AN EVALUATION OF PLAYER PERFORMANCE AS A DETERMINANT OF BASEBALL CARD PRICING IN THE CASE OF STAR PLAYERS

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Economics

Abstract

Previous research has effectively shown how in connection with race, and free-agency, performance statistics have affected the value of the baseball card market. However examination has not been done on how a player's performance directly relates to their popularity and card value. This study attempts to determine which performance statistics for pitchers and batters significantly affect their rookie card value in the card trading market. The abundance of statistical data from the MLB allows an evaluation through regression-based analysis to determine what attributes from Hall of Fame players are determinants. The implications from this research used correctly can aid collectors in determining which cards to invest in.

KEYWORDS: (Baseball, Baseball Cards, Player Performance, Hall of Fame)

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CHAPTER I

INTRODUCTION

Once upon a time, baseball cards provided a way for vast numbers of fans, especially youngsters, to connect with players and the games. Before television, before ESPN, before computers, smart-phones and the Internet, cards gave fans things that people today take for granted: what does the player look like, how did he do last season, what has he done over the course of his career? Today, the National Football League feels compelled to run an advertising campaign urging kids to play outside for at least 60 minutes each day, but in the past, the challenge was getting kids to come in from the playground. During their hay-day, baseball cards were widely prized by the youth of America, with small card trading markets filling the playgrounds.   However, in an era when easy, instant access to information and products has been greatly expanded by the Internet, collecting pieces of cardboard from past eras has lost its appeal for many youngsters. For those who participated in this pastime as a child, card collecting has aged with them into an adult market. Looking at auction prices for rare cards, it becomes clear that no child can participate, because you can't trade your lunch dessert for a Mickey Mantle 1951 bowman rookie card that sells for $162,000.

The crown jewel of baseball cards, at least from the standpoint of avid collectors, is the 1909-1911 T206 PSA 8 Honus Wagner card. Now, Wagner himself was one of the greatest baseball players of all time, but the notoriety of this particular baseball card involves more than Wagner's wonderful career. Many believe that production of the card was stopped quickly and only a few hundred made it into circulation, some say because of Wagner's possible aversion to tobacco or the fact that he wasn't being compensated for the card's distribution. Beyond mere scarcity, this card has had a long history of controversy stemming from its odd texture and shape, and the well-publicized purchase of one by hockey great Wayne Gretzky in 1991. Starting with a trading price of $50 in 1933 (itself an exceptional price at that time), this specific card sold at auction for $2.8 million in 2007. While the reasons for this specific card's extraordinary value are attributed to scarcity and its specific history, the broader question remains: what drives prices for the baseball cards of elite players?

1991 isn't only notable for the Gretzky purchase of the Wagner card. It also marked the peak year for baseball-card sales. Growth in the market started in the 80's as baby boomers entered their peak earnings years. In searching for items from their youth, this generation caused a huge spike in prices, leading to returns of up to triple digits for baseball cards[1]. According to estimates from *Sports Collector's Digest*, card sales amounted to $1.2 billion in 1991, but by the end of the millennium total sales had declined to $400 million[2]. Even so, there remains today a robust submarket for the tiny fraction of all baseball cards that relate, not to ordinary players, not to this year's stars, but to the greatest players that ever played the game.

This submarket has inspired this study of baseball card value as a function of player performance statistics. With large databases and markets such as Beckett online, card trading is no longer done with among neighborhood buddies; instead, it involves

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[1] Zillante, A. "Survival in a Declining Industry: The Case of Baseball Cards." Industrial Organization (2005)

[2] Ambrosius, G. "Time for a Change." Sports Collector's Digest 29, no. 26 (2002): 72—74

card appraisals by multiple graders to determine exact condition and authenticity, with that appraiser quoting a value for the card, and then finding a buyer who could be nearby, or across the country, or even in Japan.

This paper examines the pricing of baseball cards generally, and then presents and tests a model for valuing the baseball cards of elite players. In particular, it seeks to determine how much performance statistics affect card value. The second chapter provides detailed information on baseball cards and the secondary trading market for them, and reviews the relevant literature that has already been published in the academic community concerning various factors affecting the pricing of baseball cards. Chapter three discusses the applicable economic theories relating to assets like baseball cards and the markets in which they are traded. In this regard, it is useful to consider baseball cards, for conceptual purposes, as a capital asset. The fourth chapter sets forth the framework of the regression model and sources for the dataset used to test it. Chapter five presents the results from the regression, explains their meaning and significance, and draws the conclusions and implications of the study.

