

A Class Experiment: The Dollar Auction as a Teaching Tool to Demonstrate the Theories of Behavioral Finance

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ABSTRACT

This paper discusses how to use an interactive classroom exercise, the Dollar Auction, to demonstrate the effects many of the psychological traits and biases discussed in the behavioral finance literature can have on financial decisions. In a Dollar Auction, dollars are auctioned off to the highest bidder where the second highest bidder also pays their bid but receives nothing. During the typical Dollar Auction student behavior is consistent with the biases associated with behavioral finance. The paper also discusses how students can learn from these mistakes by formulating strategies to minimize the effects these biases have on future financial transactions.

INTRODUCTION

Individuals do not always act rationally. Shefrin (2000) argues that psychological biases have impacted all areas of finance. One of the goals of finance is to help students recognize and avoid suboptimal behaviors in monetary situations. Kahneman and Riepe (1998) contend that to do well investors must know their own cognitive and emotional weaknesses. The purpose of this paper is to present how an interactive classroom exercise, the Dollar Auction,¹ allows students to gain first-hand knowledge of the effects six characteristics of behavioral finance can have during financial transactions. The six characteristics examined are (1) following the herd mentality, (2) holding onto losers too long, (3) overconfidence, (4) updating prior beliefs too slowly, (5) putting more money into failures for which one feels responsible, and (6) risk-aversion for opportunities expressed as gains while risk-seeking for the same opportunity when it is expressed as a loss. Furthermore, the paper explores how students can apply the lessons learned from this exercise to avoid common mistakes in both investing and corporate finance applications.

In the typical Dollar Auction, students bid on one dollar bills. Through the course of the auction students generally exhibit each of the six aforementioned psychological traits and biases. As the exercise is repeated, even though students learn from past behavior, these biases continue to manifest themselves. At the conclusion of the exercise, a brief discussion concerning the results of the auction helps students identify, recognize, and avoid these biases in the future. The goal of the discussion is to demonstrate how easily these biases can affect behaviors in even the simplest of financial transactions. Van Eaton (2000) and Baker and Nofsinger (2002) both argue

¹ The Dollar Auction is generally credited to Shubik [1971].

understanding the effects of psychological biases can help one avoid the biases and may result in increased performance. Further, as noted by Shefrin (2000) while some of the investor errors caused by these biases can be minor, others can be fatal.

The rest of this paper is organized as follows. The next section discusses the pedagogical advantages of using an in class exercise to demonstrate the psychological traits and biases associated with behavioral finance. The methodology of the Dollar Auction and examples of common auctions are provided in the following section. Next, a description of the relationship between the typical results from the Dollar Auction and the basic psychological traits and biases utilized in behavioral finance is discussed. The following section provides remarks on how students can use this exercise and concepts from a typical Investments and Portfolio Management class to formulate strategies to minimize the effects of the psychological biases associated with behavioral finance. The final section concludes.

PEDAGOGICAL USE OF AN IN CLASS EXERCISE

As noted by Fels (1993), different people learn in different ways. Repetition in a variety of contexts is vital for the learning process. The exercise in this paper provides an additional means to cover the psychological biases associated with behavioral finance beyond the traditional lecture. Chang (2005) argues that while teaching financial theory is extremely important, the empirical evidence that either supports the theory or refutes it must also be examined. The Dollar Auction exercise provides a means where the students can be part of that discovery process. Cebula and Toma (2002) observed that student scores and comprehension increased when a financial market portfolio game was introduced. Likewise, Gremmen and Potters (1997) perform experiments in economics classes to test the effectiveness of exercises versus lecturing. They concluded that classroom exercises enhance the student learning outcome on exams relative to a lecture only control group. In class exercises also provide benefits beyond increasing student retention and comprehension. Pavlik and Nienhaus (2004) found that a simple option trading game increased student engagement. Additionally, the game allowed the professor to get to know the students better and provided a platform for judging the students level of comprehension. Balalan and Yost (2006) found that presenting the students with an interactive exercise provided an excellent means to engage the students in a strategic thinking activity where the professor could guide the process. Holt and McDaniel (1998) similarly argue that in class exercises promote learning at a deeper level. Nilson (1998) summarizes the research in the area and notes that exercises increase student motivation, provide for learning at a higher cognitive level, impart a greater appreciation for the subject, and increase the retention of the subject matter.

