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ABSTRACT

A simple hedonic pricing model is developed for baseball cards, of the type often used successfully to model prices for artworks. The model is estimated for a dataset of twelve well-known players observed at eight points in time over a span of twenty years. Dummy variables are used to capture various relevant characteristics of the player or card. This model was estimated separately for two different approaches or assumptions about rates of return. Estimates perform extremely well, explaining most differences among baseball card prices for the cards in the sample. Among extrinsic variables that represent specific players and card characteristics that differentiate cards issued during the same season, race had a significant positive effect on price for black players. Batting average and number of World Series appearances had significant positive impacts on price, but surprisingly, rookie cards tended to be worth relatively less than non-rookie cards. Similarly unexpected findings with respect to players' death and elevation to the Hall of Fame may result from trying to estimate too many characteristics simultaneously on a limited dataset. Results suggest famous players' cards generally are extremely attractive investment instruments.

INTRODUCTION

The economic literature on appreciation of non-financial investment assets has generally found low rates of return accompanied by high risk. Assets studied have included real estate, artworks, wines, and sports memorabilia. Sports memorabilia comprise an especially promising subject for further study. One essential feature rendering sports memorabilia more favorable subjects is the relative homogeneity of collectibles such as baseball cards, a feature clearly not shared by artwork or real estate.

All cards of a certain issue should have their value determined by characteristics intrinsic to the card, such as a card's age, condition, and scarcity, and characteristics extrinsic to the card, such as the particular player's records, fame, and popularity. Intrinsic characteristics are generally properties of the whole issue and are shared by all cards of a given year printed by a given manufacturer, assuming that equal numbers of each player were printed. Obscure player's cards will be sought to complete sets of a given issue, and famous or star player's cards will face additional demand to complete sets or enhance partial sets of star player or team cards.

This paper develops a simple hedonic pricing model for baseball cards, of the type often used successfully to model prices for artworks. We estimate this model with an illustrative sample of card prices for several different years. The results are used to demonstrate the construction of price indices (i.e. rates-of-return) for baseball cards for this particular set of cards using two methods. Finally, we extract specific values that individual player characteristics contribute to the value of a card. The paper is organized as follows: a review of the literature is followed by a development of the hedonic pricing model and consequent price indices, a discussion of the data used, presentation of the empirical results, and finally the conclusion.

LITERATURE

This section discusses some of the relevant economic literature on pricing sports memorabilia and other non-financial investment assets, such as artwork. Stoller (10) provides a valuable analysis of the Fleer v. Topps antitrust case as well as a discussion of the underlying economics of the baseball card business. The loss of Topps' monopoly power in 1980 and the introduction of competition (10, p. 23) may have caused the collapse of a speculative bubble in card prices. Stoller (10, p. 19) documents a 31.6 percent annual return on Topps cards.

Nardinelli and Simon (7) and Andersen and La Croix (2) both found that a player's race significantly affected the price paid for baseball cards on the secondary market. These studies focus on the secondary market for sports memorabilia to isolate consumer discrimination from co-worker and employer discrimination. McGarrity, Palmer, and Poitras (6) found little evidence of racial discrimination in the market for baseball cards. They used a dataset with constant supply, where effects from speculative demand are largely removed by considering only retired players. Using a variety of econometric specifications allowed them to assess the robustness of their results. Fort and Gill (5) study racial discrimination in baseball card markets using continuous, non-binary racial perceptions of market participants, as reported by surveys. They find evidence of discrimination against black and Hispanic hitters and against black pitchers, but not Hispanic pitchers. The mixed results leave no clear indication of the impact of racial discrimination on baseball card prices.

The literature on pricing artwork has significant implications for sports memorabilia markets. Ekelund, Ressler, and Watson (4) examine how an artist's death affects the demand for that artist's work. They find a clustered rise in the artwork's values immediately around the time of the artist's death. This phenomenon has two implications for the sports memorabilia market. The supply of baseball cards is effectively frozen for a particular player when the player retires from the game, rather than at death. Ancillary memorabilia, including autographs, and public appearances can continue to generate nostalgia and interest in a player, enhanced by the player's death.