Chapter II

LITERATURE REVIEW

While baseball cards were once just a mechanism to keep cigarettes packs firm during shipping, they have become an investment opportunity for sport enthusiasts and investors alike. Baseball cards first appeared in tobacco products packaging starting in the late 19th century, then migrated to caramel packaging and, finally, by the 1930s were included in bubble gum packaging. With the introduction of Topps bazooka bubble gum, baseball card collecting became more than a kids hobby[1]. Topps dominated the baseball card business until 1980, when a district court ruled that Topps had an illegal monopoly on the production and sale of baseball cards, and required Major League Baseball to use multiple card vendors[2]. Each year since then, other companies have joined Topps in producing and selling cards, however the market is still dominated by Topp, Fleer, and Donruss.

UNDERSTANDING THE BASEBALL CARD MARKET

A different set of baseball cards is printed annually, with each card displaying the image of an active player and his performance statistics, and maybe some biographical information, both for the previous season and over the course of his career.

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[1] McCollister, J. "BASEBALL'S BIG BUCKS? IT'S IN THE CARDS." Saturday Evening Post 262, no. 3 (1990): 62-63.

[2] Hewitt, J. D., R. Muñoz, W. L. Oliver, and R. M. Regoli. "Race, performance, and baseball card values." Journal of Sport & Social Issues 29, no. 4 (2005): 415

While some cards are distributed in bubble gum packages, others are sold on a stand-alone basis, either as a complete set or in subsets. After the cards for a given year are printed, the quantity of each card is fixed (there are no reprints). The producers do not disclose to the public the actual production quantities for each card. In any given year, the physical characteristics of the cards are uniform as to size, material and design, so there is no basis for differentiating among new cards except for the player the card depicts.[3]

Secondary Market for Baseball Cards

There is an active secondary trading market for baseball cards. Dealers buy and sell cards among themselves or collectors, and collectors also transact with other collectors, either directly or, more recently, through on-line marketplaces. There is no central reporting service that tabulates the price for each transaction. However, there are price guides published annually and monthly that are widely used, especially the Beckett price guide. There are grading conventions for classifying the condition of a card, and the pricing guides specify the current value for each card from each year, depending on the card's condition. Typically, the value for most individual cards from a given year having the same quality is the same; however, some cards command a premium.

Card Value Determinants

The value of a specific baseball card is dependent on a number of variables. The most important indicators of value are an individual player's career statistics or

[3] Thorn, J., P. Palmer, M. Gershman, M. Silverman, S. Lahman, and G. Spira. Total baseball: the official encyclopedia of Major League baseball. Total Sports Kingston, NY, 2001.

performance, and the scarcity of the card, but there are other factors at work as well because certain cards are worth tens of thousands of dollars while others are worth less than the pennies they originally cost. Values vary depending on the condition of the card and year produced: generally, the better the card's condition and the older it is, the greater its value. Mint or near-mint card condition increases the value of the card exponentially. In addition, rookie cards (that is, the card issued after a player's first season – his rookie season) are worth more than the same player's cards issued in other years, especially if the player subsequently becomes a star performer[4]. Researchers have identified other factors that may affect card values. For example, in his 1976 paper, Medoff argued that fans have a natural preference for offensive players (batters) over defensive players (pitchers)[5], although other evidence disputes this (for example, the unequal distribution of Hall of Fame membership favoring pitchers over field players). Card values may also reflect factors such as race, as well as intangibles not captured by performance statistics, such as "star quality." Research work on these factors is discussed in detail below.

