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Third-Party Grading as a Useful Measure of Demand: Evidence from NBA Cards

George Langelett[1] · **Zhiguang Wang**[2]

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Abstract Since collectibles are potentially prized artifacts, determining value is subjective by nature. The value of any collectible is difficult to measure because it is perceived based on desirability, condition, and rarity. The purpose of this paper is to better understand the determinants of market price in a sports card market, namely rookie cards from the National Basketball Association. Empirical data from 2001 to 2009 were collected from the eBay and Professional Sports Authenticator websites to disaggregate price into intrinsic value versus quantity available. After controlling for market supply, third-party grading was used to help quantify demand. Simultaneous endogeneity of both market price and quantity was tested through a two-stage least squares model. This study found that both third-party grading and player performance variables affect the value of graded National Basketball Association basketball cards. The Professional-Sports-Authenticator-10-grading dummy variable carries the largest economic impact. Holding all else constant, a card graded Gem Mint trades at roughly 339% above a grade 8 baseline. The use of third-party grading is a novel measure of demand in markets for collectibles.

Keywords Market value · NBA rookie cards · Intrinsic value · Rarity · Collectible goods

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✉ George Langelett
George.Langelett@sdstate.edu

[1] Harding Hall 244, Economics-Box 2220, South Dakota State University, University Station, Brookings, SD 57007, USA

[2] Harding Hall 125, Ness School of Management & Economics-Box 2220, South Dakota State University, University Station, Brookings, SD 57007, USA

Introduction

In a market economy, price represents the value of any good (Gijsbrechts, 1993; Monroe, 1990), and comprehending the determinants of price is paramount for a better understanding of the nature of a market. Because price is determined by the intersection of demand and supply, and both curves affect price, identification can be challenging. It is difficult to isolate the effects of a change in demand because indirect effects may also change supply. To resolve this conundrum, there is a unique market to study where quantity is held constant, namely the market for antiques and collectibles (Masset & Weisskopf, 2018). Collectibles may serve as a useful market if supply is fixed and measurable. However, identification of demand may remain problematic.

In the collectibles market, examples may have no usefulness in ownership, except for a potential display of pride, joy, and even wealth. Although not useful, except for identification with a favorite team or athlete, one market of financial significance is sports collectibles. Today college and professional sports are an important source of entertainment in the United States and in countries around the world. In the aggregate, college and professional leagues are valued in hundreds of billions of dollars. The market for sports collectibles is a $26.1 billion market annually. Research suggests that the sports memorabilia market may reach $227.2 billion by 2032 (Valuemystuff.com, 2024).

Given the uniqueness of the collectibles, if a fixed supply can be quantified, then the identification of demand becomes feasible. This study is novel in its approach because finding useful instruments to identify demand can be problematic. To overcome this issue, third-party certification was used to help measure collector demand, in this case, demand for National Basketball Association (NBA) rookie cards. Third-party grading services are used by collectors to certify the condition of collection pieces and create value-added to each graded piece.

Literature Review

Collectibles are defined as prized artifacts. They are neither edible nor used in any production process (Jacoby, 1995). The collectibles market size was estimated at $462 billion in 2023 (Yahoo.com, 2024) which includes both physical and digital artifacts, with many collectibles currently experiencing a boom (Masterworks, 2024). Collectibles are highly desirable for a variety of reasons, including the enjoyment of a hobby (Joule, 1908; Silverman, 1931), a potential investment (Olmstead, 1991; Lee et al., 2022; Langelett &Wang, 2023), a display of wealth (Belk, 2013), or simply nostalgia (Schwager, 2017).

Kleine et al. (2020) found that collecting is an inherent economic behavior that is characterized as neither pure consumption nor investment activity. Serious collectors have above-average education, income, and available assets. Pearman et al. (1983) surveyed and found that 35% of collectors are motivated primarily by the prospect of financial gain as opposed to fun and enjoyment. Another study by Formanek (1994) found related results with 22% of survey respondents indicating financial investment

as their primary motivation for owning a collection. Finally, McInish and Srivastava (1982) found that 31% of respondents to their mail survey owned some type of collectible. The study also found that individuals who invest in collectibles are also likely to invest in traditional financial instruments. Langelett and Wang (2023) found that collectibles can help diversify a portfolio of traditional investments.

Measuring the financial value of collectibles has been of considerable interest to academia since the early 1970 s, but price estimation remains challenging. Collectibles can be valued based on their expected future scarcity (Stoller, 1984). Furthermore, the monetary gains obtained from collectibles are uncertain (Kleine et al., 2020) and may not be the primary motivation for the individual collector. Burton & Jacobsen, (1999) pointed out that collectibles exhibit greater risk (or variance) and lower returns than stocks, and one of the major factors affecting the market price is the age of a collectible. The non-reproducibility of the original artifact and the supply remaining constant or shrinking contributes to increases in the financial value of the artifact over time. For example, recently a 100-year-old Honus Wagner baseball card was sold at auction for $7.25 million (Randhawa, 2022). For a variety of physical collectibles, including trading cards and art, the better the quality of the condition, the higher the market value (Dickie et al., 1994).

