auction, a voucher bid is worth the same as a purchased bid (\$0.60). When used by a loser of an auction, a voucher bid is worth nothing because it cannot be used towards the Buy-Now feature.

In order to calculate the fraction of bids used by winners, we take our full bid histories, and find the fraction of bids submitted by the winners of each auction. We find that 4,548 bids of the total 102,486 bids are submitted by winners. Assuming that voucher bids are spread evenly among winners and losers, this means that voucher bids belong to winners $4548/102,486 = 4.438\%$ of the time. We can then find the true value of a voucher bid taking a weighted average of voucher bid values. We do this by multiplying the probability that a voucher bid belongs to a winner (4.438%) by the value of a voucher bid to a winner (\$0.60), and adding this to the product of the probability that a voucher bid belongs to a loser (1-4.438%) and the value of a voucher bid to a loser (\$0). This means that voucher bids are on average worth $4.438\% \times \$0.60 + (1 - 4.438\%) \times 0 = \$0.0266$.

Taking this as the value of each voucher bid, we can calculate QuiBids' costs by taking the number of voucher bids won in the week of data (561,035), multiplying by the value of each voucher bid (\$0.0266). We find that QuiBids' costs are \$14,923.53. We then find QuiBids' revenues from voucher bid auctions by taking the product of the number of bids spent in voucher bid auctions (1,688,459) and the value of each bid (\$0.60). We find that the revenues from these voucher bid auctions are \$1,013,075.40. We therefore find QuiBids' profit from voucher auctions to more accurately be $\$1,013,075.40 - \$14,823.53 = \$998,151.87$.

If QuiBids adopts Swoopo's 70% policy, and assuming bidders don't change their behavior, we can again calculate the value of QuiBids' voucher bids but instead of having no value to losers, the voucher bids now have a value of 70% of \$0.60. Running the same value estimation calculation as before, we find that voucher bids are now worth $4.438\% \times \$0.60 + (1 - 4.438\%) \times 70\% \times \$0.60 = \$0.428$. We therefore find that a voucher bid under the 70% policy is worth over 16 times the value of a voucher bid under QuiBids' current policy. This drastic difference demonstrates how a small change in the rules can significantly affect the valuation of a bid.

Running the same profit calculation as before, we calculate that under the 70% policy, QuiBids would have profits from voucher bid auctions of $1,688,459 \times \$0.60 - 561,035 \times \$0.428 = \$772,952.42$. Therefore we can see that QuiBids would lose an estimated $\$998,151.87 - \$772,952.42 = \$225,199.45$ in revenue in a single week if they adopted the 70% policy. This is a concrete demonstration of how QuiBids implementation of voucher bids allows Buy-Now to impact its profits less than the policies of Swoopo. This is because QuiBids' voucher bids cannot contribute any value to the Buy-Now option while Swoopo's 70% policy allows voucher bids to contribute 70% of a purchased bid's value. Swoopo's poor implementation of voucher bids is therefore likely one of the reasons it had to file for bankruptcy following its implementation of Buy-Now.

5 Long-Term Profitability

Given that QuiBids has survived so far, we now explore if we expect QuiBids to continue to survive. Although it has not gone out of business yet, survival does not guarantee that QuiBids is making a profit. Thus we explore a variety of situations regarding the existence of the Buy-Now option and voucher bids and what these situations reveal about QuiBids' expected profit. All of these calculations operate under the assumption that the only costs QuiBids incurs are the retail prices of the items it is selling and that QuiBids offers fair shipping costs.

5.1 Ignoring Buy-Now Effects

We start out by replicating the analysis of past research by looking at what QuiBids' expected revenues, costs, and profits are when we assume that no bidders use the Buy-Now option. Our analysis is reliant on the assumption that bidders do not change their behavior as a result of not using the Buy-Now option.