The ultimate measure of greatness for a baseball player is induction into the Hall of Fame. The Baseball Hall of Fame in Cooperstown NY was founded in 1936 to celebrate the centennial of "the first scheme for playing baseball," and inducted five of the most famous players in Major League history: Ty Cobb, Walter Johnson, Christy Matthewson, Babe Ruth and Honus Wagner[6]. As of January 2010, there are only 292

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[4] McCollister, J. "BASEBALL'S BIG BUCKS? IT'S IN THE CARDS." Saturday Evening Post 262, no. 3 (1990): 62-63

[5] Medoff, M. H. "On monopsonistic exploitation in professional baseball." Quarterly Review of Economics and Business 16, no. 2 (1976): 113-121.

members of the Hall of Fame, including field players, pitchers, managers, and umpires from Major League Baseball, and members who played in the Negro League. There are two processes to be admitted into the Hall: the most common method is to be elected by the Baseball Writers Association of America or BBWAA, the second being inducted by the 15 member Committee on Baseball Veterans. To be eligible for election to the Hall of Fame through BBWAA voting, a player must satisfy many prerequisites, including having played in the major league for at least ten years, having been an active player within 20 years of election and having been retired for at least 5 years[7]. If these restrictions are met, the player is elected if he receives “yes” votes from 75% of the ballots submitted. In effect, a qualified player gets 15 chances to be chosen for the Hall of Fame through BBWAA voting. Thereafter, the Committee on Baseball Veterans allows one “old-timer” to be admitted each year if he receives “yes” votes from 75% of the Committee. The criteria for membership is stated as follows: “Voting shall be based upon the players record, playing ability, integrity, sportsmanship, character and contributions to the teams on which the player played”. Since the composition of the voters changes over time, as does the way each voter uses his individual judgment to assess these factors, there can be significant uncertainty after a player has retired as to his prospects for ultimately being elected to the Hall of Fame. The inclusion of only Hall of Fame members in this research allows this study to examine how various factors affect the pricing not of ordinary players’ cards, but the cards of the greatest players ever to play the game. Is the exceptionally high value of Hall of Famers’ cards

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[6] Findlay, D. W., and C. E. Reid. "Voting behavior, discrimination and the national baseball hall of fame." Economic inquiry 35, no. 3 (1997): 562-578.

[7] Ibid

explainable primarily by their exceptional performance over the course of their careers, or are other factors at work when it comes to pricing the cards of star players?

Scholarly research has assessed the value of baseball cards through the development of various pricing models. Generally, these models posit that the main factor determining the value of a card is a player's productivity over an extended time. Because there is an abundance of statistics on the performance of each player each year, there is ample data for researchers to use in various ways as a measure of each player's productivity. Likewise, the availability of secondary market pricing data on specific cards makes it possible to measure the correlation between card prices and player productivity. However, analysis shows that variations in player productivity do not explain all of the variation in prices among different baseball cards, even when controlling for other important factors such as card condition, or the "rookie card" phenomenon discussed above. Therefore, the residual unexplained variation in prices must reflect other factors. One such factor examined by several researchers is the significance of racial discrimination by card buyers against minority players as a factor in card pricing. Other researchers have developed card pricing models in order to investigate monopsonistic exploitation in the labor market for Major League players. Before this study presents its own pricing model, it is helpful to review the models that other researchers have developed and tested.

Race and Baseball

Racism has been associated with organized baseball in many respects, starting with the segregated leagues of the late 19^{th} century. As Feagin states in his book Racist America, " racism is integral in the foundation of the United States and pervades every facet of life in society"[8]. Andersen and La Croix (1991) hypothesized that the economic impact of racial discrimination by fans against minority players could be quantified by its effect upon baseball card values[9]. Their four-part study analyzed player productivity data (sub-dividing it into pitchers and hitters) from different time periods relative to the value of corresponding baseball cards. The race of each player was also included as a factor. One of the difficulties of implementing their pricing model was choosing the best measure of player productivity over the course of an entire career, and adjusting it to control for the performance of teammates and the characteristics of their home park (some favor hitters, while others favor pitchers). Another difficulty was accounting for the effects of potential productivity for mid-career players: a mid-career slugger may have fewer home runs than a retired slugger, but the value of his card at that time will reflect the expectation that he will hit many more home runs before his career is finished. Andersen and LaCroix also adjusted their pricing model to control for the effects on card values of differences in fan familiarity and in population of the areas in which teams were located. Finally, lacking any means of controlling for differences in card scarcity over time, Andersen and LaCroix only used card prices from the same time period that the card was issued. Their findings were mixed, and only showed significant racial discrimination in three samples with the inclusion of interactive race-productivity variables. With these variables, they determined that, within the 1977 hitters sample, black card prices were lower than their white counterparts at all productivity levels and black card values increase at a slower rate. The 1960-61 pitcher

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[8] Hewitt, J. D., R. Muñoz, W. L. Oliver, and R. M. Regoli. "Race, performance, and baseball card values." Journal of Sport & Social Issues 29, no. 4 (2005): 411.