Leibenstein (1950) suggested that there may be competition within a collectible community to obtain highly sought-after pieces. This snobbish behavior can also be referred to as conspicuous consumption when individuals use consumption to display one's wealth or status in society (Corneo & Jeanne, 1997). Three factors affect the perceived value of a collectible: condition, rarity, and the reputation of the manufacturer or artist (Hughes, 2022).

Condition and the reputation of the manufacturer are measurable but attempting to measure the impact of rarity on valuation is more challenging (Hughes, 2022) for three reasons. First, collectibles, like other goods, have diminishing marginal utility with additional consumption, resulting in a downward-sloping demand curve. Without identification of both a supply and demand curve, pricing based on supply becomes challenging. Second, higher prices may reflect a supply issue instead of a demand issue if more desirable pieces are more costly to produce or obtain. Finally, rarer pieces may be better quality or more ascetically pleasing than common examples. Thus, quality rather than quantity may account for the price premium over common pieces.

For sports collectibles, popular National Basketball Association (NBA) merchandise includes team posters, jerseys, signed basketballs and player sports cards. The NBA is a popular sports league with around two billion fans worldwide (Hoopsaddict.com, 2024). From December 22, 2020 to December 25, 2020, NBA games averaged 3.4 million viewers (Young, 2021). During the 2018–2019 season, the year before the pandemic, the NBA generated $1.67 billion in ticket sales and generated $8.76 billion in total revenue (Curcic, 2024). During the 2021–2022 season the NBA passed $10 billion in total revenue (Beyers, 2022). All NBA merchandise has the potential to appreciate or depreciate over time depending on player and team performance and the condition and rarity of the individual item. NBA sports cards were chosen for two reasons. The first is market depth. The second is the existence of third-party grading services to independently verify card condition.

To better understand the market for NBA cards, during the 1990's three companies dominated the basketball card market, Topps, Fleer/Skybox, and Upper Deck (VerifiedMarketResearch.com, 2024). In July 1992, Marvel Entertainment purchased Fleer for US$540 million. Then in March 1995, Marvel purchased Skybox Cards International for $150 million (Bryant, 1998). In early 2005, Fleer filed for chapter 7 bankruptcy protection. In July 2005, Upper Deck purchased the Fleer/Skybox group for $6.1 million. Topps Inc. re-entered the basketball card market in 1992 and by the early 2000's, Topps' Chrome ™ basketball cards were the preeminent cards that collectors were willing to pay a premium to acquire. Then in 2009, Panini Group purchased an exclusive licensing agreement with the NBA to become the only licensed company to sell NBA cards.

Market for Collectibles

In the collectibles market, the consumer's utility maximizing problem is defined as:

$$\text{Collector}_i \qquad \max_{X_i} X_i \left(E[V_i\,(C,R,D)] + \Delta Y_i - P - G Y_i\right) \tag{1}$$

where X_i, $Y_i = \{0,1\}$ is the decision whether to buy and grade the collectible good i, respectively; V_i is the collector's perceived value of the sample based on (C)ondition, (R)arity, and (D)esirability without being graded; Δ is the value added due to the grading service by a third-party, defined as $E[V_i\,(C,R,D|G)]—E[V_i\,(C,R,D)]$ for an assigned G(rade); P is price and G is the cost of the grading service. Based on the perceived value of the collectible, the collector may decide to get it evaluated by a third-party grading service. The collector's decision to grade the particular collectible is:

$$Y_i = \begin{cases} 0\ if\ \ \Delta < G \\ 1\ if\ \ \Delta \geq G. \end{cases} \tag{2}$$

This value-added third-party grading certification will only take place if the value added of the collectible exceeds the cost of the grading service.

Grading collectibles is not an exact science. Obviously, if the collectible has a scratch, chip or stain, it is not in original pristine condition. In the case of sports cards, even if a card appears in new condition to the naked eye, it may come back as an 8, 9, or 10 on a 10-point scale (with 10 being pristine condition). Collectibles sent to a grading company have an expected value for the grade received. There are significant financial-valuation differences based on the grade received by an evaluation from a third party. Given a grading scale from 1 to 10, the expected value of an assigned grade G is as follows:

$$E[G] = \sum_{g=1}^{10} g p_g \tag{3}$$

where g is a possible assigned grade from 1 to 10 and p_g is the probability of each assigned grade. Now with grades being random, the value added by the grading service can be rewritten as

$$\Delta = \sum_{g=1}^{10} p_g \left(E\left[Vi(C, R, D|G = g) \right] - E[Vi(C, R, D)] \right).$$

Regarding the market price of collectibles, $P = \frac{nV}{k}$, where P is the price of the collectible, n is the number of collectors wanting to own it, V is the item's perceived value, and k is the number of pieces in existence. Rearranging for n and k:

$$\text{Supply} = k = \frac{nV}{P} \text{and}$$

$$\text{Demand} = n = \frac{Pk}{V}.$$

In the case of collectibles, where k is a finite number, based on either a limited print run, or production being ceased, the limited supply, k, suggests that price will reflect perceived value. Demand, n, suggests that there is a trade-off between price and the number of pieces in existence. This suggests a downward-sloping demand curve.

