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Pricing in Auction Markets for Collectibles: Theory and Experimental Evidence

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Abstract

This study investigates the pricing of collectibles. A model of an auction market for collectibles is induced from the results of prior empirical studies. Results indicate that overbidding by non-professionals forces professionals out of the market, ensuring that investments in collectibles return less than zero net present value. Heterogeneous expectations on the part of non-professionals make it likely that at least some non-professionals overbid for collectibles. Also, collectible enthusiasts derive utility from both financial returns and the pleasure associated with holding collectibles; hence they are willing to pay a premium—called a pleasure premium—to own the asset.

Introduction

Alternative assets constitute a broad class of investments, ranging from hedge funds, venture capital, infrastructure and real estate to artwork and other collectible items. As of year-end 2011, there were $6.5 trillion worth of alternative assets under management globally; during 2005-2011 the growth rate of alternative asset holdings was 14% per year—seven times that of traditional assets (McKinsey & Company, 2012). Fuelling such growth are investment advisory firms like BlackRock, which tout the diversification and return benefits of holding alternative assets.[1,2] This study focuses on a category of such assets comprising artwork, wine, antiques, and other similar assets (henceforth "collectibles").

Articles in popular media indicate that investors see collectibles as worthwhile investments (Jannarone 2011). Rudimentary collectibles market indexes often report impressive returns. For example, the Historic Automobile Group International (HAGI) Top Index, which is published monthly on the Financial Times website, often outperforms the S&P index and HAGI proclaims that investing in historic cars is "better than gold."[3] According to academic studies, however, collectibles do not generate risk adjusted abnormal returns (Renneboog and Spaenjers, 2012) and are unlikely to improve the diversification of risk when added to financial asset portfolios (Pesando and Shum, 2008). Moreover, collectibles generally exhibit much less liquidity and higher transaction costs than financial assets with similar risk.

This study investigates the utility participants derive from collectibles and the prices they are willing to pay for them using data gleaned from an experiment involving human subjects. An auction market model is induced from the results of prior empirical studies, incorporating characteristics of professional and non-professional investors. Some predictions of the model are then developed and tested. Given the distribution of prices subjects are willing to pay for various collectibles, an analysis is conducted to determine the probability of various investors purchasing collectibles at prices that generate abnormal returns, i.e., positive net present values (NPVs).

The results indicate that profit-maximizing investors are unlikely to earn abnormal returns by investing in collectibles and are likely to be forced out of the market if they can only participate in public auctions. This exclusion stems partly from a utility premium—henceforth called a "pleasure premium"—that a subset of non-professional investors include in collectibles' prices because, as suggested by Anderson (1974), such investors derive consumption services or other forms of pleasure from holding the assets. However, it also stems from non-professional investors having heterogeneous expectations as to the value of collectibles. The results indicate that when such investors attend public auctions, it is very likely that at least one will over-bid for assets even when they do not derive pleasure from holding them. Overbidding by non-professionals drives professionals from the auction market and causes investments in collectibles to exhibit returns that are inferior to those of financial assets. The model and experimental methodology provide a simpler alternative to computationally complex heterogeneous agent models while retaining intuitive results.

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[1] The New Diversification: Open Your Eyes to Alternatives, BlackRock (2013).

[2] http://www2.blackrock.com/us/individual-investors/products-performance/alternative-investments

[3] http://www.historicautogroup.com/. The site indicates "…HAGI™ is an independent investment research house and think tank with specialised expertise in the rare classic motorcar sector. The group has created benchmarks which track this alternative asset class accurately for the first time, using rigorous financial methodology usually associated with more traditional investments."

The paper proceeds as follows. The next section reviews the relevant literature on collectibles and develops hypotheses as to their pricing that are consistent with evidence presented in prior studies. This is followed by the introduction of the auction market model and a description of the experiment. After a presentation of empirical results, the paper concludes with a discussion of implications, limitations and suggestions for future research.

Literature Review and Hypothesis Development

Anecdotal evidence suggests that investments in alternative assets like collectibles provide benefits such as abnormal returns and portfolio diversification (see, for example, Kumar's *Wine Investment for Portfolio Diversification, How Collecting Fine Wines Can Yield Greater Returns than Stocks and Bonds*). According to The World Wealth Report:

> In 2011, young HNWIs [High Net Worth Individuals] from emerging markets showed themselves to be an especially powerful force behind many of the classes of IoP [Investments of Passion, including art, jewelry and memorabilia], and especially those that are seen as solid investments likely to appreciate in value over time and/or offer a low correlation to mainstream financial instruments. (Capgemini, 2012, p. 24, words in parentheses added.)

Moreover, several reality-TV shows feature investors generating enormous returns from investments in homes (*Flip This House*), storage lockers (*Storage Wars*), cars (*Counting Cars*) and pawnable items (*Pawn Stars*). Although the episodes likely constitute a biased sample of successful investments, they implicitly invite watchers to wonder if they could achieve similar success by participating in such activities.

Academic studies paint a relatively gloomy picture of collectibles as investments. Mei and Moses (2002) report that equity investments outperform artwork investments but artwork investments outperform fixed-income investments and may enhance portfolio diversification; however, investments in masterpieces underperform those in artworks not classified as masterpieces. Ashenfelter and Graddy (2003) report that artwork tends not to provide risk-adjusted abnormal returns; however, the results are mixed. More recent studies show that collectible investments do not provide diversification benefits (Pesando and Shum, 2008) or significant abnormal returns (Renneboog and Spaenjers, 2012); the latter study claims that prior studies exhibit estimation issues and sample biases that impede the reliability of their results. Thus, academic research indicates that there is little or no financial benefit to investing in collectibles; or the evidence is ambiguous at best.

Why, then, do investors participate in the market for collectibles? This study hypothesizes and finds that the answer lies in the composition of investors' utility functions and in the heterogeneity in their expectations as to asset values.

Investors' Utility for Collectibles

The assumption that investors seek to maximize expected utility, deriving utility only from purely financial returns, underpins much of modern finance. Other branches of economics posit procedural utility, whereby individuals derive utility from sources other than financial or other instrumental outcomes:

> In a simple microeconomic analysis, procedural utility enters the utility function in addition to any instrumental arguments of utility. Thus it is possible to trade-off

> procedural utility against the other arguments. This can be practiced in the equilibrium approach of compensating variation: if, for example, workers intrinsically value a specific organizational procedure, they should be willing to accept a lower wage (a worse instrumental outcome) in order to work in an organization that is applying it (Frey, Benz, and Stutzer, 2003, p. 20).

This broader notion of utility implies that individuals derive utility from holding collectibles as well as realizing financial returns from buying and selling them. Consistent with this view, a CNBC article "Antiques Can Mean New Life For Your Portfolio" features an antique dealer claiming that clients base decisions to buy antiques chiefly on emotional or personal preferences, with financial returns being secondary: "…If [the antique] turns out to be only an OK investment, it still paid a dividend everyday because they got to enjoy it."[4]

In a similar vein, Anderson (1974) posits that artworks are inherently different from financial assets as they provide both financial and consumption services. Financial services depend on the expected future value of the assets and their associated risk; consumption services stem from decorative and aesthetic-prestige services. Any systematic underperformance of collectibles as investments relative to financial assets is consistent with investors having paid for consumption services as well as financial services. Mandel (2009) models the consumption component of art value as increasing with price; he refers to this as conspicuous consumption and proposes that "utility dividends" increase with the value of artworks held. Using a consumption-based CAPM and a simulation model, he predicts returns and risk premia for art assets; he then compares simulated results with empirical results reported in prior studies (e.g., Mei and Moses, 2002). Mandel does not, however, address the primary research question in the present study: Can purely profit maximizing investors participate in the market for collectibles? Moreover, Mandel only partially generalizes the results of the CAPM/simulation model.[5] The current study's theoretical model, experimental design and probability analysis differ significantly from Mandel's methodology.