[9] Andersen, Torben, and Sumner J. La Croix. "Customer Racial Discrimination in Major League Baseball." *Economic inquiry* 29, no. 4 (1991): 665

sample showed that card prices for black players increased more than white players with increased performance, meaning consumers discriminate against average or below average black players but are willing to pay a premium for the elite black pitchers.

Other studies such as Nardinelli and Simon's (1990)[10] also address racial discrimination using baseball card pricing data. Player productivity was measured using different statistics than those used by Andersen and LaCroix, and no adjustments were made for several factors that Andersen and LaCroix addressed (such as team location and team performance). Nardinelli and Simon argued that, to the extent that the statistics they chose resulted in errors in the measurement of player performance, such errors would be uncorrelated with race and so would not affect any findings their analysis showed specifically with respect to racial discrimination. In preparing the data set, they corrected for an issue not addressed by Andersen and LaCroix, namely the fact that, before 1974, cards were issued not all at once but gradually over the course of the season, with fewer cards being issued later. This meant that prices for cards issued later tended to have a scarcity premium because fewer were issued. Finally, they argued that the proper way to think about a card price was to separate the gross price into two components, a "common player" price that is unaffected by player performance, and a residual, the amount of which varies with player performance and other factors. Doing so allowed them to correct for mistakes in card values used in previous studies, and it shows in the results: they found that the cards of black hitters sell for 10% less than white counterparts, and the cards of black pitchers sell at a 13% discount.

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[10] Nardinelli, C. and Simon, C. "Customer Racial Discrimination in the Market for Memorabilia: The Case of Baseball." The Quarterly Journal of Economics, Vol. CV, issue 3 (1990): 575-595.

In 2005, Hewitt et al re-evaluated the race variable as a function of card value in studying Hall of Fame members and their rookie card value.[11] Hewitt hypothesized that card values for white players were foremost based on their “on-the-field” performance while those for black players were based more on extra performance factors such as the Most Valuable Player award and other achievements. Compared to Nardinelli and Simon, Hewitt uses a much simpler pricing model. First, he uses a new statistic as a variable to determine career performance simplifying the regression substantially, that being Total Baseball Ranking (or TBR) as conceived by Thorn. Total Baseball Ranking ranks players by their total wins contributed in their entire career, and is considered (at least by Thorn) the best baseball statistic measuring a player’s performance over his entire career[12]. Second, Hewitt incorporates some data indicative of how scarce a specific card is relative to other cards, while conceding that actual data on supply isn’t available. Finally, he makes none of the adjustments to control for factors that the previously discussed analyses made. Regressions using the independent variables TBR, race, and card availability showed surprising results. As expected, all card values increased with scarcity and performance and were normally distributed. Evaluating race showed statistically insignificant results, although had they been significant, the coefficients would have indicated discrimination in card value. In fact, after omitting three observations (Morgan, Mantle, and Matthews), which skewed the results, the coefficient for race became insignificantly positive, meaning that cards for black players

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[11] Hewitt, J. D., R. Muñoz, W. L. Oliver, and R. M. Regoli. "Race, performance, and baseball card values." Journal of Sport & Social Issues 29, no. 4 (2005): 411-425.

[12] Thorn, J., P. Palmer, M. Gershman, M. Silverman, S. Lahman, and G. Spira. *Total baseball: the official encyclopedia of Major League baseball.* Total Sports Kingston, NY, 2001.

cards are valued higher than white players. The most evident and surprising aspect of discrimination in baseball is shown not in card value but in Hall of Fame inductions. As Gonzalez and Jackson state “respondents attributed the success of white players to socioeconomic factors and blacks to physiological factors.”[13] Taking this further, Hewitt discovers that there is a disproportionate racial divide for positions in Major League Baseball, with white players dominating the “mental” positions of pitcher and catcher, while black players dominate outfield positions requiring more speed and quickness[14].