Valuation

Since collectibles can be any of a variety of different types of artifacts, determining value is subjective by nature. A collector's valuation of any artifact, including collectibles, is intrinsic, based on desirability, condition, and rarity. As pieces of a particular collectible are bought and sold, a market or a mutual understanding by the community regarding the value of the collectible is established. To better understand the variables affecting valuation, the Hughes (2022) model was augmented. Assume a consumer's valuation of any collectible good V_i is a combination of intrinsic value $f(X_i)$ and rarity value $V_r(Q_i)$, of the good:

$$V_i = f\left(X_i\right) + V_r\left(Q_i\right) \tag{4}$$

$$Q_i = f\left(Q_{owned} + Q_{total} + Q_{available}\right) \tag{5}$$

$$f\left(X_i\right) = f\left(X_{prized} + X_{condition}\right) \tag{6}$$

where Vi is increasing in $f(Xi)$ and decreasing in Qi. The underlying quantity Qi, which gives value to the collectible good may be broken down into three subcomponents: total quantity in existence, Q_{total}, quantity available on the market, $Q_{available}$, and quantity already owned by the collector Q_{owned}. Based on diminishing marginal utility, assume:

$$\frac{\partial V_r}{\partial Q_{owned}} < 0, \ \frac{\partial V_r}{\partial Q_{total}} < 0, \ \frac{\partial V_r}{\partial Q_{available}} < 0, \text{ and} \tag{7}$$

$$\frac{\partial^2 V_r}{\partial Q^2{}_{owned}} > 0, \ \frac{\partial^2 V_r}{\partial Q^2{}_{total}} > 0, \ \frac{\partial^2 V_r}{\partial Q^2{}_{available}} > 0. \tag{8}$$

Furthermore, the intrinsic value $f(X_i)$ of any individual example of the collectible can also be broken down into two subcomponents: prized examples within the population, X_{prized}, and specimens in near pristine or original condition, $X_{condition}$. Examples of a prized specimen may include memorabilia from a hall-of-fame athlete, personal possessions from a famous person in history, or original pieces from a famous author, artist, or composer. Based on the desirability of exceptional specimens, assume:

$$\frac{\partial V_i}{\partial X_{prized}} > 0, \text{ and } \frac{\partial V_i}{\partial X_{condition}} > 0. \tag{9}$$

Thus, in summary, the value of any collectible good depends on both the quantity of examples in existence and the quality of individual specimens.

Fig. 1 illustrates the effects of both intrinsic value and quantity in existence on the valuation of collectible goods. In the case of collectibles, supply could be perfectly inelastic due to limited edition production or to the collectible no longer being produced.[1] *Qc* and *Qr* are the available supply of a common and a rare example of a collectible, respectively. Regarding the intrinsic value *f(Xi)* of the collectible, $D_{ordinary}$ is the inverse demand curve for ordinary or less desirable collectible pieces and reflects the sum of individual valuations.[2] D_{prized} and D_{prized} + *Pristine* are the

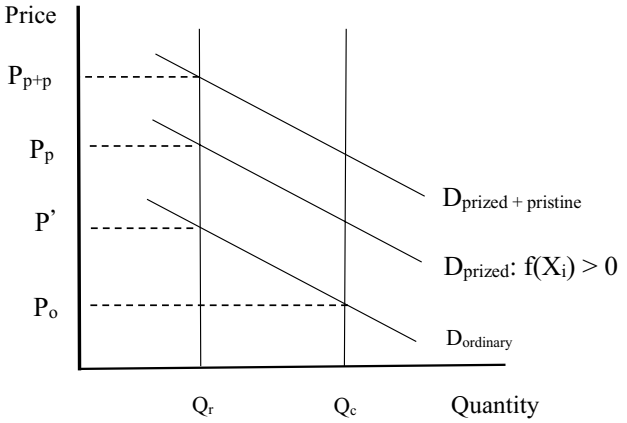

Fig. 1 Price of collectibles

[1] By nature, any product continuously being produced is not collectible. It is a common product that is neither unique nor limited. Any limited-edition that is overproduced will lose desirability as a collectible.