The works cited above motivate the first hypotheses (stated in alternate form):

Hypothesis 1: Individuals who derive non-financial utility from holding assets include a pleasure premium in the maximum price they are willing to pay for the assets.

Mei and Moses' (2002) finding that the returns from investing in masterpieces are generally less than those from investing in non-masterpieces is consistent with Hypothesis 1. As was noted earlier, utility from vanity or conspicuous consumption may be derived from holding masterpieces as status symbols (Mandel 2009). If masterpieces yield higher consumption benefits than non-masterpieces for some individuals, then those individuals are willing to pay a premium for masterpieces, ceteris paribus. To the extent that non-financial utility is reflected in the prices of masterpieces, the financial returns from investments in masterpieces are likely to be less than those of non-masterpieces as well as those of equity securities.

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[4] http://www.cnbc.com/id/39444057/Antiques_Can_Mean_New_Life_For_Your_Portfolio

[5] Mandel (2009) states: "Though applied to the low or negative risk premium observed for indexes of art, the logic of the model is by no means limited to paintings. The same could be said of any good with a low rate of depreciation that is conspicuously consumed, any good with sentimental value, or, more broadly, any good or investment with nonpecuniary benefits. What is important is the potential."

It is hypothesized that only some investors include pleasure premia in the prices they are willing to pay for collectibles; others, termed "professionals," are only willing to pay prices that reflect purely monetary returns and thus do not include a pleasure premium. In such a market with heterogeneous agents, recent studies suggest that the standard representative agent model does not necessarily predict market outcomes.

Heterogeneous Agent Models

Hommes (2005) reviews the heterogeneous agent model literature. Several works in this vein are particularly germane to this study. Simon (1957) presents a theory of bounded rationality, positing that individuals often have insufficient resources—such as time, intellectual ability, capital and computational technology—to make optimal decisions. Instead of optimizing, they satisfice: they use rules of thumb or other simplistic procedures to make satisfactory decisions. Bounded rationality spawns heterogeneous expectations since individuals with superior resources can more accurately determine the likely monetary payoffs from assets like collectibles. Consistent with this view, Higgs and Forster (2014) find that the auction prices of Australian artists' paintings tend to be higher after announcements of the artists winning portraiture prizes, suggesting that some successful purchasers at auctions are not fully informed concerning the value of artwork.

Shiller (1984) posits that one group of rational investors with superior ability face "risk" because they know the probability distributions of future outcomes of investing in securities. A second, irrational group faces "uncertainty" because they do not know the distributions. Sandroni (2000) finds that rational agents drive irrational agents out of complete markets. In incomplete markets, however, Blume and Easley (2002) find that rational agents do not always drive out irrational agents.[6] Indeed we posit that in the collectibles market, which is inherently incomplete and often conducted as an auction market, agents who appear to be economically irrational, by virtue of their willingness to pay pleasure premia, tend to drive professionals out of the market by overbidding. This leads to the second hypothesis (stated in alternate form):

Hypothesis 2: Professionals are likely to be out-bid by agents who exhibit non-zero pleasure premia; hence, professionals are unlikely to generate expected profits in the collectibles market.

An auction model is developed to facilitate testing the hypotheses and exploring their implications in an experimental setting.

Auction Model

Auctions are often used to sell collectibles. To capture the salient features of auctions suggested by the literature review, a simple setting is considered where bidders are endowed with fixed information; there are no costs to enter the auction, no collusion among bidders and no game theory strategies. The auction proposed is a second-price, sealed-bid, or Vickrey auction in which bidders privately submit bids without knowing others' bids. The asset is sold to the

[6] Arthur (1995) explores the implications of a bounded rationality model in which some agents' predictions of the likelihood of future outcomes are based on their predictions of others' predictions. Arthur's simulation indicates that when agents' expectations are distributed around fundamental expectations, price bubbles and crashes occur, much like those witnessed in actual markets.

highest bidder for the second highest sealed-bid amount. Given the restrictions on the auction setting, the second-price auction is equivalent to an ascending or English auction (Klemperer, 1999), which is commonly used to sell collectibles.

A chief goal of the study is to determine the sealed-bid prices of individuals called "type-A agents" (professionals) and "type-B agents" (non-professionals). As described in the next section, type-A and type-B agents have different utility functions pertaining to collectibles and differ in their ability to price assets that yield only monetary payoffs. Agents at the auction follow a private-value model in which all agents have predetermined prices they are willing to pay for the assets; other bidders do not know those prices. In this setting it is optimal for all agents to bid their maximum purchase prices since securing the collectibles at any price up to and including the maximum provides the required utility at a satisfactory price.

It is also assumed that agents' appetites for assets are unsatiated after making a purchase and they do not have budget constraints. These two characteristics result in all agents participating and placing bids for all assets offered for sale. The number of agents at the auction can vary. As will soon be apparent, the auction model's predictions and decisions to reject the null hypotheses depend on the number of agents attending the auction.

In the auction model developed below, agents are assumed to have heterogeneous utility and heterogeneous expectations. Heterogeneous utility is defined as utility that varies across agents. Heterogeneous expectations are defined as variability in agents' pricing of assets. The aim is to create a simple and intuitive model as suggested by Hommes' (2005) review of the literature on heterogeneous agent models (HAMs):

> The search for a (large) computational agent-based HAM capturing the stylized facts as closely as possible deserves high priority. But at the same time one would like to find the simplest behavioral HAM (e.g. in terms of number of parameters and variables), with a plausible behavioral story at the micro level, that still captures the most important stylized facts observed at the aggregate level. The simplest HAM can then be used to estimate behavioral heterogeneity in laboratory experimental and/or empirical time series data. Simple and parsimonious HAMs can thus help to discipline the wilderness of agent-based modeling (p. 58).

We begin by developing two-agent models and then proceed to *n*-agent models with increasing degrees of heterogeneity with regard to utilities and expectations.

Two-Agent Model

Assume that two types of investors participate in alternative asset markets: Agents A and B. Agent A, a professional investor, is a profit-maximizer who derives utility solely from monetary returns:

$$U_A = U(P_a) \tag{1}$$

where $U(P_a)$ is Agent A's financial utility associated with purchasing the asset at price P_a. The highest price at which the professional is willing to purchase the asset is the discounted value of the asset's future selling price:

$$P_a = \frac{fv}{(1+i)^t} \tag{2}$$

where *fv* is the future value, or future selling price of the asset, *i* is the discount rate, and *t* is the number of discounting periods. It is assumed that the discount rate does not vary across agents but expected future values can vary across agents. At price P_a Agent A's net present value (NPV) of the investment is zero. He therefore purchases the asset if $P \leq P_a$.

Agent B is a collector who derives both financial utility from monetary returns and consumption utility from owning the asset:

$$U_B = U(P_b) + U(\omega) \quad (3)$$

where $U(P_b)$ is Agent B's financial or monetary utility derived from purchasing the asset at price P_b and $U(\omega)$, $\omega \geq 0$, is Agent B's consumption utility associated with holding the asset. Given the definition of P_a, define:

$$P_{a_{max}} = P_a \quad (4)$$

where $P_{a_{max}}$, the maximum price at which Agent A will purchase the asset, is equal to the price at which NPV = 0. Agent B's maximum price is defined as:

$$\psi_{b_{max}} = P_b + \eta = \psi_b \quad (5)$$

where $\psi_{b_{max}}$ is equal to P_b, the expected present value of the asset's expected future cash flow, plus η, which is defined as the monetized value of the utility generated by holding the asset, $U(\omega)$. Since $\omega \geq 0$, the monetized value of the utility must be non-negative: $\eta \geq 0$.