5.1.1 Total Costs, Revenues, and Profits

In order to estimate QuiBids' true costs, we must estimate the average value price markup. We estimated this by taking a sample of 25 items from QuiBids and calculating the markup from the lowest retail price we could find to QuiBids listed value price. We find that the value price is on average 21% larger than the retail price of each item. (See appendix A for the data used to reach this value.)

We can now easily calculate the estimated cost of each auction in our week of auction ending data by taking the value price for each auction item and dividing it by 1.21. We can

also easily calculate the revenue generated by each auction by taking the number of bids submitted (the auction end price multiplied by 100), multiplying by the $0.60 bid fee, and adding the auction end price. We can then calculate the estimated profit of each auction by subtracting cost from revenue. In order to calculate these values over the entire week we simply sum the individual auction values. We find that QuiBids total costs are $1,636,838.98 for the week, with revenues of $3,646,044.42. This leads us to calculate a profit for QuiBids of $2,009,205.44, or a profit margin of 55.11% for the week of November 15th, 2011.

5.1.2 Profit Breakdown

In order to see where this profit comes from, we look at the distribution of auction by auction profit for all 37,233 auctions in Figures 2 and 3. Interestingly, we find that despite the enormous total profit, the median profit is still slightly negative, meaning QuiBids loses money on more auctions than it makes money on. QuiBids might actually encourage this negative median profit in order to further appease new bidders by letting them make profits on a few smaller items in an attempt to get them to bid on higher cost items where QuiBids makes more money. While there are very few auctions where QuiBids loses more than $500, there are a significant number of auctions where QuiBids has profits above $500. This leads us to suspect that there might be a few auctions that make QuiBids a disproportionately large amount of its money. When we split the profit data based on the items price, as seen in Figure 4, we can clearly see that this is the case. For instance the top 0.132% priced auctions generated 11.1% of profits, and the top 2.50% priced auctions generated almost 43% of the profits. In an extreme case, in auction ID 798938403, QuiBids made $44,107.98 in profit on a single auction selling a MacBook Pro. During the auction, 75,492 bids were submitted. All of this further lends credibility to the claim that QuiBids keeps many unprofitable, inexpensive auctions around to increase consumer retention in the hope that those customers will then go on to give QuiBids extremely large profits in higher priced auctions. (For a bidding strategy that utilizes this fact to consistently make small profits on QuiBids, see the Appendix B).

5.1.3 Consumer Retention

We are also interested in seeing what percentage of QuiBids' profits come from experienced bidders and what percentage come from inexperienced bidders. If most of the profits are coming from experienced bidders, it is a good indication that QuiBids' consumer retention measures are working as intended. We first define experienced bidders as bidders that have placed more than 50 bids within an auction based on Augenblick's assessment which stated that the vast majority of inexperienced bidders (75%) were discouraged before placing 50 bids [1]. We then count the number of bids submitted by each bidder in our complete auction histories and classify bidders as experienced or inexperienced. Next, we sum the number of bids submitted by experienced bidders and the amount submitted by inexperienced bidders. We find that 77,916 (76.0%) bids are submitted by experienced bidders, and 24,570 (24.0%) are submitted by inexperienced bidders. Ignoring the effects of Buy-Now, an estimated 76.0% of revenues come from experienced bidders, while only 24.0% of revenues come from inexperienced bidders. We re-ran our analysis with a more conservative definition of experienced bidders, where an experienced bidder was defined as having placed more than