[2] Examples include artwork by non-famous artists or sports cards of athletes with little playing time.

demand curves for prized examples of a collectible and prized examples in pristine or brand-new condition.

Starting with existing demand for an ordinary collectible, $D_{ordinary}$, which is also common or readily available in supply, Q_c, in equilibrium, has low desirability as reflected in P_o. Likewise, P' reflects the equilibrium price for rare examples, Q_r, with fewer pieces in existence. Prized examples, D_{prized}, that are rare will command a higher price as reflected in P_p. Finally, rare, prized examples that are also in pristine or brand-new condition will result in the highest price for collectibles, P_{p+p}. Thus, define P'- P_o as the rarity effect, $V_r(Q_i)$; and P_{p+p}-P' as the intrinsic value effect, $f(X_I)$.

Data

To better understand the issue of intrinsic value versus value from being rare, collectible market data from the sports card industry were utilized, specifically cards from the NBA. Regarding sports cards, there are two separate markets. First, in the primary market, collectors purchase and open packs of cards, hoping to find a rookie card in each pack. Next, for the secondary market, eBay is the dominant market for sports cards, for buying and selling individual rookie cards. Currently, there are over 400,000 individual NBA cards for sale on eBay. The dataset consisting of sold listings on eBay were used for price discovery of 282 unique NBA rookie cards from 2001 until 2008.

In collectible markets where examples are purchased sight unseen, the possibility of asymmetric information is problematic. The actual condition may not match the advertised condition. To remedy this issue, websites (such as eBay) offer a money-back guarantee if not fully satisfied. This policy can lead to reluctance on behalf of potential sellers from fear of being scammed. A buyer could receive a card, request a full refund, and return a card in poorer condition. Therefore, to remove this issue of asymmetric information, third-party grading services were developed to accurately appraise and encapsulate each card. In 1991, the Professional Sports Authenticator (PSA) grading service was started by David Hall (Allvintagecards.com, 2024). Although today over a dozen grading card grading companies exist, PSA remains the most recognized grading service for sports cards. To date, PSA has graded over 40 million sports cards (PSA.com, 2024). Cards are graded on a scale from 1 (Poor) to 10 (Gem Mint). The presence of third-party-graded-and-encapsulated cards establishes benchmarks for condition and removes asymmetric information from auction sales and internet websites.[3] The sample was comprised of Topps Chrome™ NBA rookie cards from 2001 to 2008.[4] Topps Chrome™ were considered premium basketball cards during this era. Each year, Chrome™ cards were numbered, so

[3] PSA.com (2024) provides a free service for collectors and researchers by providing information regarding the current population for every sports card the company has graded and reports the total population for each grade of the card. These reported populations for each card in every grade provide a unique dataset regarding the rarity of each graded NBA basketball card.

[4] The sample was supplemented with second-year NBA cards from 2002 through 2009.

the number printed each year is available.[5] In 2009, Panini Corporation purchased exclusive rights to print NBA cards. The ten highest-priced rookie cards were used each year to create the sample.[6] For each player, the sample included both rookie and second year cards, in PSA 8, 9, and 10 condition. Thus, a total of six different data entries to track price for each athlete was possible, based on year and condition, for a total of 282 observations.

Model

To empirically test the issue of the intrinsic value versus the rarity value of NBA sports cards, PSA graded cards were used to verify and certify condition. The quantity printed of each card was used to identify supply. Collectors grade cards at PSA to create value-added and these grades can be used to stratify demand based on condition. A cross-sectional hedonic framework was used to estimate card values. The value of card i was modeled as:

$$lnP_i = \alpha_i + \beta X_i + \delta V_r + \varepsilon_i \tag{10}$$

where lnP_i is the natural logarithm of card price, X_i is a set of unique properties that create intrinsic value for individual cards, V_r represents supply that measures card rarity (total population), and α_i and ε_i are the vertical intercept and error term, respectively.

Regarding the variables used to test Eq. (10), the log transformation of the price of each card was used to help linearize the model. Two different variables were used to capture the intrinsic value of each card, X_i. First, for each NBA rookie, two cards were used to capture the unique value of that rookie's season: the player's rookie season card and the player's second-year card. A dummy variable, *rookie*, was created to differentiate the value of the rookie season card from the second-year card. Second, each card was previously evaluated and graded by the PSA grading service. Condition grades of each card range from PSA10 "Gem mint" down to PSA1 "Poor" condition. Based on PSA grades, each card was put into one of three dummy variables based on condition *PSA10*, *PSA9*, and *PSA8 and below*. To avoid perfect multicollinearity, *PSA8* was selected as the base variable and removed from the model.