First consider the case of homogeneous expectations and homogeneous utility. It then follows trivially that Agent A can never purchase the asset at auction unless Agent B's premium is $\eta = 0$. Now relax the homogenous expectation assumption and define P_b as a random variable with mean P_a and standard deviation σ:

$$P_b \sim f(P_a, \sigma) \quad (6)$$

First suppose that $\eta = 0$ so that non-financial utility is homogeneous across agents. Agent A's price is then fixed, while Agent B's price is drawn from a distribution with Agent A's price, P_a, as the mean and with standard deviation σ. In this asymmetric information setting, Agent A has expertise in valuing the assets and so is able to determine the correct expected future cash flow (*fv*) associated with the asset. Agent B does not have such expertise in pricing the assets and will generally incorrectly price the asset at a premium or discount relative to the professional's estimated value.

Consider the following scenarios:

(a) $P_a > P_b$: In the second-price sealed-bid Vickrey auction, Agent A purchases the item for the price P_b and realizes an excess return, ε:

$$\varepsilon = P_a - P_b \quad (7)$$

(b) $P_a < P_b$: Agent B then purchases the item for the price P_a and realizes zero NPV. This occurs because Agent B cannot purchase the item at a price less than the price at which the true NPV is zero because Agent A will bid up to and including this price. It is assumed, however, that the minimum bid increment is infinitely small; hence if $P_a < P_b$, then Agent B's NPV is zero.[7]

***n*-Agent Model**

Now suppose that there are *n* type-B agents, again imposing the restriction $\eta = 0$ so that nonfinancial utility is homogeneous across agents. Adding additional type-A agents does not alter the results as all type-A agents act the same way. Then:

[7] More generally, if Agent B purchases the asset for the price P_b, she realizes a loss (or negative NPV) of τ: $\tau = P_b - P_a$. This would not occur in a Vickrey auction, however, for the reasons given in the text.

(c) Suppose $P_a < P_{b_1} < P_{b_2}$: Then Agent B_2 purchases the item and generates a loss τ equal to:

$$\tau = P_{b_1} - P_a \tag{8}$$

In this case, since $P_b \sim f(P_a, \sigma)$, one expects at least some type-B agents to submit bids in excess of P_a but no type-B agent can earn excess financial returns and Agent A will never realize a loss since Agent A will not submit a bid in excess of the true present value.

Assuming there are *n* type-B agents in the pool of bidders and assuming normality of the distribution, the estimated probability of Agent A purchasing the asset at auction is:

$$prob_a = 0.5^n \tag{9}$$

In this scenario, Agent A is likely to be driven from the market because at least one type-B Agent is likely to overprice the asset and submit the winning bid. Type-B Agents earn negative abnormal returns because of asymmetric information and overpayment. A pleasure premium is not necessary for Agent A to be forced from the market. However, as the next paragraph shows, relaxing this assumption further reduces the probability that Agent A buys the asset.

Relaxing the restriction $\eta = 0$ implies that Agent A purchases only if $P_a - \psi_{b_i} \geq 0$ and, extending the definition of ψ_b to include *n* agents, $\psi_{b_{ij}} = P_{b_{ij}} + \eta_{ij}$ for a given asset *j*. The monetary value of the pleasure premium η_{ij} is determined by personal preferences and represents the non-financial utility associated with asset *j* for agent *i*. Since $\eta \geq 0$, Agent A purchases the asset only if all type-B agents price the asset at amounts less than the price at which NPV = 0 for Agent A, i.e., the true present value. Since $P_b \sim f(P_a, \sigma)$, however, it is virtually certain that at least one type-B agent will bid more than P_a when the number of type-B agents attending the auction is large. The question of how "large" the number must be to ensure this can only be investigated using empirical data—a task that is undertaken in the next section of the paper.

Consider the case where Agent B's maximum purchase price occurs when $\eta_{ij} = 0$ and therefore $\psi_{b_{ij}} = P_{b_{ij}}$. This individual generates only financial utility from owning the asset. Consistent with Higgs and Forster (2014), however, Agent B is not fully informed about the value of the collectible; hence, the agent is unlikely to price the asset correctly since $P_{b_{ij}} \sim f(P_{a_j}, \sigma)$. This individual is referred to as a "non-enthusiast" type-B agent. A type-B agent with $\eta \geq 0$ is termed an "enthusiast."

Asset-Pricing Experiment

Two implications of the auction model are investigated in an experimental setting. First, the experiment seeks to determine if a pleasure premium is incorporated in the prices of collectibles, i.e., whether there exists $\eta_{i_j} > 0$. Second, the distribution of asset prices facilitates the computation of the probability that a type-A agent succeeds in purchasing the asset, given the number of type-B agents attending the auction. The research design also facilitates partitioning participants into art enthusiasts and non-enthusiasts exhibiting disparate pricing distributions for the assets at auction. This provides an opportunity to determine whether enthusiasts exhibit larger pleasure premia than non-enthusiasts.

This experimental setting has at least two advantages over prior archival studies using empirical data from auction houses. Archival data do not generally include information as to bidders' characteristics (enthusiast, non-enthusiast, professional). Moreover, they do not include the maximum prices individual bidders were willing to pay; they only contain the prices paid by winning bidders. The experiment in the present study allows for the measurement of proxies for these amounts. A disadvantage of the experiment is the question of whether it achieves external validity.

Experimental Design

The experiment is a mixed factorial design combining a within- and a between-subjects design. The within-subjects variables are the assets that participants are asked to value and the between-subjects variables are demographic variables such as gender, year of study and interest in art (enthusiast vs. non-enthusiast). Multiple regression methods are thus appropriate for analyzing the data.

The experiment was conducted in a controlled classroom setting under the supervision of a PhD student. Undergraduate business school participants volunteered to join a Student Research Pool, thereby becoming eligible to garner an increment of one final grade in one eligible course by participating in three hours of experiments. The time to complete the experiment for this study averaged about ten minutes in which participants responded to questions related to asset valuation scenarios and demographics. Asset valuation scenarios were randomized within the experiment but the scenarios always preceded the demographic questions.

Participants were asked to price a known and unknown asset for each of the following categories: stocks, bonds, art, antiques, collector automobiles and vintage wine. Appendix 1 lists the names of the assets. For example, the known painting (PAINT K) is a work by Pablo Picasso, whereas the unknown painting (PAINT U) is a work by a fictitious artist, Alonzo Villa. Participants were given a guaranteed future value of the asset in ten years and were asked to provide the maximum amount they would be willing to pay for the asset today, assuming they had the resources to make the purchase. Participants had the option of choosing from a list of potential purchase prices or providing their own price. Appendix 3 provides a list of the experimental scenarios.

Two forms of bias can impact the results of studies like this one. Anchoring bias occurs when individuals overly rely on a reference point provided; e.g. $100,000 future value of the asset (Tversky and Kahneman, 1974). Although this bias may impact the subjects' valuation, the anchor is the same for each collectible item across enthusiast and non-enthusiast groups. There is no evidence to suggest that the anchor differentially impacts enthusiasts and non-enthusiasts and because we are primarily interested in the pricing difference between these two groups, anchoring does not significantly impact our results.

The second potential bias is familiarity bias, which occurs when individuals prefer that which is familiar over that which is novel (see Baker and Nofsinger, 2002 for a discussion of familiarity bias' impact on investors). Familiarity bias may impact our results in two ways. First, our subjects are likely more familiar with financial assets compared to collectible assets and this may impact the perceived risk associated with the asset. For example, financial assets may be perceived to be less risky if the subjects are more familiar with stocks and bonds compared to collectibles. However, guaranteed future values of the assets were provided in the scenario which implies that the assets are risk-free. All participants in the study had formal business training and we assume that the participants understand that a "Pablo Picasso painting that you are certain will be worth $100,000 (no more, no less) in ten years" implies a risk-free asset. Second, if the riskless nature of the assets was not identified by the participants, familiarity bias would predict that more familiar assets are less risky. Participants are drawn from a pool of undergraduate business school students suggesting that stocks and bonds are likely more familiar than collectible assets. We explore this source of bias in the next section.