DOLLAR AUCTION METHODOLOGY AND EXAMPLES

The Dollar Auction is a relatively simple auction with one very important twist. One dollar bills are auctioned off in an oral ascending auction (English auction) with four simple rules:

1. The dollar bill will be sold to the highest bidder.
2. The second highest bidder must also pay his or her bid, but receives nothing.
3. Students may not collude during the auction.
4. The minimum increment for a new bid is \$0.05.

While the last rule is not necessary for the exercise, it helps to facilitate the exercise by decreasing the length of a single auction. For some classes, the denomination of a single dollar maybe too small, and thus \$5 or even \$20 may be more appropriate with the minimum increment for a new bid adjusted accordingly. As noted by Shubik [1971], the ‘no collusion’ rule is necessary for insuring that students are not able to block the auction. Shubik [1971] notes that without the rule a student could bid \$0.05 for the dollar and then state that if anybody else bids, then the student will immediately bid \$1.00 (or 5 cents more than the other students bid if the other student bids \$1.00 or more) guaranteeing that the next student who bids loses money.

The key component to the auction is the second rule. This auction is unique in that it places a heavy penalty for finishing second. An analogy in the equity markets would be placing a limit-buy order at a price just below the market level that is never executed because the stock immediately and permanently rises sharply. By placing the limit-buy at a price that was too low, the stock was never purchased and thus the opportunity to realize the gain was not available. Similarly, bidding too low in the Dollar Auction results in a missed opportunity for a gain and furthermore can even result in a loss.

Because of the penalty for finishing second, there is a fairly strong short-term incentive to keep bidding if you are currently in second place. Of course as soon as the second highest bidder increases his or her bid and becomes the highest bidder, a new second highest bidder is created. The new second highest bidder has the same incentive to increase his or her bid as the former second highest bidder. In many auctions, the dollar is sold to the highest bidder for more than a dollar. The dynamics of the auction are driven by the short-term incentive not to finish second which in the long-run leads to suboptimal decisions.

Although not all Dollar Auction exercises produce the same results, the following is a typical class session lasting about ten to fifteen minutes where six dollar bills are auctioned. The dollars were auctioned off sequentially and to save time payment arrangements were deferred until the end of the exercise.² The results are based upon a compilation of approximately 30 auctioning sessions where 4 to 8 dollar bills were auctioned off in each session. In addition, the Appendix lists the specific results for the two class sessions during which the exercise was performed. Allowing for a five to ten minute discussion following all of the auctions, the entire exercise can usually be completed in about fifteen to twenty minutes.

In the first auction, frequently five or six students bid on the dollar until about the \$0.30 to \$0.40 range. Once the bidding level reaches \$0.50 to \$0.60 usually only two students remain. These students each continue to bid until the dollar is selling for more than a dollar. At this point the auction slows down as each bid seems to take longer than the previous. Eventually, one of the students drops out and both students end up losing money. In the first auction, most of the bids are only \$0.05 (the minimum increment) higher than the previous bid until the bidding level reaches about \$1 and then the increment generally increases.

The pattern of the second auction frequently follows the first with two exceptions. There are generally fewer participants in the second auction and many of the bids are at increments larger than the minimum increment of \$0.05. In any case, the second dollar almost always sells for more than a dollar.

The third and fourth auction will frequently see new participants (i.e. some of the students who did not bid in either of the first two auctions will bid in the third or fourth auction). Sometimes these new participants will quickly drop out of the auction while in other auctions

² The auction will still work as long as the students think that the money will be collected; it is not necessary to actually collect the money.

they end up being one of the last two bidders. Additionally, it is not unusual for the highest bids to occur in the third or fourth auctions.