Major League Baseball as a Monopsony

The pivotal work of Gerald Scully (1974) concentrates on differences between player compensation and the revenue they produce as a way of quantifying the economic loss players experienced due to the reserve clause, and monopsony[15]. Contracts were one-year deals until the installation of free agency in 1975. The reserve clause was instituted by the team owners to prevent players’ salaries from increasing as much as they would in a free market and, so, allowed them to retain their talent at below-market costs. To compute how much the reserve clause constrains players’ salaries, Scully makes a crude estimate of each player’s marginal revenue product (MRP) based upon a computation of team marginal revenue products estimated using team statistics. The use of MRP becomes a staple in evaluating the true value of players

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[13] Gonzalez, GL, and N. Jackson. "Perceptions of success in professional baseball as determined by race/ethnicity: A photo-elicitation study." (2001)

[14] Hewitt, J. D., R. Muñoz, W. L. Oliver, and R. M. Regoli. "Race, performance, and baseball card values." Journal of Sport & Social Issues 29, no. 4 (2005): 412.

[15] Scully, G. W. "Pay and performance in major league baseball." The American Economic Review (1974): 915-930.

in future studies. Scully assumes that one batting statistic, namely team slugging percentage, has the greatest influence on a team's winning percentage. Slugging percentage is a measure of power for hitters by dividing total number of bases by their number of at bats. His findings were able to quantify a significant detrimental affect on player's salaries due to the reserve clause. Determining the extent to which the MLB was a monopsony, and evaluating a player's worth relative to his compensation made Scully's research the grounding elements of future research. What Scully was missing however, was a better way of determining each player's MRP.

Gill and Brajer (1994) evaluate the presence of a Major League monopsony again by combining Scully's MRP analysis with the use of baseball card pricing. Their work advances the ideas of Scully and Medoff in assessing the extent to which players are paid according to their worth. Because baseball card sales take place in a competitive market, baseball card prices can be used as a proxy for a competitive labor market, thereby providing a better dataset to use in computing the MRP of players on an individual basis.[16] Moreover, baseball card prices capture unmeasured productivity that analysis of purely baseball statistics omits. Gill and Brajer's findings showed that the baseball labor market at some level is monopsonistic. Their finding that non-free agents are underpaid is no surprise; however, their interpretation that more skilled players suffer more from monopsony is particularly interesting, indicating weaker incentives for superior performance than would prevail in a freer market. Gill and Brajer start using a simple regression to determine how much performance and race affect the value of a player's card. This is the basis for this study, however new

[16] Gill, A.M., V. Brajer. 1994. Baseball stars and baseball cards: A new look at monopsony in Major League Baseball. SOCIAL SCIENCE QUARTERLY – AUSTIN – 75: 195-195.

variables are added to shed light on other causes for increases in card value, such as admittance to the Hall of Fame. Using basic statistics such as home runs, runs batted in (RBIs), and stolen bases for batters, and wins, losses, earned run average (ERA), complete games and saves for pitchers, Gill and Brajer's regressions indicate that non-free agent players are regularly underpaid approximately 39% of their MRP. They attribute this to the restrictions on player mobility that Major League baseball contractually imposes on non-free agents. They also conclude that free agents are not significantly underpaid and, so, are less exploited.

Summarizing the review of the literature to this point, baseball card pricing has been used as the dependent variable in models developed to detect and quantify the effects of racial discrimination or to develop better estimates of players' MRPs for the purpose of measuring the monopsonistic effects of Major League baseball's restrictions on labor mobility. There is broad agreement that player productivity is a principal determinant of card prices, although there is substantial variation in the choice of statistics used to express such productivity. There is evidence that race is another factor in the pricing of cards, although the research does not agree upon the degree to which race affects pricing, nor on the significance of the factor as a variable. Beyond player productivity and race, there is evidence that another factor is at work in card pricing. Mullin and Dunn's 2002 work again uses card pricing to derive players' MRPs for the purpose of assessing monopsonistic exploitation. They hypothesize that the other factor at work in card pricing is an attribute they call "Star Quality," which they characterize as an "intangible characteristic … which exists over and above productivity as indicated in official game statistics."[17]