The demographic variables included questions relating to the degree to which the participants considered themselves enthusiasts of each of the collectibles, whether they would consider purchasing the assets as investments, whether they owned the assets as investments and whether they were familiar with each of the collectibles. Additional questions included: year of study, area of specialization, number of courses taken in Finance or Economics, gender, whether the individual participated in a previous asset pricing study, and the level of effort expended in completing the study. Appendix 1 provides summary statistics for the characteristics of the participants in the experiment.

Table 1 – Pricing Outcomes

	Average Price	% of Future Value	Standard Deviation	Weighted St. Deviation
PAINT U	$58,700.00	58.70%	$24,196.85	24.20%
PAINT K	66,282.50	66.28%	24,846.49	24.85%
STOCK U	61,335.00	61.34%	22,194.95	22.19%
STOCK K	60,205.25	60.21%	23,469.89	23.47%
BOND K	6,430.00	64.30%	2,087.91	20.88%
BOND U	6,405.00	64.05%	2,239.63	22.40%
CAR K	33,220.00	66.44%	12,012.10	24.02%
CAR U	32,307.50	64.62%	14,984.64	29.97%
ANT K	5,612.50	56.13%	2,435.31	24.35%
ANT U	5,517.50	55.18%	2,385.77	23.86%
WINE K	705.35	70.54%	324.19	32.42%
WINE U	704.08	70.41%	318.82	31.88%

Each of the variables is defined in Appendix 1. “K” and “U” refer to known and unknown, respectively and the preceding word refers to the asset type. “% of Future Value” refers to the average price participants were willing to pay as a percent of the future value presented in the experiment; all suggested prices were the same fraction of the future value. Weighted Standard Deviation uses valuations as a percentage of the future value, allowing for comparison across assets with different future values.

Asset Pricing Results

Table 1 gives summary statistics for each of the assets used in the experiment. For example “Paint K” is the “Known” painting by Pablo Picasso. The subjects were told that it was certain that the painting would be worth $100,000 ten years from now. On average, the participants were willing to pay $66,282.50 for it and the standard deviation of responses was $24,846.49. The mean and standard deviation are normalized as 66.28% and 24.85% of the ten-year-away selling price. Normalization (or deflation) is necessary because the selling prices range from $100,000 for paintings and securities to $1,300 for rare bottles of vintage champagne.

The deflated standard deviation statistic illustrates the degree to which participants varied in their valuation of an asset. The standard deviation ranges from 20.88% to 32.42% of the participants’ maximum purchase price, suggesting that between-subject price variation exists. Within-subject price variation is also considerable. The mean normalized purchase price is 0.78; the mean normalized standard deviation across participants is 0.15. The standard deviations of the prices of financial instruments, stocks and bonds, are the lowest among the group of assets, i.e., there is more uniformity in pricing these assets than others. This observation is consistent with the pleasure premium hypothesis, with the pleasure premium varying across individuals. The level at which the financial instruments are priced is inconsistent with the pleasure premium model, however, because the model predicts that these assets should be priced lower than all other collectibles and such is not the case. Moreover, there does not appear to be a size effect associated with the future value of the asset. The wine assets (lowest future value) were priced highest; antiques and bonds (second lowest future value) were priced lowest and near the average, respectively.

To address the familiarity bias concern we compare the maximum price paid for financial assets—stocks and bonds—to the price paid for collectible assets. Our subsequent analysis focuses on artwork as the collectible of interest, we therefore focus on the comparison between artwork and financial assets. Familiarity bias suggests that known stocks and bonds should carry lower risk and higher prices compared to known paintings as all participants have formal business training but only a minority of the participants consider themselves to be art enthusiasts (20%). However, Table 1 suggests that the average maximum purchase price for a known paining was higher than the maximum purchase price of a stock or bond implying that familiarity bias does not significantly impact the results.

Table 2 – Differences in Mean Prices Matrix

	PU%	PK%	SU%	SK%	BK%	BU%	CK%	CU%	AK%	AU%	WK%	WU%
PU%	1											
PK%	0.076***	1										
SU%	0.026	0.049**	1									
SK%	0.015	0.061**	0.011	1								
BK%	0.056**	0.02	0.03	0.041*	1							
BU%	0.053**	0.022	0.027	0.038*	0.002	1						
CK%	0.077***	0.002	0.051**	0.061***	0.021	0.024	1					
CU%	0.059**	0.017	0.033	0.044	0.003	0.006	0.018	1				
AK%	0.026	0.102***	0.052**	0.041*	0.082***	0.080***	0.103***	0.085***	1			
AU%	0.035	0.111***	0.061***	0.050**	0.091***	0.088***	0.113***	0.094***	0.01	1		
WK%	0.044*	0.120***	0.070***	0.059**	0.100***	0.098***	0.122***	0.104***	0.019	0.009	1	
WU%	0.045*	0.121***	0.071***	0.060**	0.101***	0.099***	0.123***	0.105***	0.02	0.1	0.001	1

The Difference in Means Matrix provides the difference in the mean values of the variables for all pairs of assets. Critical values care calculated using a two-tailed paired T-test with unequal variances among each of the asset pairs. The variables are defined in Appendix 1. Critical values at the 10%, 5%, and 1% level of significance are denoted by *, **, and *** respectively.

Table 2 provides two-tailed t-tests for differences in the mean prices of all pairs of assets. Consider, for example, the price of the known painting (PK) and the price of the known stock (SK). The previous Table 1 shows that the mean standardized value of the known painting is 0.663 and the mean standardized value of the known stock is 0.602, representing a premium of 0.061 for the painting; the latter number is shown in Table 2 with three asterisks indicating that the difference in means is significant at the 1% level.

Thirty-seven of the 66 relevant pairings (56%) exhibit significantly different mean prices at the 5% level or better and 41 of the 66 (62%) do so at the 10% level. Most (62%) of the asset combinations were differently priced. This is consistent with non-financial utility being priced for some of the assets. Although the standard deviation of the known painting is larger (0.2485) than the known stock (0.2347), which implies a lack of uniformity in pricing, the means should converge as the sample size increases if mispricing as opposed to non-financial utility drives the difference in price. This does not appear to be the case. Referring to the first hypothesis:

Individuals who derive non-financial utility from holding assets include a pleasure premium in the maximum price they are willing to pay for the assets.

The evidence presented in this section rejects the null in favor of the alternate for many but not all asset pairs. This is consistent with the existence of a pleasure premium for collectibles.

Asset Prices and Participant Traits

This section investigates whether the induced asset prices are associated with participant traits.[8] The analysis is presented for the known painting (a Pablo Picasso painting); results are similar across other alternative asset classes. Preliminary regression analyses included all of the demographics variables. Regressions across asset types (dependent variables) and including all control variables indicate that several control variables do not significantly contribute to the regression results and are therefore excluded from the subsequent analysis: number of completed courses in Finance or Economics; asset ownership; whether the participant would purchase the asset as an investment; gender; and whether the individual participated in the previous asset pricing study. Results were similar for all asset groups.