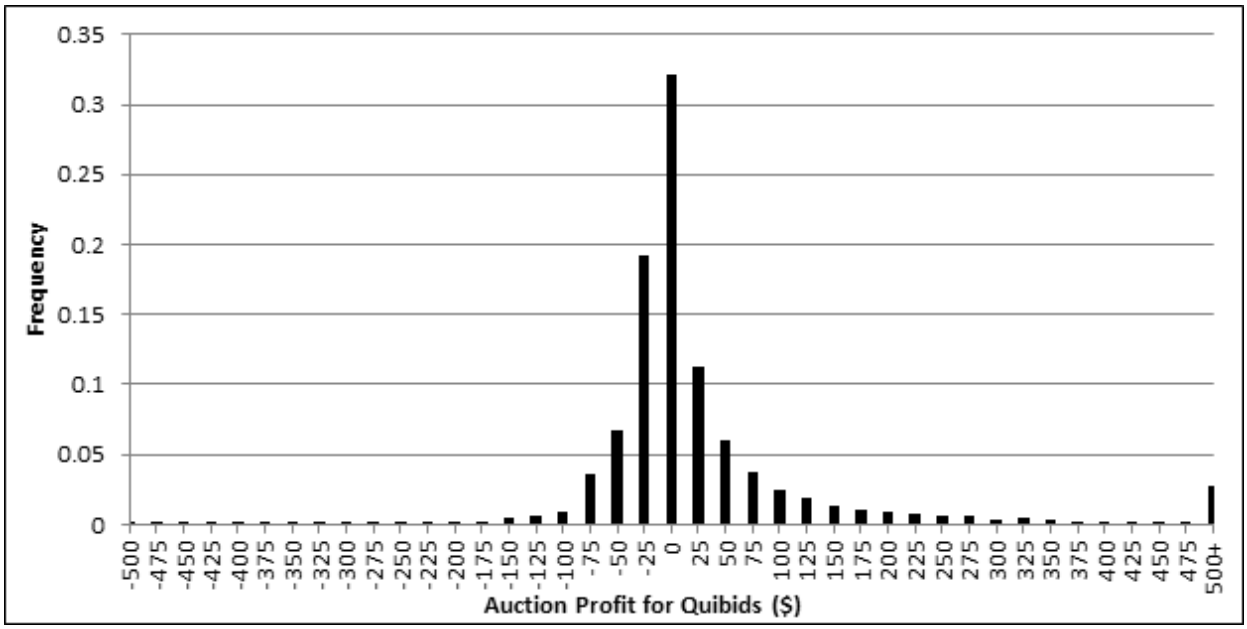

Figure 2: A frequency histogram of QuiBids' profits per auction

Mean	$53.96303
Median	$-1.41669
Standard Deviation	442.1452
Sample Variance	195,492.4
Range	45,531.45
Minimum	$-1,423.47
Maximum	$44,107.98
Sum	$2,009,205
Count	37233

Figure 3: Descriptive statistics for the distribution of profits across all QuiBids auctions for the week of November 15th, 2011.

Value Price Range	**$0-$285**	**$285-$1,000**	**$1,000+**
Count	36,303	881	49
Fraction of Auctions	0.975022	0.023662	0.001316
Total Cost	$1,251,866	$320,440	$64,532
Total Revenue	$2,402,805	$956,544	$286,694
Total Profit	$1,150,939	$636,104	$222,161
Margin	47.90%	66.50%	77.49%

Figure 4: Descriptive statistics for the distribution of profits across QuiBids auctions split by value price for the week of November 15th, 2011. The bounds for each price range were decided by the bounds for each win limit rule of QuiBids.

100 bids in a single auction. We decided to test this definition as well because the starter bid pack for QuiBids is 100 bids, therefore users placing over 100 bids have shown that QuiBids has at least convinced them to buy more than one bid pack. Using this definition of experienced bidders, we find that 61.9% of revenues are generated by experienced bidders, and 38.1% of revenues are generated by inexperienced bidders. The fact that according to both definitions, the majority of QuiBids' revenues are generated by experienced bidders is an extremely positive signal regarding the longevity of QuiBids' bidders.