Mullin and Dunn argue that players having this "Star Quality" have greater revenue production than justified by their statistics and they test this proposition by adding a dummy variable to their pricing model that differentiates star players from their ordinary counterparts. For field players, a positive value was attributed to this variable if, in the year examined, he won a Golden Glove (an award for the best fielder at each position), or the Most Valuable Player award, or was in the top ten players in batting average, home runs or stolen bases. For pitchers, a positive value was assigned if the player won the Cy Young award that year (the award for best pitcher), or the Most Valuable Player award, or was in the top ten pitchers ranked by earned run average, wins or saves. Otherwise, Mullin and Dunn's pricing model follows the conventions seen in other pricing models. They use various statistics (principally the same ones as actually printed on the cards) in order to measure productivity, they add a dummy variable to account for the effect of race on card pricing and, like Nardinelli and Simon, they regress the independent variables not against the absolute value of card prices, but against the excess of premium card prices over the common card price. To control for the effect of scarcity upon card pricing, they use pricing data for the current card from the current year for each year in the period 1989-1993, arguing that the supply of cards was essentially constant throughout this period (not enough time having elapsed for card attrition to affect supply). Mullin and Dunn's results indicated that non-free agents generally were substantially underpaid relative to their MRP, while free agents (especially pitchers) were underpaid to a lesser degree. More interesting, for the

[17] Mullin, C.J. and Dunn, L.F. 2002. Using Baseball Card Prices to Measure Star Quality and Monopsony. Economic Inquiry Vol. 40, No. 4: 620.

purposes of this paper, was the substantial disparity that Mullin and Dunn found between the MRP of star players computed including the "Star Quality" factor versus an MRP computed excluding that factor: the former ranged as high as 74% greater than the latter. In other words, card prices for stars were substantially higher than player productivity and race would have otherwise indicated. Obviously, the pricing of cards of star players works very differently than the pricing of other players' cards. For purposes of this study, it is worth noting that the literature indicates support for baseball card pricing models that are based on player productivity and "Star Quality." Race is an additional factor, although it is less strongly supported by results than the first two factors.

CHAPTER III

THEORY

Many regard the baseball card market as the "poor man's stock market". In fact, it could be considered one of the most competitive markets because of the simplicity of the good traded. In the capital markets, stocks and bonds constitute claims on future cash flows of companies engaged in a very wide array of businesses, with the businesses differing dramatically from one another, whereas in the baseball card markets, the "business" underlying each of the cards being traded is the same, namely, the game of baseball.

ECONOMIC THEORIES

This chapter outlines the fundamental theories of finance and relates them to the baseball card trading market. Theses theories include models representing the consumer in the card market as well as theories that incorporate the human preferences existing in the card market.

Market Structure

The aftermarket for baseball cards reflects several attributes of the cards printed each year. The cards have virtually no intrinsic value other than as baseball cards (unlike, say, pennies which, being made out of copper, have a residual value as an industrial commodity apart from being currency). The cards are not differentiated from one to another as to size, appearance or other physical attributes except for the image and information of a specific player. Once the print run for a given year's cards is completed, the supply of cards is fixed because there are no subsequent reprints. The actual quantity made of each card each year is not disclosed to consumers, and may vary from year-to-year. The quantity of a given card from a given year declines over time, because the cards are, well, discarded: either the cards suffer physical deterioration and at some point cease to be worth any further effort by the owner to keep and preserve them; or, regardless of the cards' condition, the owner's tastes and preferences change such that the utility formerly realized by the owner through owning the cards diminishes. In either case, over time, the quantity that exists of a specific card from a specific year diminishes.

Card owners' tastes and preferences are not homogenous, so the utility to any given owner of any given card will vary. Many people will be indifferent to any card, while some individuals will feel a strong sentimental attachment to a specific card from a specific year. The latter group constitutes the natural source of long-term investors for a given card. The buy-side of the aftermarket consists of these collectors, as well as speculators and dealers. As in the stock market, speculators seek to buy cards at prices below what they believe the cards are worth, expecting to re-sell them at a gain in the future, while dealers seek to make a market, bringing buyers and sellers together and taking a piece of the spread between the bid and asked price. The activity of the speculators and dealers bring liquidity to the aftermarket, reducing the transactions costs that sellers would otherwise face in trying to find buyers for unwanted cards.