Equation (10) below is used to provide estimates of the impact of being an art enthusiast on the maximum purchase prices participants say they are willing to pay for the known Picasso painting. All participants are included since it seems safe to assume that they are type-B (non-professional) investors in art:

$$\psi_{b_{ij}} = \alpha + \beta ART_j + \gamma X_j + \varepsilon_{ij} \tag{10}$$

where $\psi_{b_{i_j}}$ is type-B investor j's price for asset i, ART_j is a measure of the degree to which individual j says he or she is an art enthusiast, X_j is a vector of control variables, α is a constant and ε_{ij} is an error term. The results appear in Table 3.

[8] Year of Study may impact the pricing of the assets as a higher level of training in finance or economics may provide insights into how to price assets or typical rates of return on riskless and risky assets. Area of Specialization and the Number of Courses taken in Finance or Economics provides a proxy for the level of participants' financial expertise. Gender is included as a control but there is little a priori evidence to suggest males and females price assets differently. Participation in a Previous Asset Pricing Study may bias responses upwards or downwards but there is little theoretical justification for its inclusion. Level of Effort expended in completing the study may influence the results as a minimal level of effort may suggest that the participants did not thoroughly read and absorb the scenarios; this may negatively skew the results. The Enthusiast variable was included as enthusiasts are more likely than non-enthusiasts to derive non-financial utility from owning the asset and be willing to factor this utility into the maximum purchase price as a pleasure premium. The Currently Owning the Asset for investment purposes variable or the Willingness to Purchase the Asset as an Investment variable may impact the price of an asset as individuals who do not currently own the asset or would not consider purchasing the asset as an investment may pay more for the asset.

Table 3 – Picasso Painting

Regression coefficients for $\psi_{b_{ij}} = \alpha + \beta ART_j + \gamma X_j + \varepsilon_{ij}$ (standard errors in parentheses)

	(1)	(2)	(3)
e_art	6029.96**		
	(2009.49)		
e_ant	406.56		
	(2613.24)		
e_car	-2868.07		
	(1952.71)		
e_wine	-622.71		
	(2395.56)		
art_ex		18218.02**	16837.84**
		(4253.47)	(4237.48)
Intercept	58369.84**	67916.39**	63162.16**
	(14151.43)	(4556.68)	(2330.02)
Year FE	Yes	Yes	No
Major FE	Yes	Yes	No
Number of observations	138	138	138
R^2	0.19	0.18	0.08
adj. R^2	0.09	0.09	0.07

e_ant, e_car, e_art, e_wine: a categorical numerical variable capturing the degree to which the participants classified themselves as enthusiasts of the asset – antiques, automobiles, art, and wine, respectively.[9] art_ex: dummy variable indicating if the participant agreed or strongly agreed with the statement "I consider myself an art enthusiast."Year FE are dummy variables for the year of study the participant is in. Major FE are dummy variables for the participants' major. Standard errors in parentheses when +. *, and ** indicate significance at 10%, 5%, and 1%, respectively.

In regression 1 of Table 3, ART_j takes five values ranging from 1 (strongly disagree that I consider myself an art enthusiast) to 5 (strongly agree). In this specification, art enthusiasm is

[9] The specific categories and questions asked are provided in Appendix 3.

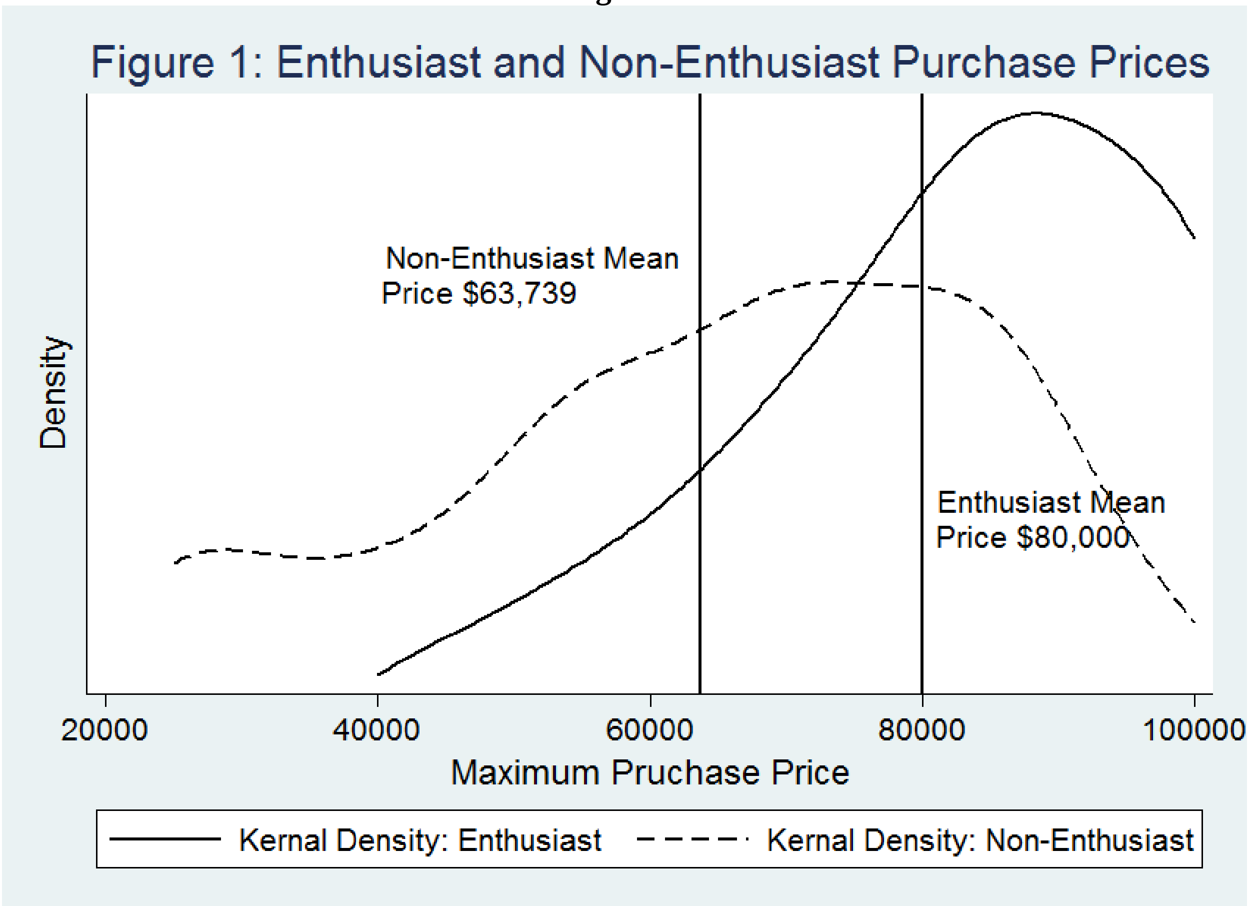
associated with a significant premium for paintings but not for wine, antiques or cars.[10] The coefficient of the art enthusiast variable, $6,030, is significant at the .01 level.

In regression 2 of Table 3, ART_j is an indicator variable taking the value 1 if participant "agrees" or "strongly agrees," zero otherwise. This specification reduces collinearity that is present in the prior specification. To verify that the dummy variable still captures participants' non-financial utility for art, a difference-in-differences test is conducted before proceeding with the regression analysis. Whereas enthusiasts price the known painting $15,556 higher than the unknown painting on average, non-enthusiasts price the known painting only $5,554 higher than the unknown painting on average. A t-test indicates that this $10,002 difference-in-differences is significant at the .001 level.

In the dummy-variable specification of Equation (10), the premium associated with the enthusiast variable is $18,218 with control variables included (regression 2) and $16,837 with control variables excluded from the regression (regression 3). These coefficients are significantly different from zero at the .01 level.

[10] When the dependant variable matches the coefficient of interest (e.g. price of antiques (dependant variable) and antique enthusiast (independent variable) the coefficient on the enthusiast variable is positive and significant.