Next, the number of cards printed, *Print Run*, was used to measure the impact of card rarity, V_r, on price. Also, the entire population of cards graded in each condition is published on the PSA website. The PSA *Graded* variable captures the number of cards in existence in each PSA grade. Not only do PSA grades affect demand, but also the number of cards graded by PSA reflects demand for each card. Finally, the variable *For Sale* measures the number of cards in each condition available on the market at one point in time. This variable captures the economic issue of available supply affecting market prices with both demand and supply affecting market

[5] 2008 had the lowest print run at 499 cards, and 2007 was the highest with 1499 cards printed.

[6] For the years 2003, 2006, and 2007, the sample size was 9, 8, and 9 NBA rookies, respectively, because the underperformance of the remaining rookies resulted in either no cards being graded and/or no cards being offered for sale on eBay.

availability. Table 1 presents the variables used to test Eq. (4). The card prices range from $1 up to $86,000 for Lebron James' rookie card in PSA10. *Rookie* Cards and *PSA8, PSA9,* & PSA*10* grades are dummy variables.

Results

Hedonic regression analysis was utilized to better understand the importance of both intrinsic value and rarity variables on price. Results from estimating Eq. (10) are presented in Table 2. The dependent variable, *card price*, was transformed into log form to linearize the model. To control for unequal variance in the residuals, heteroskedastic consistent standard errors were used in the regression. *PSA8* was used as the baseline to compare the effects of cards being graded *PSA9* and *PSA10*. The first three columns of Table 2 include the number of cards printed, *Print Run*, to estimate the impact of quantity supplied, which turned out to be statistically insignificant. The last two columns report the ordinary least squares (OLS) regression results without the *Graded* variable due to the potential endogeneity of the grading decision. The coefficients and regression statistics are similar in both cases.

All coefficients except for *Draft Pick* and *Print Run* were statistically significant and the signs were as expected. The negative sign on *Draft Pick*, although statistically insignificant, suggests those drafted first, i.e. 1 st pick, might on average command higher prices for their rookie cards than lower draft picks. The PSA variables, *PSA9*, *PSA10* and number of graded cards, *Graded*, are useful indicators of demand for each

Table 1 Descriptive statistics of NBA rookie card prices and regression variables

Variable	Mean	Median	Maximum	Minimum	Std Dev	Skewness	Kurtosis
Price	$723.43	$5.00	$86,000.00	$1.00	$5,503.37	13.73	207.85
lnPrice	3.33	2.71	9.90	0.00	1.89	1.38	1.50
Print Run	752.52	600	1499	499	308.87	1.16	.37
PSA8 (Dummy)	0.22	0.00	1.00	0.00	0.41	1.39	−0.08
PSA9 (Dummy)	0.41	0.00	1.00	0.00	0.49	0.36	−1.88
PSA10 (Dummy)	0.37	0.00	1.00	0.00	0.48	0.53	−1.73
Graded	17.94	5.00	346	1.00	40.85	4.47	24.09
For Sale	1.16	0.00	22.00	0.00	3.05	4.41	22.39
Rookie (Dummy)	0.66	1.00	1.00	0.00	0.47	−0.69	−1.53
All Star	3.22	1.00	19.00	0.00	4.65	1.49	1.49
Games							
Champions	0.67	0.00	4.00	0.00	1.16	1.74	2.00
Draft Pick	5.43	5.00	28.00	1.00	4.36	2.92	12.96

N = 282; Data sources: PSA.com (2024); eBay.com (2024); and Topps Company (2024)

Table 2 Parameter estimates least squares: Dependent variable: *lnPrice*

Variable	Coefficient		t-Value		Coefficient	t-Value	
Intercept	1.18		4.31		0.88	3.24	
	(0.27)***				(0.27)***		
Graded	6.42E-3		2.66				
	(2.42E-3)***						
PSA9	0.57		3.43		.75	4.56	
	(.17)***				(.16)***		
PSA10	1.45		8.37		1.56	9.12	
	(.16)***				(.17)***		
Rookie	0.58		4.62		0.74	6.08	
	(.13)***				(.12)***		
All Star	.30		14.00		.34	20.15	
Games	(.02)***				(.02)***		
Champions	.14		2.49		.19	3.23	
	(.06)**				(.06)***		
Draft Pick	-.03		−1.25		-.03	−1.56	
	(.02)				(.02)		
Print Run	−7.00E-5		−0.38		5.52E-5	0.77	
	(1.85E-4)				(1.90E-4)		
R-Square	.77	F-Statistic	112.90	R-Square	.76	F-Statistic	123.92