An auction that is frequently seen around the third or fourth auction is one in which the auction proceeds as usual with two to four participants until the price reaches the \$0.25 to \$0.30 range. At that point, a student (who may or may not have previously bid) bids \$0.95 confident that they have just made \$0.05. However, given that the previous bid was around \$0.25, that student frequently bids \$1 and the auction escalates from there. Another variant of this strategy frequently seen is where the student jumps to \$1 rather than to \$0.95 when the auction reaches the \$0.25 to \$0.30 level. When this occurs it is almost always the case that the student who bid \$1 was the second highest bidder at the time. Again, the student who made the previous bid at the \$0.25 to \$0.30 level has a short-term incentive to bid again and the auction escalates from there.

Behavior in subsequent auctions is less predictable. Auctions late in the process tend to take one of three forms. First, in many cases these auctions are fundamentally similar to previous auctions with one notable exception – fewer participants. Second, occasionally a student will open the bidding at \$1. More often than not, another student will then bid \$1.05 and the bidding escalates. When this happens, the dollar almost always sell for a new high and the person who bid \$1.05 is frequently somebody who finished second in an earlier auction to the student who originally bid \$1. Finally, it is not uncommon in the last auction (especially if the students know that it is the last auction) for that auction to have only one bidder. At this point it appears that the class is tired of losing money to the professor and they do not care who buys the dollar for a bargain, just so long as at least one dollar is sold for less than its intrinsic value.

Additionally, as noted by McAfee and McMillan [1987], as the size of the auction crowd increases, so does the number of bids and the bid frequency. Thus, the exercise works best when there are at least 15 students in the class. However, the exercise can still be successful with as few as 7 or 8 students. The next section discusses how the psychological traits and biases utilized in behavioral finance are typically exhibited by students as they participate in the Dollar Auction.

PSYCHOLOGICAL TRAITS AND BIASES OF BEHAVIORAL FINANCE AS DEMONSTRATED THROUGH THE DOLLAR AUCTION

A number of psychological traits and biases have been included in the literature on behavioral finance. Two survey articles that detail the literature on behavioral finance are Barberis and Thaler [2003] and De Bondt and Thaler [1995]. Textbook treatment of the psychological traits as they apply to behavioral finance can be found in Bodie, Kane, and Marcus [2005, p. 396-399] and Reilly and Brown [2006, p. 189-190].

During the Dollar Auction, students usually exhibit at least six of these characteristics. While each of the six characteristics listed above are not generally present in any one auction, they all tend to manifest over the course of three or four sequential auctions. Early in the auction process (especially for the first auction) students often get caught up in the process and as many as 6 or more students will bid on the first dollar auctioned. This is a clear example of the ‘following the herd’ mentality. With more students bidding, the likelihood of the first auction escalating is fairly high. As noted by Shubik [1971], it is easily possible to sell the single dollar for three to five dollars. This is frequently the case for the first auction and demonstrates the market volatility and danger associated with following the herd when the herd is wrong.

Additionally and even more striking is the frequency at which students who did not participate in either of the first two auctions ‘join the herd’ and participate in the third or fourth auctions.

In general, while the number of bidders participating in subsequent auctions tends to decrease, the price at which the dollar is sold does not. As noted previously, it is not unusual to sell five to seven additional dollars all for more than a dollar. These dollars are all frequently sold for more than a dollar as students adopt a short-term mentality where each additional bid has a positive expectation under the assumption that other students will not continue bidding. This behavior illustrates three separate behavioral finance biases. First, students tend to hold on to losers for too long. When only two students remain in the auction and each has bid over a dollar, they are both already positioned to lose money. However, more often than not the auction does not stop there. In Muringhan, [2002], \$20 bills were sold in a similar auction for \$250 and \$2,000.³ As noted by the author, these were ‘very extreme’ results.

Second, students are overconfident in their ability to outbid other students. Even after two or three auctions have all sold dollars for more than a dollar, students will continue to play the game. Thus, the students are also exhibiting the bias where they are slow to update their beliefs. When asked about this behavior after the auctions are over, students usually agree that they were overconfident in their ability to outbid other students.