Figure 1



The kernel density estimate is based on a gaussian kernel with bandwidth = 8.6e+03 and uses a winsorized (5%) sample.

Figure 1 provides graphical representations of the stated maximum prices participants were willing to pay for enthusiasts, whose mean is $80,000 and non-enthusiasts, whose mean is $63,739.[11] Art enthusiasts place an average premium of $16,261 (26%) on price of the Picasso painting compared with non-enthusiasts. This premium is consistent with the regression results above and implies that enthusiasts derive additional non-financial utility from owning the asset—the pleasure premium. Both distributions are skewed to the left, indicating that the prices for subjects who value the items more than average are more closely clustered than for those who value the items less than average.

Robustness Tests

Robustness tests are performed to ensure that individuals who say they are art enthusiasts do not price all assets—including those in which they are not enthusiasts—higher than other individuals. First, the premium placed on the known painting by the enthusiasts relative to the other assets is examined. The mean price for the known painting is $80,000 for the 28 enthusiasts

[11] Figure 1 employs a Winsorized (5%) sample to construct the kernel density estimates.

vs. $63,192 for the 112 non-enthusiasts. The $16,838 difference is significant at the .01 level. Second, an average non-enthusiast price variable is created, using the variables for the known asset as a percentage of the future value, for each of the assets in which the art enthusiast is not an enthusiast. For example, if an individual self-identifies as a wine and art enthusiast, the non-enthusiast variable is the average percent of the future selling price of the known car and known antique assets. This procedure only reduces the number of art enthusiast observations by two, to 25. The average price art enthusiasts say they would pay for the known painting is 80.8% of its future value; The average price art enthusiasts say they would pay for assets in which they do not consider themselves to be enthusiasts is 54.1% of future value. The 26.7% difference is significant at the .0001 level. Moreover, only one art enthusiast priced the Picasso painting lower than the average of the other assets in which the individual was not an enthusiast.

Additional robustness tests are conducted comparing art enthusiasts with non-enthusiasts to establish whether they differ in some way—other than love of art—that may influence their pricing decisions. Difference-of-means tests were conducted between the two groups with regard to number of finance or economics courses taken, year of study, gender, participation in the previous study, and level of effort. The two groups are similar except that more females indicated that they considered themselves art enthusiasts.

Additional Implications of the Auction Model

Descriptive results from the experiment show that asset-pricing variation exists between and within individuals. The auction model facilitates an elaboration of these differences and the calculation of the professional investor's purchase probabilities. Although a true professional investor does not exist in the experiment, a proxy for Agent A is constructed and its implications are examined.

Recall that the model defines the price associated with the estimated financial utility for type-B agents as a distribution around Agent A's price, $P_b \sim f(P_a, \sigma)$. A pleasure premium enters the utility function as an additional amount, independent of Agent B's estimated price. Thus, the mean price for individuals with $\eta = 0$, i.e., those who place no pleasure premium on holding the asset, equals the price at which Agent A is willing to purchase the asset.

For experimental purposes, it is assumed that subjects who identified themselves as "non-enthusiasts" constitute proxies for individuals with $\eta = 0$. Justification for this assumption comes from the fact that non-enthusiasts do not exhibit a statistically significant difference between the prices they are willing to pay for the known bond and the known painting.[12] The price of the known painting is higher than that of the known stock but the difference is statistically significant only at the 10% level.[13] This suggests that non-enthusiasts are unlikely to factor a significant amount of non-financial utility into their purchase decision ($\eta = 0$). Thus it seems reasonable to use non-enthusiasts as a proxy for Agent A.

Following the notation in the model, define:

$$\$63{,}192 = P_{a_{max}} = P_a = \frac{\sum_{i=1}^{n} \psi_{b_{i_j}}}{n};\ P_b \sim (\$63{,}192, \sigma)$$

[12] The mean value of the known bond, as a percent of the future value is 0.6427 and the mean value of the known artwork as a percent of the future value is 0.6680. The p-value associated with a paired T-test of these assets is 0.2379.

[13] The mean value of the known stock, as a percent of the future value is 0.6299 and the mean value of the known artwork as a percent of the future value is 0.6684. The p-value associated with a paired T-test of these assets is 0.0547.

where $63,192 is the average maximum purchase price non-enthusiast type-B agents are willing to pay for the known painting. Then $63,192 proxies for Agent A's maximum purchase and σ is the standard deviation of the distribution based on the experimental pricing variation. The discrete distribution facilitates the determination of the probability that Agent A will succeed in purchasing the asset.

Given a maximum purchase price for Agent A of $63,192, one can determine the probability of a randomly selected type-B agent having a maximum purchase price less than $63,192; this is an estimate of the probability that Agent A will succeed in purchasing the asset at auction. Appendix 2 presents frequency distributions of the maximum purchase prices for the enthusiasts and non-enthusiasts in the sample; 44.14% of non-enthusiasts and 18.52% of enthusiasts priced the asset below $63,192. The non-enthusiasts comprise 80.58% of the sample, with the remainder classified as enthusiasts. Given these proportions, the probability of a random auction attendee bidding less than Agent A is .3917. This is calculated as the proportion of non-enthusiasts whose maximum purchase price is less than $63,192 (0.4414) times the percent of non-enthusiasts (80.58%) plus the proportion of enthusiasts whose maximum purchase price is less than $63,192 (0.1852) times the percent of non-enthusiasts (19.42%). As the number of type-B agents attending the auction increases, the probability of Agent A purchasing is 0.3917^n where *n* is the number of type-B agents.

Table 4 – Probability of Agent A Purchasing as a Function of the Number of Type-B Bidders Attending the Auction

Number of Type-B Agents at the Auction	Probability of Agent A Purchasing
1	0.3917
2	0.1534
3	0.0601
4	0.0235
5	0.0092

Table 4 calculates the probability that Agent A purchases at an auction. Experimental data is used to calculate the probabilities.

Table 4 provides the probabilities that Agent A will succeed in purchasing the asset for various numbers of type-B agents attending the auction. When the number of type-B Agents at the auction reaches four or five, the probability that all agents bid below Agent A's maximum purchase price is extremely low. Thus it is unlikely that a purely profit maximizing agent can purchase any collectibles in an auction market dominated by collectors. Referring to hypotheses 2:

Professionals are likely to be out-bid by agents who exhibit non-zero pleasure premia; hence, professionals are unlikely to generate expected profits in the collectibles market.

The null is rejected at the 5% level in favor of the alternate when the number of type-B agents attending the auction exceeds three, since the probability that Agent A purchases is then less than

5%. However, if the number of type-B agents attending the auction is three or fewer, the null is not rejected at the 5% level.

Discussion

The generalizability of the results above may be questioned in at least four respects: 1. Time to resale; 2. Zero-NPV price; 3. Number of auction participants; and 4. Private sales. This section explains the nature of these potential limitations and attempts to address them when possible

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Time to Resale

In the model, type-B agents' pricing distribution is assumed to center on the present value of the future selling price regardless of when Agent A expects to sell the asset. In practice, perhaps Agent A can soon resell the asset to a preselected client. Agent A would then expect to profit from a quick sale if type-B Agents' pricing distribution is time-variant and negatively skewed for future value estimates near the current date. This complication is not addressed in the present study.

Zero-NPV Price

It is argued that the mean non-enthusiast price is a serviceable proxy for the zero-NPV price. In practice various agents have different costs of capital, storage costs, transportation costs, and other costs associated with buying and selling collectibles. Arguably, the sum of these costs is lower for Agent A due economies of scale and specialized knowledge; hence, Agent A may be willing to bid more than the auction model indicates.