5.2 Including Buy-Now Effects

Now that we have shown that QuiBids is very successful if we ignore the Buy-Now feature, we should see what effects introducing the use of this feature into our analysis has on profits and consumer retention. We define the rational use of Buy-Now as using Buy-Now whenever it lessens the losses of a bidder who has lost an auction. As shown in section 2, this means that a bidder should use Buy-Now whenever the cost of his bids in a lost auction exceeds the value price markup. This analysis also relies upon the assumption that bidders do not change their behavior as a result of not using the Buy-Now option. It is unclear whether the Buy-Now option increases or decreases the number of bids a bidder submits. According to Augenblick, bidders may overbid significantly due to the "sunk cost fallacy" [1] if Buy-Now is not implemented; however it also seems reasonable to assume that because Buy-Now places a limit on the losses of a each bidder, bidders would instead be willing to bid more if Buy-Now is implemented.

5.2.1 Total Costs, Revenues, and Profits

Using our complete auction histories, we can estimate the fraction of revenues that QuiBids loses to the Buy-Now feature by calculating estimated revenues with no use of Buy-Now, and with full rational utilization of Buy-Now. In order to calculate estimated revenues without Buy-Now we simply add the total number of bids submitted and multiply them by the bid fee of $0.60. We find that the revenues of the auctions for which we have recorded a complete bid history are $61,491.60. In order to calculate the revenues assuming full rational utilization of Buy-Now, we must first determine the amount of revenue contributed to each auction by each individual bidder. We calculate this by taking the number of bids from each bidder and multiplying by the bid fee of $0.60. Next, we must calculate the estimated retail price of each item by taking QuiBids' listed value price and dividing by the average markup, 1.21. We then find the threshold for the maximum amount of revenue each bidder can contribute to the auction, which is equal to the value price markup or an estimated 21% of the estimated retail price. To simulate rational use of Buy-Now, we assume every individual whose cost of bids exceeds each items value price markup only generates revenues equal to the value price markup. We then sum these limited costs over all bidders and find that our total revenue is now $41,670.00. This is a reduction of 32.2% of revenues. If we take this estimate of revenue reduction and apply it to all QuiBids auctions using our auction end data, we find that QuiBids' revenues have been reduced to $2,472,018.12. With the same costs as before ($1,636,838.98), we find that QuiBids' estimated profits have been reduced to $835,179.14, or only 41.57% of the estimated value we attained when we assumed that bidders didn't use

Buy-Now. This is actually still quite good news for QuiBids, because based on our model, we estimate that QuiBids has a significantly positive profit with its current rules and features.

5.2.2 Consumer Retention

Given that we have the expected revenue contribution for each bidder in our complete auction bid histories including the effects of Buy-Now, we can again calculate if the majority of QuiBids' revenue is coming from experienced or inexperienced bidders. Using Augenblicks definition of an experienced bidder (>50 bids [1]), we find that $34,195.80 (69.9%) of revenue comes from experienced bidders, while $14,742.00 (30.1%) comes from inexperienced bidders. Using our other definition of experienced bidders (>100 bids), we find that $21,683.40 (52.2%) of revenue comes from experienced bidders, while $19,986.60 (47.8%) comes from inexperienced bidders. Again we find that according to both definitions of an experienced bidder, the majority of revenue comes from experienced bidders, in stark contrast to studies on Swoopo (e.g. Wang et al. [4], Augenblick [1], and Zheng et al. [5]). This further supports our belief QuiBids is far better equipped to remain profitable in the long run than other auctions have been in the past because of its ability to retain users.

5.3 Including Buy-Now Effects, Excluding Voucher Bids

Based on our earlier calculation that voucher bids are worth only $0.0266 with QuiBids' rules, we can conclude that users should almost never bid on voucher bids. This is because 94.0% of bid voucher auctions come with packs of 50 or less bids. The real values of these bid packs are therefore less than or equal to $50 \times \$0.0266 = \$1.33$. The minimum amount a user must spend to acquire one of these bid packs is the sum of the price of a single bid ($0.60), the transaction fee ($1), and the lowest possible ending price ($0.01). This means the packs are purchasable for a minimum of $1.61 and therefore have a minimum price that is higher than their value. Therefore no bidders should ever participate in these auctions.