The aftermarket is an over-the-counter market: there is no single exchange or clearinghouse for card transactions. Instead, cards are bought and sold at a wide variety of forums, in person, through the mail or over the phone, even on-line. There is no comprehensive system for collecting data on each transaction, making the current "market price" for a given card less transparent, although at least one service provider -- Beckett online -- is attempting to provide a stable unified marketplace. In pricing cards, many market participants rely on pricing guides, each edition of which expresses an estimate of the current value of each individual card from each individual year. Typically, such guides express such estimates in terms of a premium, that is to say, any card from a given year is worth a specified minimum amount, whereas some cards from that year command a premium above and beyond the specified minimum amount. The guides do not disclose the data used or judgments made in developing their estimates of the current value of cards, apart from the scarcity, age and condition of the card. However, their credibility among collectors is demonstrated by their widespread use and acceptance.

Fundamental Value

Assume that the marginal investor for any given baseball card is a speculator. Surely there are exceptions, but in general, those collectors who have strong sentimental reasons for owning a particular card will acquire it (if they can afford it) and keep it indefinitely: such collectors are highly price-insensitive. Speculators, on the other hand, are highly price-sensitive, and therefore are much more likely to transact in response to any given change in prices. In mathematical terms, a rational speculator compares the current price of a given card against its fundamental value, that is, the present value of future cash flows associated with owning the card, all discounted at a rate that reflects the risk of that asset relative to the risks and returns offered by any alternative asset.

The speculator buys when fundamental value is high relative to the asking price, and sells when the reverse is true. Many alternative assets have significant carrying costs and other interim cash flows (e.g., the receipt of interest in the case of bonds, and dividends in the case of some stocks). For baseball cards, the situation is simpler: there is only one future cash flow, the proceeds from the re-sale of the card at some future point in time. Estimating what that re-sale price might be at future points in time is one possible source of error in calculating fundamental value; using an inappropriate discount rate is another. The speculator looks to player productivity (as expressed in the form of various baseball statistics) as the primary determinant of a card's future re-sale price. As for the choice of discount rate, the Capital Asset Pricing Model provides a framework for determining an appropriate rate.

The Capital Asset Pricing Model

The Capital Asset Pricing Model (CAPM) is used in finance to determine an appropriate rate of return for an asset that would make that asset worthy of investment. Conceptually, baseball cards can be considered a capital asset, and part of the market portfolio of all capital assets. This suggests that the principles of CAPM would apply to baseball cards the same way they also apply to stocks, bonds, gold, commodities, and so on. CAPM posits that the expected return on any asset will equal the sum of the expected return on a risk-free asset plus an additional amount that varies in direct proportion to the asset's sensitivity to systematic risk (its beta). According to CAPM, the riskier the asset (in terms of beta), the higher its expected return.

Expressed in mathematical terms, CAPM states that:

$$E(R_i)= R_f+\beta(E(R_m) - R_f) \tag{3.1}$$

where: E (R_i) is the expected return on the capital asset, R_f is the risk-free rate of interest, $_i$ is the sensitivity of the expected excess asset returns to the expected excess market returns, E (R_m) is the expected return of the market[1]. CAPM implies that all investors choose to hold their portfolio on the tangency point of the capital market line and the efficient frontier.

The idea of "systematic risk" (as opposed to all forms of risk) arises out of Modern Portfolio Theory (MPT). The central idea of MPT is that investors can construct a portfolio of assets that diversifies away certain forms of risk that are specific to certain individual assets. The resulting portfolio is not risk-free -- there remain certain risks that affect all assets to varying degrees (that is, "systematic risk") – but the portfolio is less risky than individual assets. For instance, in the baseball card market, a portfolio of cards concentrated in players who were New York Yankees would be vulnerable to a change in investor tastes and preferences against the Yankees and in favor of another team. This risk can be eliminated by constructing a portfolio with the appropriate weighting of cards for players from all other teams, thus a shift in favor against the Yankees and in favor of others would result not only in losses in value for Yankees cards but also gains in value on non-Yankees cards. MPT implies that investors wanted to be compensated for bearing systematic risk, and that they will not pay more to bear risk that they can diversify away themselves.