N = 282; Standard errors in (parentheses). *** and ** are significant at the 1% and 5% levels, respectively. The dependent variable *lnPrice* is the logarithm of the NBA rookie card price. The independent variables *Graded*, *PSA9*, *PSA10*, *Rookie*, *AllStarGames*, *Champions*, *DraftPick*, and *PrintRun* are the number of PSA graded cards, the dummy variable representing *PSA9* grade over the baseline *PSA8* grade, the dummy variable representing *PSA10* grade over the baseline *PSA8* grade, the rookie season dummy variable, the number of All-Star game selections, the number of championships won, the number of draft picks, and the original number of prints of the rookie cards, respectively. Data sources: PSA.com (2024); eBay.com (2024); and Topps Company (2024)

card, whereas the player performance variables *All Star Games*, *Championships*, and *Draft Pick* have the potential to influence both the supply and demand of NBA cards.[7]

One issue arose regarding the number of cards graded by PSA, which could be a reflection of demand for each card. Thus, there was concern with using *Graded* as an explanatory variable to explain card prices. To deal with this potential problem of endogeneity, this issue was tested with two-stage least squares. Hedonic regression analysis was used again. *For Sale* is the listed quantity on eBay, but in a supply-and-demand framework, is endogenous to the dependent variable, the logarithm of the price on eBay. To address this issue of endogeneity in *Graded*, the total population of rookie cards graded by PSA was used as the instrument variable (IV). *For Sale* is highly related to *Graded*, which meets the relevance criterion for IV. *Graded*

[7] The hedonic regression in Table 2 was also run using the natural log specification for each of the explanatory variables. The signs and level of significance for each of the explanatory variables did not change.

impacts *For Sale*, the listed quantity, which in turn influences the listing prices set by the sellers. A typical eBay seller looks at the sold price of past listings and uses the popularity of a player as a guide to set the listing price. A seller does not typically check the PSA website in setting the listing price. Rather one looks at the price of past sales on eBay. *Graded* also meets the exclusivity criterion for IV. Thus, to address this confoundment of an endogenous explanatory variable, a two-stage-least-squares regression framework was used.

First stage regression:

$$\begin{aligned} ForSale_i = {} & a_0 + a_1 * Grade_i + a_2 * PSA9_i + a_3 * PSA10_i + a_4 * Rookie_i \\ & + a_5 * AllStarGames_i + a_6 * Champions_i + a_7 * DraftPick_i \\ & + a_8 * PrintRun_i + \eta_{i.} \end{aligned}$$

Second stage regression:

$$\begin{aligned} lnPrice_i = {} & b_0 + b_1 * \widehat{ForSale}_i + b_2 * PSA9_i + * b_3 * PSA10_i + b_4 * Rookie_i \\ & + b_5 * AllStarGames_i + b_6 * Champions_i + b_7 * DraftPick_i \\ & + b_8 * PrintRun_i + \varepsilon_{i.} \end{aligned}$$

Table 3 reports the results for the first stage of the two stage least squares regression (2SLS).[8] After controlling for the intrinsic value variables, including both athlete performance and card condition, the *For Sale* related variable, namely *Graded* has a positive coefficient at the 1% level of significance. This suggests that *Graded* is a useful instrumental variable for *ForSale*, but to confirm the strength of the instrument, the Stock-Yogo (Stock & Yogo, 2005) test was used to test for weak instruments. The resulting F statistic is 317.02, which strongly rejects the null hypothesis of a weak instrument.

Next, a Hausman Test was used to test for endogeneity. The *For Sale* residuals (η) from the first stage regression in the model were included:

$$\begin{aligned} lnPrice_i = {} & b_0 + b_1 * ForSale_i + b_2 * PSA9_i + b_3 * PSA10_i + b_4 * Rookie_i \\ & + b_5 * AllStarGames_i + b_6 * Champions_i + b_7 * DraftPick_i + b_8 * PrintRun_i + b_9 * \eta_{i.} \end{aligned}$$

Table 4 presents the test results. The resulting t-value for b_9 is 3.06 and its p value = 0.002, confirming the issue of endogeneity in the empirical model.

In the second stage of the 2SLS regression, the fitted estimates of *For Sale* ($\widehat{ForSale}$) from the first stage regression were included. Regression results are reported in Table 5. Both the *For Sale* and intrinsic value variables significantly affect the log form price of graded basketball cards. The signs on the coefficients are as expected, with the negative coefficient on *DraftPick* suggesting that players picked earlier tend to have higher priced cards than later draft picks. Note that the coefficient for *DraftPick* is statistically significant in contrast to the result in the OLS regression. The coefficient on *Print Run* is negative, as predicted, but statistically

[8] Regressions without the original print run, the total number of cards ever printed, were run. All regressions showed an insignificant coefficient for the *Print Run* variable. As a robustness check, the regression results are reported without the *Print Run* variable in OSA Tables 1, 2, and 3. The results are nearly identical to those with *Print Run* included.