Rengers and Velthuis (8) and Agnello and Pierce (1) study determinants of artwork prices based on characteristics of the artwork, artist, and gallery. This approach generalizes fairly readily to baseball cards, which have characteristics attributable to the player, team, and year of issue. Reneboog and Van Houtte (9) and Agnello and Pierce (1) find that artworks significantly underperform when compared with financial assets, owing to the very high risk of investing in art, the heterogeneity of artworks, high transactions costs, and high costs of insurance, transportation, security, and resale. It is particularly worth noting that none of these negative features generally applies to sports memorabilia. Baseball cards of a given player, issue, and condition are always non-unique, homogeneous assets.

Clearly, researchers have laid much of the groundwork for estimating financial models for investment in baseball cards. We build on this foundation of art models with research on similar relevant factors for a limited set of baseball cards.

MODEL

Baseball cards appreciate in value in a fashion similar to wine, though for different reasons. The supply of cards of a particular brand, player, and year is limited to the number printed. Surviving copies appreciate in value, as some are lost, destroyed, or decay in condition as time passes. This gradual diminution of the supply of cards is similar to what happens as vintage wines are consumed, mature forests are harvested for lumber, or petroleum deposits are pumped out of the ground. Unlike wines, baseball cards and other sports memorabilia do not acquire chemical changes as they age which improve their quality, and desirability. In fact, the chemical changes to which sports memorabilia are subject over time normally detract from their desirability, and collectors attempt to prevent or delay chemical changes.

Changes in demand also affect the prices of sports memorabilia. Demand for such memorabilia increases with interest in the particular sport or athlete, with interest in the memorabilia for its own sake, and with increased chances of return on them as investment assets. Demand effects can occasionally be negative, as documented for the collapse of baseball card prices caused by the end of monopoly pricing in 1980 (10, p. 23), an exceptional event in this market.

Sports memorabilia and athletes have unique characteristics as well. Though old baseball cards of comparable significance, condition, and quality are generally more valuable than newer cards, the career performance and general fame of the player make a card more desirable and therefore more valuable. All cards of a given issue had the same price when new, and appreciate over time. A rookie card of an average player appreciates much less than that of a better-known player. A rookie card of a presumed hot-prospect may appreciate rapidly early on, but plateau or even decline in value as the player's career fails to achieve its initial promise. Some players' cards are especially desirable due to tragically brief careers. To capture the effect of factors that distinguish among a group of well-known players, we augment the model with variables, such as hall-of-fame induction, and death.

A hedonic price model incorporates these effects in a manner that is useful for evaluating the value and prospects for cards as an investment. The generalized form of the model is:

$$\ln P_t = \sum a_t X_t + \sum b_t Z_t + e_t$$

Where X and Z are vectors of observable characteristics, extrinsic and intrinsic, respectively, to a specific card. The natural logarithm of price, $\ln P_t$, is typically employed in these models and avoids the problem with extremely large or small prices.

Extrinsic characteristics are associated with specific players and vary across cards of a specific year. Estimates of the effects of such variables are useful to investors, because they show the typical change in price whenever one of these explanatory factors changes. For example, if a player improves his batting average, appears in the World Series, or is elected to the Hall of Fame, then we expect his card value to increase. Economists call these values *shadow prices*, because they show the price of the factors or how investors value the factors.

When we include such extrinsic factors in the model, we are able to separate and distinguish the combined play of intrinsic factors, such as deteriorating cards, diminishing supply, and breaking of records. These factors affect all cards issued during a single season, and we assume they affect all cards similarly, that is, at the average effect. To avoid multicollinearity, a single trend variable or a related series of time dummy variables capture the effect of these intrinsic factors simultaneously.

Using a(t) momentarily to represent the intrinsic pattern (and dropping the error term for simplicity), the model is:

$$\ln P = a + b\,\text{Black} + c\,\text{HallFame} + d\,\text{BatAvg} + e\,\text{WrldSer} + f\,\text{Rookie} + g\,\text{Deceased} + a(t)$$

Building on the significant literature concerning race, we include a dummy variable for race in the specification. Election to the Hall of Fame and batting average measure a player's actual performance. Note that earned run average would be used for pitchers, who would generally have to be priced with a separate model. The number of World Series appearances improves the desirability of a player's cards (a player's team is more likely to make it to the World Series the better the player's performance). Many collectors desire rookie cards, which are generally more rare, especially for famous players. If rookie cards are valued in any way differently from ordinary cards, including a dummy variable for rookie card status should improve the model's forecasting performance. Table 1 includes a complete list of variable definitions.