Frequently, the same student or group of students will participate in the later auctions even if they have lost money in previous auctions. After the auctions are over, their explanation for this behavior is that they felt that they needed to make up for the prior losses. These students are clearly exhibiting an escalation bias as they are putting more money into failures that they feel responsible for rather than into successes.

When there are only two students bidding on the dollar and the auction slows down, comments like “if you don’t bid then you owe me X, and you don’t get anything in return” or “well, it looks like you are going to lose X dollars” usually gets the auction going again. Phrases such as these change the way in which the student views additional participation in the auction from an “if I bid what can I gain” mentality to a “if I don’t bid, what do I lose” thought process. This illustrates the typical framing bias where students are risk-averse for gains but are risk-seeking for losses.

MINIMIZING THE IMPACT OF THE PSYSHOLOGICAL BIASES

As noted by Belsky and Gilovich (1999), the biases associated with behavioral finance can be hard to overcome. Nofsinger (2001), Baker and Nofsinger (2002), and Hirshey and Nofsinger (2008) provide detailed strategies to reduce the effects of these biases. These discussions can roughly be summarized by three steps. The first step to reducing the impact of these psychological biases is to learn to recognize the effects of these biases in our own behavior. The Dollar Auction and the accompanying class discussion can provide a relatively safe mechanism for students to begin to achieve this goal. Additional steps for mitigating the effects of these biases directly utilize material traditionally covered in an Investments and Portfolio Management classes.

The second step to reduce the effects of the biases associated with behavioral finance is to maintain a well-diversified portfolio. A well-diversified portfolio reduces risk by ensuring that no single asset or asset class is overweighted (or underweighted) in an investment portfolio.

³ It should be noted that in both of these auctions, the professor did not collect the entire amount owed by the students.

The last step is to establish objective investment criteria. These measures include determining the criteria for when to buy and when to sell assets and setting conditions for when to rebalance the portfolio.

Each of the biases associated with behavioral finance can lead to suboptimal behavior on the part of the investor. However, once the student begins recognize the effects of these biases, diversification and objective investment criteria can help to minimize their effects. The bias associated with a following the herd mentality causes traders to purchase stocks because they are trendy. Following a set of objective investment criteria for when to buy and when to sell stocks decreases the effect of this bias. Likewise, the effect of losing additional money because investors tend to hold onto losers too long can be similarly mitigated by following a predetermined set of investment criteria. Overconfidence causes investors to both trade too often and to take too much risk. Maintaining a well-diversified portfolio and following objective investment criteria both decreases the effect of this bias. When one updates their beliefs too slowly, they are not rebalancing their portfolio often enough. Following a set of investment criteria for when to rebalance a portfolio and maintaining a well-balanced portfolio can mitigate this effect. Investors will chase losses when they put more money into failures for which they feel responsible. Both maintaining a well-diversified portfolio and following investment criteria decrease the effect of this bias. When one is risk-averse for opportunities expressed as gains while being risk-seeking for the same opportunity expressed as a loss they tend to miscalculate the risk of an asset. Maintaining a set of investment criteria helps to minimize the magnitude of this bias while maintaining a well-diversified portfolio decreases its effect.

The effects of these biases extend beyond investing. Corporate finance decisions can also be affected by these biases. Two of the most important corporate finance decisions are capital budgeting and capital structure.

Capital budgeting is arguably the most importance corporate finance activity. However, capital budgeting is very susceptible to the biases associated with holding onto losers too long, overconfidence, and putting more money into losers for which one feels responsible. Each of these biases could easily cause the firm to misallocate resources among departments or projects. As mentioned earlier, the bias associated with being risk-averse for opportunities expressed as gains while being risk-seeking for the same opportunity expressed as a loss causes one to miscalculate the risk of an investment or project. This tendency would also increase the likelihood for misallocation of resources.