Table 5

Agent A's Price	Probability of Purchase
$\$25{,}000 < Price < \$40{,}000$	0.1179^n
$\$40{,}000 < Price < \$55{,}000$	0.2103^n
$\$55{,}000 < Price < \$70{,}000$	0.3846^n
$\$70{,}000 < Price < \$85{,}000$	0.6256^n
$\$85{,}000 < Price < \$100{,}000$	0.8667^n

The sample consists of maximum purchase prices at values of $25,000, $40,000, $55,000, $70,000, $85,000, and $100,000. Due to the discrete nature of the pricing distribution, any maximum purchase price calculated by Agent A between two price points is qualitatively equal as it does not affect the probability that Agent A purchases. For example, Agent A's probability of purchasing will not differ if his/her calculated maximum price is $56,000 or $69,000.

Table 5 gives a sensitivity analysis of Agent A's purchase probability as a function of the zero-NPV price. If the zero-NPV price lies between $25,000 and $40,000, the probability of Agent A being the successful purchaser tends to zero when the number of B-type agents at the auction exceeds two.[14] At the other extreme, between $85,000 and $100,000, the probability of Agent A being the successful purchaser tends to zero when the number of type-B agents at the auction exceeds thirty-two.[15] The latter range of prices seems unlikely, however, as it is above the mean price at which enthusiasts price the asset ($80,000), which includes a pleasure premium. If the zero-NPV price lies between $70,000 and $85,000, Agent A's purchase probability tends to zero when the number of B-type agents exceeds nine.[16] Under this conservative estimate of the maximum purchase price it is very unlikely that Agent A will succeed in purchase the asset.

Number of Auction Participants

An additional identified limitation involves estimating the number of type-B agents at the auction. The Barrett-Jackson Classic Car Auction of 2013 provides an extreme example. The auction featured more than 1,000 automobiles and approximately 2,500 registered bidders attended.[17] The authors of the study recently attended an auction of smuggled goods seized by the Canada Customs and Revenue Agency in Kingston, Canada, which is a small city of approximately 100,000. Approximately 50 bidders attended, almost all of whom appeared to be type-B. Thus it seems reasonable to assume that the number of type-B bidders attending a public collectibles auction, such as Barrett-Jackson, Sotheby's, or Christie's, greatly exceeds ten. With regard to the Picasso painting, however, Table 6 implies that when the zero-NPV price is between $70,000 and $85,000, Agent A's purchase probability tends to zero when the number of type-B bidders approaches ten ($0.6256^{10} = .009$).

Private Sales

Suppose Agent A purchases collectibles at private sales. In this scenario there are only two people in the "auction": a buyer and a seller. The type-B asset sellers may be non-enthusiasts or enthusiasts. The non-enthusiasts have heterogeneous expectations, generating mispricing with respect to the zero-NPV price. The enthusiasts also have heterogeneous utility, which adds a pleasure premium to the price. Still, the absence of additional type-B buyers reduces competition for the asset, increasing the probability that Agent A will purchase it.

One can use data from the experiment to determine selling prices for type-B agents if the *maximum* price they said they would pay for the asset is viewed as an indifference point, i.e., the agent sells at any greater price. Then Table 6 shows that the probability of Agent A bidding above a randomly selected Agent B's indifference point is about 39%; this is simply the probability that a randomly selected Agent B prices the asset below $63,192 (Agent A's zero-NPV price). Thus, Agent A will be successful in purchasing the asset much more frequently at private sales than at public auctions. Of course, if Agent A is skilled at finding "suckers" with low indifference points, even more transactions will occur.

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[14] $0.1179^3 = 0.0016$

[15] $0.8667^{33} = 0.0089$

[16] $0.6256^{10} = 0.0092$

[17] http://phoenix.about.com/cs/events/a/barrettjack01.htm

Conclusion

This study finds that art enthusiasts derive utility from both financial returns and the pleasure associated with holding collectibles; hence they are willing to pay a premium—called a "pleasure premium"—to own collectibles. This direct confirmation of the existence of the pleasure premium is consistent with a hypothesis induced from prior research. The study also indicates that the probability of a purely financially motivated professional investor purchasing collectibles at a public auction is negligibly small given the number of non-professional collectors who normally attend auctions. Moreover, the probability of a non-professional, financially motivated investor generating abnormal returns from purchasing a collectible at an auction is virtually zero because, given the heterogeneity in the beliefs of non-professional investors, the winning bid is almost certain to exceed the price at which the net present value of the investment is zero. The presence of non-professionals who derive pleasure from holding collectibles further reduces the probability of professionals purchasing collectibles and the financial returns that are likely to be realized by purchasers. The results are consistent with prior studies indicating that investors who hold collectibles as investments derive little in the way of return benefits.

The study contributes to the literature on heterogeneous agent models (HAMs). In contrast to existing HAMs that are complex and mathematically sophisticated, the auction model in the present study is a simple and intuitive depiction of how heterogeneous agents price collectibles. Experimental evidence is consistent with the model's predictions.

Investment advisors as well as individual investors should be aware of the existence of pleasure premia in making investment decisions. They should also be aware that auctions with many non-professional bidders are likely to constitute unfertile ground for growing financial wealth. To the extent that the findings are generalizable, similar results would apply to other markets, such as housing markets, where investors have heterogeneous expectations and derive utility from both financial and non-financial sources.

Limitations of the study include the question of the external validity of the results, given the subjects who agreed to participate in the experiment and the experimental design. Before attempting to generalize the results to other settings, future research may seek to verify and extend the results with larger samples of subjects who actually participate in the market for collectibles. It would also be interesting to examine the degree to which professional investors supplement their holding period returns with rental income by temporarily allowing other individuals to possess the collectibles.

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Appendix 1 – Asset Definitions

Variable	
PAINT U:	Alonzo Villa painting
PAINT K:	Pablo Picasso painting
STOCK U:	JDC stock
STOCK K:	Twitter stock
BOND K:	Twitter zero-coupon bond
BOND U:	JDC zero-coupon bond
CAR K:	1969 Ford mustang
CAR U:	1969 Rinaldi GT
ANT K:	Victorian era antiques
ANT U:	Matildian era antiques
WINE K:	1990 Dom Pérignon Champagne
WINE U:	1990 François Bourgault Champagne
PU%:	Alonzo Villa painting (normalized price)
PK%:	Pablo Picasso painting (normalized price)
SU%:	JDC stock (normalized price)
SK%:	Twitter stock (normalized price)
BK%:	Twitter zero-coupon bond (normalized price)
BU%:	JDC zero-coupon bond (normalized price)
CK%:	1969 Ford Mustang (normalized price)
CU%:	1969 Rinaldi GT (normalized price)
AK%:	Victorian era antiques (normalized price)
AU%:	Matildian era antiques (normalized price)
WK%:	1990 Dom Pérignon Champagne (normalized price)
WU%:	1990 François Bourgault Champagne (normalized price)

Appendix 2 – Enthusiast and Non-Enthusiast Pricing Distributions

Non-Enthusiasts

PAINT K	Freq.	Percent	Cum.
1000	1	0.90	0.90
5000	3	2.70	3.60
25000	11	9.91	13.51
40000	12	10.81	24.32
55000	22	19.82	44.14
70000	26	23.42	67.57
80000	1	0.90	68.47
85000	26	23.42	91.89
100000	8	7.21	99.10
120000	1	0.90	100.00
Total	111	100.00	

Enthusiasts

PAINT K	Freq.	Percent	Cum.
40000	2	7.41	7.41
55000	3	11.11	18.52
70000	5	18.52	37.04
85000	9	33.33	70.37
100000	8	29.63	100.00
Total	27	100.00	

Appendix 3 – Description of Experiment and Participants

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon decorating your new home you decide to purchase an **Alfonso Villa painting** that you are certain will be worth $100,000 (no more, no less) in ten years.