In this model format, a coefficient, such as d represents the approximate proportionate change in card price when the factor (batting average) increases by one point (we express batting averages as whole numbers for easier interpretation of results). For a qualitative variable, such as Black or Rookie, it is the approximate proportionate change in card price when the player or card fits a certain category. We usually transform the coefficient to $100(e^d -1)$ to obtain a better approximation of the effect in percentage terms. The base for the percentage change is the price of a particular card where all variables except the one being interpreted are held constant. For instance, $100(e^d-1)$ is the approximate percentage change in Rookie card price for a one-point increase in the batting average of a Black Hall-of-Famer with two trips to the World Series as of 1983.

Several intrinsic factors relate to a player's age. Generally cards of older players should be more valuable. The number of years elapsed from the start of a player's career and from the end of that career, career longevity itself, age of a player, and age of the card are closely related. They all change with the passage of time. To avoid multicollinearity problems, we allow a(t) to capture their combined effects.

The time function, a(t), appears in two formats. The simpler case adds a single term with a trend variable, t, to the model. In this case, a(t) becomes ht, where h is the coefficient of t. e^h quantifies the relative price of a card from one year to the next. The assumption in this case is that the annual percentage change is constant over the 20-year period. The transformation $(e^h)^t$, for various values of t, forms a series of indices that represent price changes, and $100(e^h-1)$ produces the approximate annual percentage change or rate of return.

The second a(t) case uses seven dummy variables for the different periods (1982 is the omitted period, so it is the base year for indices and return rate calculations), so

$$a(t) = h_{83}D_{83} + h_{84}D_{84} + h_{85}D_{85} + h_{88}D_{88} + h_{93}D_{93} + h_{99}D_{99} + h_{02}D_{02}$$

To determine the price advance from the base year (1982), we use the coefficient of the year i dummy variable (h_i) to obtain e^{h_i}. This allows for different rates of price changes during different time periods, a less restrictive model. This form allows for unexpected fluctuations and specific events, such as the 1980 price collapse. We discuss estimates of both models in the results section, where we use the above transformations to interpret the results.

DATA

This section documents the data we use to estimate the model. A convenience sample of twelve well-known players, listed in Table 2, illustrates the estimates, analysis, and interpretation of the model. The sample is not random and is biased toward familiar talented players, which limits the generalizations we can make. Instead, we present the model as a demonstration of the method and a basis for further research.

Internet sources, from baseball-reference.com, provided extensive data on extrinsic variables for individual players. Prices for one card for each player were taken from the Price Guides for eight different years over a twenty-year span from 1982 to 2002. One significant difference between these data and the auction prices used in empirical examinations of artwork prices should be noted. Artworks are unique and each auction price for a given artwork records a unique transaction at a unique point in time. In contrast, the Price Guide observations of card price in a given year are taken from dealer surveys. There is never any specific, single exchange that can be documented at the listed price. Generally, the Price Guide is used as an authority for dealers to price and update their inventory. Many transactions occur at the price listed in difference derives from the fact that there are many identical copies of a given card, even in the same condition, while an artwork is always absolutely unique.

RESULTS

This section presents the estimated results. Table 3 displays the actual estimates of the models; single trend term under "constant change" and the assortment of time dummy variables under "flexible change". Overall, the results are good. High R-squares and F-values suggest both models offer investors and collectors a useful tool.

Extrinsic Factors

The estimates of coefficients of the extrinsic factors, the ones that distinguish individual players, are generally good. The results are very similar for both models of time (intrinsic) changes. Overall, that the model produces any significant findings amongst the twelve renowned players attests to the importance or robustness of the variables.

Consider player performance variables, BatAvg, WrldSer, and HallFame, measures of player performance. They produce different results. Higher batting averages do produce statistically significant higher prices, as expected. Using the transformations suggested earlier, the estimated impact of a one-point increase in the batting average is a 2.63-2.68% increase in the card price. However, the coefficient of Hall of Fame is negative and insignificant in both models. Indirect player performance, reflected by number of World Series appearances, is also significantly positive. An additional appearance is calculated to bring an average price increase of 40-41%. Batting average and number of World Series appearances may account for the unexpected Hall of Fame estimate. It is probably too much to ask for all variables for outstanding-performance for these sampled players to show a strong impact on price.