Based on the fact that buying most bid vouchers is therefore irrational, we should look at QuiBids' estimated profits based on completely rational behavior. In order to calculate this we simply deduct the previously calculated profit QuiBids makes from bid voucher auctions from Section 4.2 ($998,151.87), from the estimated profit with rational bidder use of Buy-Now in Section 5.2.1 ($835,179.14), and find that QuiBids' expected profit with rational Buy-Now use and without voucher bids is -$162,972.73. This casts the future of QuiBids somewhat in doubt because this shows that with bidders that rationally approach voucher bid auctions, QuiBids would be taking a loss even before we add in operating costs.

6 Conclusions

By observing the behavior of QuiBids, we were able to determine two differences that likely led to the demise of Swoopo, while allowing QuiBids to survive. We showed QuiBids appropriately implemented a larger bidder bidder-to-auction ratio after the introduction of the Buy-Now feature and can infer that if Swoopo failed to similarly increase its own ratio, its profits would have suffered. We also showed that QuiBids continues to actively maintain its

bidder-to-auction ratio. Additionally, we showed that QuiBids' policy of disallowing the contribution of voucher bids' value to the Buy-Now feature significantly decreases the worth of voucher bids, and therefore increases QuiBids' short-term profit. Therefore Swoopo's policy of allowing voucher bids to partially contribute to the Buy-Now option may have contributed to its bankruptcy.

In determining QuiBids' expected profits, we first confirmed that without the Buy-Now feature, penny auctions would be extremely profitable if we ignore the consumer retention problem. We then go on to show that QuiBids is profitable (though much less so) even when we consider full rational use of the Buy-Now feature. Additionally, we showed that QuiBids gets the majority of its revenues from experienced bidders, meaning it has probably overcome the consumer retention challenges other penny auction sites were facing and potentially solved the revolving door problem.

Finally we showed that if bidders only derive benefits from monetary gain, bidders should avoid bidding in voucher bid auctions. Moreover, we showed that if bidders rationally ceased participating in these bid voucher auctions, QuiBids would be taking a loss. This means that the only reason QuiBids is profitable is because people behave irrationally.

In order to justify the currently observed behaviors as rational, bidders would have to derive some sort of positive externality from bidding on QuiBids. With all of the claims that penny auction sites should perhaps be considered gambling[8], we might suspect that bidders like QuiBids for the same reasons people like gambling. Penny auctions are very similar to a state lottery, which has negative expected value under most circumstances, but a potentially large payoff relative to the cost of the lottery ticket. Indeed it might be accurate to model the bidders we've described as experienced bidders instead as addicted bidders, similar to addicted gamblers. Quibids' exclusion of voucher bids in the win limit rules suggests that they also are engaging in a sort of price discrimination where they allow addicted bidders to fulfill their addiction only by bidding on relatively worthless items. Further investigation of the claim that bidders must derive positive externalities from bidding is warranted. If found to be true, this claim would justify the profits of a site like QuiBids and if refuted, might signal trouble for QuiBids and other penny auction sites in the future.