What is the maximum price you would be willing to spend on the painting, assuming you have the resources to purchase at that price:

- ○ $100,000
- ○ $85,000
- ○ $70,000
- ○ $55,000
- ○ $40,000
- ○ $25,000
- ○ Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon decorating your new home you decide to purchase a **Pablo Picasso painting** that you are certain will be worth $100,000 (no more, no less) in ten years.

What is the maximum price would you be willing to spend on the painting, assuming you have the resources to purchase at that price:

- ○ $100,000
- ○ $85,000
- ○ $70,000
- ○ $55,000
- ○ $40,000
- ○ $25,000
- ○ Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon opening an investment account you decide to purchase shares of JDC Inc. that you are certain will be worth $1,000 per share (no more, no less) or $100,000 for a round lot of 100 shares, in ten years.

What is the maximum price you would be willing to spend on a round lot of 100 shares, assuming you have the resources to purchase at that price:

- ○ $100,000
- ○ $85,000
- ○ $70,000
- ○ $55,000
- ○ $40,000
- ○ $25,000
- ○ Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon opening an investment account you decide to purchase **shares of Twitter Inc.** that you are certain will be worth $1,000 per share (no more, no less) or $100,000 for 100 shares, in ten years.

What is the maximum price you would be willing to spend on the 100 shares, assuming you have the resources to purchase at that price:

- ○ $100,000
- ○ $85,000
- ○ $70,000
- ○ $55,000
- ○ $40,000
- ○ $25,000
- ○ Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon opening an investment account you decide to purchase a **zero-coupon bond** (debt obligation with no periodic payments) from **Twitter Inc.** that you are certain will be worth

$10,000 in ten years (no more, no less) and there is no chance of bankruptcy.

What is the maximum price you would be willing to spend on the bond, assuming you have the resources to purchase at that price:

- ○ $10,000
- ○ $8,500
- ○ $7,000
- ○ $5,500
- ○ $4,000
- ○ $2,500
- ○ Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon opening an investment account you decide to purchase a **zero-coupon bond** (debt obligation with no periodic payments) from **JDC Inc.** that you are certain will be worth $10,000 (no more, no less) in ten years and there is no chance of bankruptcy.

What is the maximum price you would be willing to spend on the bond, assuming you have the resources to purchase at that price:

- ○ $10,000
- ○ $8,500
- ○ $7,000
- ○ $5,500
- ○ $4,000
- ○ $2,500
- ○ Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon receiving your bonus you decide to purchase a **1969 Ford Mustang** that you are certain will be worth $50,000 (no more, no less) in ten years.

What is the maximum price you would be willing to spend on the car, assuming you have

the resources to purchase at that price:

- $50,000
- $42,500
- $35,000
- $27,500
- $20,000
- $12,500
- Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon receiving your bonus you decide to purchase a **1969 Rinaldi GT** that you are certain will be worth $50,000 (no more, no less) in ten years.

What is the maximum price you would be willing to spend on the car, assuming you have the resources to purchase at that price:

- $50,000
- $42,500
- $35,000
- $27,500
- $20,000
- $12,500
- Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon receiving your bonus you decide to purchase a small collection of **Victorian era antiques** that you are certain will be worth $10,000 (no more, no less) in ten years.

What is the maximum price you would be willing to spend on the antiques, assuming you have the resources to purchase at that price:

- $10,000

- $8,500
- $7,000
- $5,500
- $4,000
- $2,500
- Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon receiving your bonus you decide to purchase a small collection of **Matildian era antiques** that you are certain will be worth $10,000 (no more, no less) in ten years.

What is the maximum price you would be willing to spend on the antiques, assuming you have the resources to purchase at that price:

- $10,000
- $8,500
- $7,000
- $5,500
- $4,000
- $2,500
- Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon receiving your bonus you decide to purchase a bottle of **1990 Dom Pérignon Champagne** that you are certain will be worth $1,300 (no more, no less) in ten years.

What is the maximum price you would be willing to spend on the Champagne, assuming you have the resources to purchase at that price:

- $1,300
- $1,105
- $910
- $715

- $520
- $325
- Other

Scenario:

Consider that you have recently graduated from an undergraduate degree program and you have accepted a prestigious position with your ideal employer.

Upon receiving your bonus you decide to purchase a bottle of **1990 François Bourgault Champagne** that you are certain will be worth $1,300 (no more, no less) in ten years.

What is the maximum price you would be willing to spend on the Champagne, assuming you have the resources to purchase at that price:

- $1,300
- $1,105
- $910
- $715
- $520
- $325
- Other

Please respond to the following statements from Strongly Disagree to Strongly Agree

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I consider myself an antiques enthusiast	○	○	○	○	○
I consider myself a car enthusiast	○	○	○	○	○
I consider myself an art enthusiast	○	○	○	○	○
I consider myself a wine enthusiast	○	○	○	○	○

Please respond to the following statements from Strongly Disagree to Strongly Agree

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I would NEVER consider purchasing wine as an investment	◌	◌	◌	◌	◌
I would NEVER consider purchasing antiques as an investment	◌	◌	◌	◌	◌
I would NEVER consider purchasing art as an investment	◌	◌	◌	◌	◌
I would NEVER consider purchasing a car as an investment	◌	◌	◌	◌	◌
I would NEVER consider purchasing a company's stock as an investment	◌	◌	◌	◌	◌
I would NEVER consider purchasing a company's bonds as an investment	◌	◌	◌	◌	◌

Please respond Yes or No to the following statements

	Yes	No
I own shares of a company	◌	◌
I own bonds of a company	◌	◌
I own art as an investment	◌	◌
I own a car as an investment	◌	◌
I own antiques as an investment	◌	◌
I own wine as an investment	◌	◌

Please respond to the following statements from Strongly Disagree to Strongly Agree

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I am familiar with Victorian era antiques	○	○	○	○	○
I am familiar with JDC Inc.	○	○	○	○	○
I am familiar with the 1969 Rinaldi GT	○	○	○	○	○
I am familiar with Alfonso Villa's artwork	○	○	○	○	○
I am familiar with Matildian era antiques	○	○	○	○	○
I am familiar with Twitter Inc.	○	○	○	○	○
I am familiar with 1990 François Bourgault Champagne	○	○	○	○	○
I am familiar with the 1969 Ford Mustang	○	○	○	○	○
I am familiar with Pablo Picasso's artwork	○	○	○	○	○
I am familiar with 1990 Dom Pérignon Champagne	○	○	○	○	○

Year of Study

- ○ First
- ○ Second
- ○ Third
- ○ Fourth
- ○ Fifth or greater

Area of Specialization

- ○ Accounting
- ○ Economics
- ○ Finance
- ○ General Business
- ○ International Business
- ○ Management Science

- Marketing
- Organizational Behaviour
- Strategy
- Other: Please specify your area of specialization

Number of courses taken in Finance/Economics

- 1
- 2
- 3
- 4
- 5
- More than 5

Gender

- Male
- Female

Did you take the Asset Pricing study previously posted?

- Yes
- No

Descriptive Statistics

Table A2.1

Number of Students in Each Year of Study					
Year	1	2	3	4	5+
Number of Students	81	51	13	51	3

Table A2.2

Number of Students in Each Area	
Area	Number of Students
Accounting	47
Economics	3
Finance	41
General	22
International	5
Marketing	43
Org. Behaviour	6
Other	24
Strategy	9

Table A2.3

Number of Finance or Economics Courses Taken by Students

Finance/Economics Courses	1	2	3	4	5	5+
Number of Students	57	36	22	41	23	20

Table A2.4

Number of Male and Female Students

	Male	Female
Gender	87	112

Table A2.5

Number of Students Who Participated in Asset Valuation 1		
	Yes	No
Completed Previous Study	54	146