Results with the qualitative variables are mixed as well. Race coefficients are positive and significant for Black players. The magnitude is surprising, ranging from 140% to 151%. There is no evidence that rookie cards and death of the player enhance the value of cards among these players. Perhaps these variables work differently for a gifted set of players.

Intrinsic Factors: Price Indices and Rates of Return

Figure 1 and Table 4 contrast the findings for the price indices from the two models for the intrinsic variables. The flexibility of the variable-change or dummy variable approach is obvious.

The model with the single time variable, t, produces a significantly positive coefficient. When transformed, the coefficient indicates that prices of cards in this group increase by about 15.63% per year. This is an estimate of the annual rate of return. Figure 1 depicts such an increase over the 21-year period for a card that was priced at $1 in 1982. The dollar value on the vertical axis is also the price index (expressed as a proportion rather than a percentage) for that period.

In contrast, the dummy variable approach produces seven coefficients (five are significant) coefficients and a variable-path of prices and return rates. We can solve for an approximate constant annual growth rate that would produce the change from 1982 to period i by using $100(e^{h_i})^{1/t}$. For instance, the index of 1278 in 2002 means that a card period i by using $100(e^{h_t})^{1/t}$. For instance, the index of 1278 in 2002 means that a card that cost a dollar in 1982 and increased in value by 13.59% per year, would be worth $12.78 in the year 2002. The shaky early start in the 1980s probably reflects the 1980 monopoly-price disruption. Subsequently, the market took off, and then seemed to level off in the late 1990s, when record stock performances may have attracted investment funds away from cards. The slowed economy in 2002 could account for the reduced return in this year. The flexible change approach allows for such a path, while the constant change forces the change to grow ever larger and in the same direction.

Either approach shows that cards for this sample were earning a very good return with some calculations showing values that approach the 31.6% of Stoller. The choice of time span can affect these estimates. A high rate of return is not surprising given the selection of players. The hedonic price model and both time approaches provide some image of the behavior of baseball cards over the period. A more comprehensive data set, perhaps with dummy variables to identify particular players, offers the potential for better guidance for investors.

CONCLUSION

A hedonic pricing model was estimated on a sample of twelve baseball cards with prices observed in eight different years over a twenty-year period to demonstrate the approach for sports memorabilia. This model was estimated separately for two different approaches or assumptions about rates of return. Both models performed extremely well and explained differences among baseball card prices for the limited group of cards in the sample. Future research should include a more comprehensive data set.

Among extrinsic variables that represent specific player and card characteristics that differentiate cards issued during the same season, race had a significant positive effect on price for Black players. Batting average and number of World Series appearances had significant positive impacts on price, but surprisingly, rookie cards tended to be worth relatively less than non-rookie cards. In addition, a player's death and election to the Hall of Fame generally decreased the value of his cards. The unexpected findings may result from trying to estimate too many enhancements among a group of extraordinary players.

Price indices and rates of return estimates resulted from the two approaches to measuring intrinsic effects, effects that occur to all cards issued during the same season. Among the sampled cards, the return estimates indicated a set of good investments on average.

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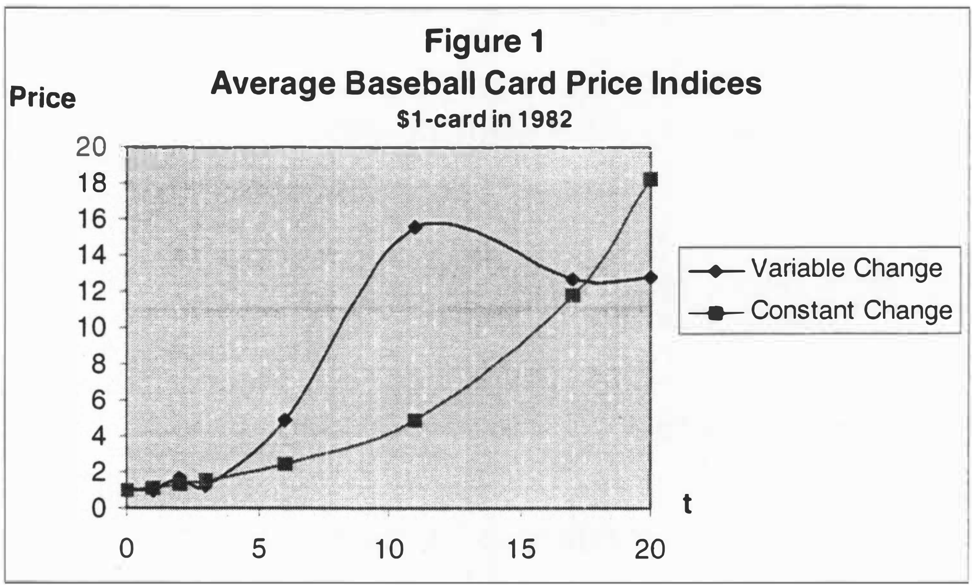
Figure 1
Average Baseball Card Price Indices
$1-card in 1982
Price
20
18
16
14
12
10
8
6
4
2
0
0
5
10
15
20
t
Variable Change
Constant Change