Table 3 Parameter estimates for first stage least squares: Dependent variable: *For Sale*

Variable	Coefficient		t-value
Intercept	0.23		.54
	(.417)		
Graded	0.63		17.80
	(.004)***		
PSA9	0.03		.01
	(.277)		
PSA10	-.31		−1.17
	(.269)		
Rookie	-.11		-.50
	(.227)		
All Star	.04		1.20
Games	(.031)		
Champions	-.12		−1.17
	(.105)		
Draft Pick	.03		1.39
	(.024)		
Print Run	−3.10E-4		−0.96
	(3.21E-4)		
R-Square	.72	F-Statistic	93.29

N = 282; Standard errors in (parentheses). *** is significant at the 1% level. The dependent variable *For Sale* is the number of cards listed for sale on eBay. logarithm of NBA rookie card price. The independent variables *Graded*, *PSA9*, *PSA10*, *Rookie*, *AllStarGames*, *Champions*, *DraftPick*, and *PrintRun* are the number of PSA graded cards, the dummy variable representing *PSA9* grade over the baseline *PSA8* grade, the dummy variable representing *PSA10* grade over the baseline *PSA8* grade, the rookie season dummy variable, the number of All-Star game selections, the number of championships won, the number of draft picks, and the original number of prints of the rookie cards, respectively. Data sources: PSA.com (202); eBay.com (2024); and Topps Company (2024)

indistinguishable from zero once graded population and market depth (among others) were controlled for. This suggests that the historical supply, despite being a meaningful factor *a priori*, may affect price only indirectly by influencing how many copies are graded and how many reach the market, rather than through a separate direct channel. Regarding the magnitude of the coefficients, the *PSA10* dummy carries the largest economic impact. Holding all else constant, a card graded Gem Mint trades at roughly 339% ($=e^{1.48}-1$) above a *PSA8* baseline. On the other hand, the *PSA9* dummy commands a premium of 77% ($=e^{0.57}-1$) over a *PSA8* baseline. By comparison, each additional active eBay listing increases price by 10%. The marginal value of achieving the highest grade substantially exceeds the premium buyers pay for an extra listing, for rookie status, additional *All-Star years*, *championships*, or changes in the original supply (*Print Run*). This is consistent with the behavior of card collectors. Avid collectors are willing to pay substantial premiums for rookie cards in PSA10 condition, as evidenced by the $86,000 price tag for a Labron James rookie card in PSA10 condition.

Table 4 Hausman test for endogeneity: Dependent variable: *lnPrice*

Variable	Coefficient		t-value
Intercept	1.16		4.80
	(.24)***		
For Sale	0.10		3.08
	(.032)***		
PSA9	0.57		3.52
	(.19)***		
PSA10	1.48		9.50
	(.16)***		
Rookie	.59		4.48
	(.13)***		
All Star	.30		15.95
Games	(.019)***		
Champions	.15		2.49
	(.060)**		
Draft Pick	-.03		−2.06
	(.014)**		
Print Run	−4.0E-5		−0.21
	(1.9E-4)		
For Sale	-.19		−3.86
Residuals	(.048)***		
R-Square	.77	F-Statistic	102.74

N = 282; Standard errors in (parentheses). *** and ** are significant at the 1% and 5% levels, respectively. The dependent variable *lnPrice* is logarithm of NBA rookie card price. The independent variables *For Sale*, *PSA9*, *PSA10*, *Rookie*, *AllStarGames*, *Champions*, *DraftPick*, *PrintRun*, and *For Sale Residuals* are the number of cards listed for sale on eBay, the dummy variable representing *PSA9* grade over the baseline *PSA8* grade, the dummy variable representing *PSA10* grade over the baseline *PSA8* grade, the rookie season dummy variable, the number of All-Star game selections, the number of championships won, the number of draft picks, the original number of prints of the rookie cards, and the residuals estimated from the first stage regression, respectively. Data sources: PSA.com, (2024); eBay.com (2024); and Topps Company (2024)

Robustness Checks

Finally, to confirm the robustness of the empirical results, supplemental checks were utilized. First to test the influence of supply on the regression coefficients, the *Print Run* variable was removed from the regression. The magnitude and significance of the coefficients remained virtually unchanged. (Online Supplemental Appendix (OSA) Table 1, Table 2, and Table 3).

Next, an additional issue arises from the number of cards graded by PSA being larger than the number of cards listed for sale. In many cases, the number of current listings on eBay was zero. There are 192 zero values for *For Sale*. Three extra regressions were run to check the robustness of the empirical results. First, the data were subsampled by excluding observations with zero *For Sale*. All

Table 5 Parameter estimates for second stage least squares: Dependent variable: *lnPrice*

Variable	Coefficient		t-Value
Intercept	1.16		4.76
	(.244)***		
$\widehat{\textit{ForSale}}$	0.10		3.06
	(.002)***		
PSA9	0.57		3.49
	(.164)***		
PSA10	1.48		9.42
	(.157)***		
Rookie	0.59		4.44
	(.132)***		
All Star	.30		
Games	(.019)***		
Champions	.15		2.47
	(.061)**		
Draft Pick	-.03		−2.04
	(.014)**		
Print Run	−3.84E-5		−0.20
	(1.88E-4)		
R-Square	.76	**F-Statistic**	112.90