Achieving the optimal capital structure can be one of the most difficult goals for a corporation. Decisions regarding capital structure issues would be particularly susceptible to the follow the herd mentality. If a company sets its capital structure based upon the capital structure of its competitors and not based upon detailed analysis, then the structure is likely to be suboptimal. Additionally, if one updated prior beliefs too slowly, then it is unlikely that a firm could maintain the optimal capital structure over time.

By introducing students to the biases associated with behavior finance via a simple in class exercise, they have the opportunity to both recognize these biases in themselves and witness first-hand the financial impact of these biases. Recognition of these biases is the first step to helping students avoid the pitfalls associated with these biases in both an investments and a corporate setting. Only after the potential effects of the biases are known and understood can students begin to fully and appropriately utilize their financial education.

CONCLUSION

O'Neill [1986] and by Leininger [1989] conclude that the optimal strategy for the Dollar Auction is simply not to play. Unfortunately, for many investing and corporate finance applications this solution is not feasible. Students need to understand how various psychological biases can lead to suboptimal financial behavior. At the conclusion of the bidding portion of the Dollar Auction, a short discussion of the exercise can be used to demonstrate how many of the suboptimal actions of the students are consistent with outcomes predicted by the theories underlying behavioral finance. The discussion can also include strategies to mitigate the effects of the psychological biases in both investment and corporate finance settings. Parallels between the escalation present in the Dollar Auction and real world conflicts have been made by Beamer and Lewis [2003] relative to labor negotiations, Leininger [1989] for arms races, and O'Neill [1986] for international disputes.

Whether for investing or the above listed conflicts, the Dollar Auction allows students to experience first-hand how various psychological traits and biases can lead to suboptimal tactics and inferior long-term strategies. These psychological traits and biases include: (1) following the herd mentality, (2) holding onto losers too long, (3) overconfidence, (4) updating prior beliefs too slowly, (5) putting more money into failures for which one feels responsible, and (6) risk-aversion for opportunities expressed as gains while risk-seeking for the same opportunity when it is expressed as a loss. The Dollar Auction provides an easy to implement teaching exercise that takes little class time and that students enjoy. Additionally, because this exercise is presented in an investment setting, students have the opportunity to recognize and identify the financial implications of these suboptimal behaviors. Students also learn how to synthesize information from other aspects of their finance classes to formulate strategies to avoid these suboptimal behaviors in future financial transactions.

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APPENDIX:

Tables 1 and 2 show the results for Dollar Auctions performed in Investments classes during the fall of 2006. The students in Table 1 were graduate students while the students in Table 2 were undergraduates. In each auction, the dollar was sold to the highest bidder for at least a dollar. The last column in each table shows the number of different individuals who participated in the auction indicated. In the graduate class, eight of the 18 students bid in at least one of the auctions. Similarly, in the undergraduate class, nine of the twenty-two students bid in at least one auction. In the first class, four one dollar bills were sold for a total of \$8.50 while in the second class four one dollar bills were sold for \$11.10. The entire auctioning process took less than fifteen minutes for both classes.

Table 1
 Dollar Auction Results
 Graduate Class

	Student A	Student B	Student C	Student D	Student E	Student F	Number of Bidders
Auction 1							5
Highest Bid	1.00						
Second Highest Bid		0.95					
Auction 2							3
Highest Bid			1.00				
Second Highest Bid				0.90			
Auction 3							4
Highest Bid				1.10			
Second Highest Bid					1.05		
Auction 4							2
Highest Bid				1.50			
Second Highest Bid						1.00	

Table 2
 Dollar Auction Results
 Undergraduate Class

	Student W	Student X	Student Y	Student Z	Number of Bidders
Auction 1					6
Highest Bid	1.25				
Second Highest Bid		1.05			
Auction 2					4
Highest Bid		1.05			
Second Highest Bid			1.00		
Auction 3					3
Highest Bid			2.15		
Second Highest Bid				2.10	
Auction 4					2
Highest Bid	1.50				
Second Highest Bid			1.00		