TABLE 1

Variables in the Hedonic Price Model

P	= card price in current dollars from the Price Guides
BLK	= 1 if player is Black, = 0 otherwise
HallFame	= 1 if player was in Hall of Fame prior to year of Price Guide, = 0 otherwise
BatAvg	= player career batting average up to and including year of price observation, t
WrldSer	= number of world series appearances prior to year of Price Guide
Rookie	= 1 if card is a rookie card, = 0 otherwise
Deceased	= 1 if player was deceased prior to year of Price Guide, = 0 otherwise
t	= year of observation, 1982 = 0
$\mathbf{D_t}$	= 1 if price observed in year t, = 0 otherwise

Price Guides from 1982, 1983, 1984, 1985, 1988, 1993, 1999, and 2002.

TABLE 2

Sample of Baseball Cards

Player	Years Played	Teams	Card Issuer and Year	Card #
Aaron, Hank	1954-76	MLN ATL MIL	1954 Topps	128
Bench, Johnny	1967-83	CIN	1968 Topps	247
Brett, George	1973-93	KCR	1975 Topps	228
Carew, Rod	1967-85	MIN CAL	1967 Topps	569
Fisk, Carlton	1969-93	BOS CHW	1972 Topps	79
Jackson, Reggie	1967-87	KCR OAK BAL NYY CAL	1969 Topps	260
Mantle, Mickey	1951-68	NYY	1952 Topps	311
Musial, Stan	1941-63	STL	1948 Bowman	36
Robinson, Jackie	1947-56	BRO	1949 Bowman	50
Rose, Pete	1963-86	CIN PHI MON	1963 Topps	537
Williams, Ted	1939-42 & 1946-60	BOS	1950 Bowman	98
Yastrzemski, Carl	1961-83	BOS	1960 Topps	148

TABLE 3

Models of Baseball Card Prices

	Constant Change		Flexible Change	
	Coeffi-cient	Two-tail P-value	Coefficient	Two-tail P-value
Constant	-4.638	0.005	-4.668	0.001
Black	0.9195	0.001	0.8735	0.000
HallFame	-0.0904	0.732	-0.1031	0.648
BatAvg	0.0264	0.000	0.0260	0.000
WrldSer	0.3432	0.000	0.3366	0.000
Rookie	-0.8876	0.007	-0.8961	0.002
Deceased	-1.0434	0.003	-0.8642	0.004
t	0.1452	0.000		
D_{83}			0.0193	0.948
D_{84}			0.5414	0.072
D_{85}			0.2100	0.482
D_{88}			1.5935	0.000
D_{93}			2.7475	0.000
D_{99}			2.5373	0.000
D_{83}			2.5480	0.000
R^2	78.4%		85.6%	
F (p-value)	45.58 (0.000)		37.48 (0.000)	
n	96		96	

TABLE 4

Price Indices & Rates of Return

		Constant Change		Flexible Change	
Year	t	Price Indices (%)	Annual Rate Since 1982 (%)	Price Indices (%)	Annual Rate Since 1982 (%)
1982	0	100		100	
1983	1	116	16	102	1.95
1984	2	134	16	172	31.09
1985	3	155	16	123	7.25
1988	6	239	16	492	30.42
1993	11	494	16	1560	28.37
1999	17	1181	16	1265	16.10
2002	20	1826	16	1278	13.59