N = 282; Standard errors in (parentheses). *** and ** are significant at the 1% and 5% levels, respectively. Dependent variable *lnPrice* is the logarithm of NBA rookie card price. The independent variables $\widehat{\textit{ForSale}}$, *PSA9*, *PSA10*, *Rookie*, *AllStarGames*, *Champions*, *DraftPick*, and *PrintRun* are the number of cards listed for sale on eBay estimated from the first stage regression, the dummy variable representing *PSA9* grade over the baseline *PSA8* grade, the dummy variable representing *PSA10* grade over the baseline *PSA8* grade, the rookie season dummy variable, the number of All-Star game selections, the number of championships won, the number of draft picks, and the original number of prints of the rookie cards, respectively. Data sources**:** PSA.com (2024); eBay.com (2024); and Topps Company (2024)

results hold, but the coefficient on *For Sale* is positive but statistically insignificant. This finding shows that the premium of a card arises mainly at the extensive margin, moving from no-market to some-market. The listing decision itself matters a great deal to the card price.

Also, *For Sale* was log-transformed by taking the logarithm of *For Sale* plus 1. The logarithm of Graded, *lnGraded,* and the logarithm of *Print Run* were also used to be consistent with the *For Sale* measure. All results are consistent with the results from the original measures.

Finally, the seller's decision to list the cards was treated as endogenous and modeled with a censored regression. The first stage regression shows *Graded* has a positive impact on the listing decision, *For Sale*.

The second stage shows qualitatively similar results to the original regression. The coefficient on *For Sale* is 0.06, slightly smaller than the 0.10 shown in the

original regression. In conclusion, each of the robustness checks provided consistent estimators with the coefficients presented in Table 5.

Discussion and Conclusions

To achieve a better understanding of the determinants of market price in an iconic collectible card market, namely sports cards from the NBA, the valuation of rookie cards was examined. After disaggregating factors affecting the price of collectibles into intrinsic value components, including the condition and desirability of each example, and a rarity component, the model was tested empirically.

Third party grading as a proxy for demand is highly correlated with price, and it also creates value added. The 3rd party grading service has been accepted by the market as a method to create value added to NBA rookie cards. The assigned grades, *PSA9* and *PSA10,* significantly increase the price of NBA rookie cards.

Next, after controlling for the problem of the simultaneous endogeneity of both market price and quantity through a 2SLS model, this study found that both *For Sale* and measures of intrinsic value affect the value of graded NBA basketball cards. Not surprisingly, all indicators of intrinsic value significantly affected price, namely, card condition, rookie-year cards, and the number of national championships the player had won, along with the number of all-star games in which the player appeared. The variable with the largest impact on price was the condition of the card. Collectors want to own examples of cards in the most pristine condition available in existence. Thus, they are willing to pay a substantial premium for cards graded in *PSA10* condition.

One of the challenges of empirical studies of collectible markets is the subjective nature of valuing unique examples. This paper contributes to the collectibles literature by disaggregating price into both quantitative (rarity) and qualitative (condition) components. Furthermore, this study is novel in its approach to collectible markets because it separates demand-side factors, collectors' use of third-party grading, from player performance characteristics that may affect both demand and supply, to better understand the determinants of price in a collectible market.

There are three implications from this study that can be applied to the more broadly defined collectible markets. First, memorabilia from famous people drive premiums: sports cards from the best athletes, original works from famous artists and musicians, and memorabilia from historical figures all create premiums over ordinary examples. Second, collectors seek third-party grading to certify condition and create value-added for prized collectibles. Demand for third-party grading signals that the expected value-added from condition certification is greater than the cost of the grading service fee.

Finally, when multiple examples of a collectible are available, collectors seek out the samples that are in the most pristine condition available. This finding reinforces the idea that collectors may be competitive and if enough participants in the market desire to own the most impressive or valuable collection possible, the condition of each piece will significantly affect price (Leibenstein, 1950).

Beyond this study, to further improve our understanding of collectibles, we plan to investigate the practice of serializing rookie cards. Is the creation of ultra-rare, numbered cards, 1 of 1, 1 of 10, 1 of 100, a marketing gimmick or does it create more interest and value-added to the market for NBA athlete cards? We will investigate the effects of an extremely limited supply on consumer demand for a collectible.

In the case of NBA rookie cards, a better understanding of the market is pertinent because in 1986 almost no one collected NBA cards. Today, with the cultural importance of professional sports in society, the market for sports memorabilia is a multibillion-dollar industry, with continued growth into the foreseeable future.

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Authors' Note Dataset used in this study is available upon request from the Authors.