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Appendix A

Item Name	Value Price	Retail Price	Markup
Samsung-PN51D6500-51-1080P-3D-HDTV	$1,100.00	$952.84	15.44%
The-New-Apple-iPad-16GB-WiFi	$530.00	$499.00	6.21%
Jamo-S426HCS3-51-Home-Theater-system	$430.00	$300.00	43.33%
Palm-Harbor-Outdoor-Wicker-Chair	$220.00	$219.00	0.46%
Nambe-MT0254-Swoop-Bowl	$212.00	$190.00	11.58%
Universal-Remote-MX450-2-LCD	$200.00	$179.00	11.73%
Yamaha-YPT-230-61-Key-Portable-Keyboard	$144.00	$111.64	28.99%
10K-Gold-Onyx-Diamond-Butterfly-Pendant	$137.00	$99.95	37.07%
Garmin-Nuvi-2250LT-GPS	$99.00	$86.50	14.45%
Ogio-METRO-II-Backpack	$82.00	$60.72	35.05%
Adidas-ClimaLite-Navy-and-Gulf-Polos	$74.00	$60.00	23.33%
Burberry-Brit-for-Women-34-oz-Tester	$68.00	$34.00	100.00%
50-Kohls-Gift-Card	$51.00	$50.00	2.00%
50-Department-Store-You-Choose-It	$51.00	$50.00	2.00%
Kalorik-Carnival-Popcorn-Popper	$51.00	$40.00	27.50%
Fox-Racing-Soleed-Digi-Camo-Boardshort	$44.00	$35.00	25.71%
Jensen-JCR-275-Alarm-Clock-Radio	$35.00	$35.00	0.00%
50-Bids-Voucher	$31.00	$30.00	3.33%
WMF-10-in-PP-Flat-Silicone-Ball-Whisk	$30.00	$15.00	100.00%
Kalorik-Jug-Kettle	$27.50	$24.95	10.22%
25-Bass-Pro-Shops-Gift-Card	$26.00	$25.00	4.00%
Slap-Watch-Regular	$20.00	$20.00	0.00%
Axis-GK-310-Multimedia-Keyboard	$16.00	$15.00	6.67%
10-Walmart-Gift-Card	$11.00	$10.00	10.00%
15-Bids-Voucher	$10.00	$9.00	11.11%
		Average Markup:	**21.21%**

Figure 5: The 25 items we used to estimate the average value price markup.

Appendix B

In looking for easy ways to make profits on QuiBids, we found that QuiBids keeps a majority of inexpensive unprofitable (for the seller) auctions. A buyer should be able to make a small profit by taking advantage of this. The following calculations assume that other bidders would not change their bids in response to our strategy.

Most auctions with value prices less than or equal to $25 are gift cards, and therefore have value prices that are exactly equal to the retail value of the item (a value price markup of $0). This means that we can use a strategy where we bid until the value of our bids has reached the value price of the item. If we win the item before our allocated number of bids, we get the item for less than its value and make a profit equal to the value price of the item minus our cost of spent bids and the auction end price of the item. If we don't win the item in the allocated number of bids, we use the Buy-Now option to buy the item for its (fair) value price. However, because we have allocated bids such that their total value is equal to the value price of the item, using Buy-Now costs us nothing in addition to the bids we have already bought and used in the auction. Therefore our only loss is the $1 transaction fee QuiBids charges on most low priced auctions.

We can calculate our expected profit using this strategy by taking every auction with a value price of $25 or less, and looking at the maximum number of bids we could have submitted in every auction (the total number of bids in that auction divided by two). We can then calculate our theoretical costs from participating in that auction by taking the maximum possible number of bids submitted, multiplying this buy the bid fee ($0.60) and adding the auction end price of the item. For example, in an auction for a $25 gift card (value and retail price is $25) that lasted 30 bids, we would expect to have spent $30/2 \times \$0.60 + \$0.30 = \$9.30$ to win the auction, meaning we would expect a profit of $\$25 - \$9.30 = \$15.70$.

Instead, if the cost we expect to pay exceeds the value of the item, we take a loss of $1 in order to simulate using the Buy-Now option and losing the transaction fee. For example, in an auction for the same $25 gift card lasting 100 bids, we would expect to have to bid 50 times to win the auction. However we find that the value of 50 bids is $50 \times \$0.60 = \$30$, which is more than the value of the item. This means that we would have simply used the Buy-Now option when the value of our bids was equal to the value price of the item. This means we could use the Buy-Now option for no additional cost because the cost of our spent bids is at the value price. We still take a loss of $1 in this situation because of the transaction fee.

If we were to use this strategy on all items with a value price of $25 or less, we would make a profit of $3.56 on average per auction. The major downside to this approach is that it is difficult to make large profits because of the auction limit rules; however this is a potentially consistent way to make money on QuiBids.