CAPM provides a measure of systematic risk – beta – that indicates the degree of exposure that a given asset has relative to the market portfolio of all assets. If a baseball card speculator knew the beta for baseball cards, the expected return on the

[1] Stanley, B. Block, and Hirt, A. Geoffrey. Foundations of Financial Management. New York New York: McGraw-Hill, 2005.

market portfolio of assets for a given period, and the risk-free rate of return for that period, then he could compute the required rate of return for baseball cards, which he could then use as the appropriate discount rate in computing the fundamental value of any given card. Unfortunately, there are practical problems in applying CAPM, and theoretical problems with some of its underlying assumptions. In practice, one can estimate expected future returns by using historical data, but using backwards-looking data as a proxy for forward-looking expectations is like driving a car using the rear-view mirror: it works fine until the road curves. Even more problematic is the adequacy of beta as a measure of "systematic risk." For example, CAPM predicts that high beta stocks will have high returns and vice versa for low beta stocks, but Fama and French (1992) showed that, after controlling for size, beta correlated poorly with returns[2]. Put differently, the stocks of small, so-called "value" companies produce higher returns than their betas would otherwise predict. This suggests that "systematic risk" has dimensions that a single co-efficient like beta doesn't fully reflect.

The biggest limitation of CAPM as a theory describing the pricing of assets may lie in CAPM's assumption that investors act rationally and make optimal choices in allocating their investments. It's not necessary to assert that investors act irrationally (although surely some do); as Kahneman and Tversky characterized it (1992), in making choices, people…"use computational shortcuts and editing operations" that result in a decision-making process that fall short of the CAPM assumption that investors know and understand everything material to an asset's valuation, and act on it

[2] Fama, E.F. and French, K.R. "The Cross-Section of Expected Stock Returns." The Journal of Finance, Vol. XLVII, No.2 (1992): 427-465

immediately[3]. Lo (2004) catalogued a whole host of examples of behavioral biases that distort investment decision-making, including loss aversion, overreaction, and overconfidence.[4] Taken individually, loss aversion refers to the tendency of people to prefer avoiding a given expected loss than for realizing a given expected gain. Overreaction is the practice of people placing greater importance on more recent experience of a given event than on an older experience of the same event. Overconfidence refers to people's tendency to overestimate the accuracy of their ability to predict future events. Taken together, the point of these behavioral biases and others suggests that investor decision-making will result in asset prices that implicitly involve different discount rates than those that CAPM would indicate. For example, in the baseball card market, CAPM would call for prices that, after controlling for scarcity (and perhaps other factors), would value equivalent player productivity consistently over time. This means that if two players from different eras had equivalent statistics, then such statistics would have the same impact on the pricing of their cards. The behavioral bias of overreaction would imply that the statistics of the more recent player would have a more powerful effect upon the pricing of his card than the same statistics would have on the pricing of the older player's card. In terms of regression analysis of card prices versus player productivity, using cards of players from different eras, CAPM implies that player productivity will be a more powerful variable in explaining current prices than behavioral biases would indicate.

The earlier discussion of fundamental value for a baseball card focused on two

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[3] Tversky, A. and Kahneman, D. "Advances in Prospect Theory: Cumulative Representation of Uncertainty." Journal of Risk and Uncertainty, No. 5 (1992): 317.
[4] Lo, A.W. "The Adaptive Markets Hypothesis." Journal of Portfolio Management, Vol. 30, No. 5 (2004): 15-29.

components, the future re-sale value and the discount rate to use in computing its present value. CAPM provided a theoretical framework for thinking about the discount rate. The Efficient Market Hypothesis (EMH) provides a framework for thinking about the extent to which information relevant to future re-sale value is actually reflected in card prices.

Market Efficiency

Later in this paper, a model for baseball card prices will be examined. Among other things, that model posits that player productivity (as measured by certain baseball statistics) is a key variable determining the prices of cards. The model will be tested using regression analysis of actual card prices. Therefore, it is reasonable to consider the extent to which actual card prices reflect available information (such as the player productivity statistics). The more fully that information is reflected in card prices, the more efficient the market for baseball cards is. One benefit of an efficient market for the specific purposes of this analysis is that it makes for clearer interpretation of results. For example, if the baseball card market is efficient and regression analysis shows that player productivity statistics are <u>not</u> a significant variable in explaining card prices, we can be confident concluding the relationship between them is weak or non-existent. If, however, the market is inefficient, there is an alternative possible explanation for the results: it would be possible that the relationship is significant, but not fully reflected on a current basis in the observed prices due to market inefficiency. So, the question of baseball card market efficiency is relevant to interpreting the results of the regression analysis later in this paper.

Samuelson’s aptly named article “Proof That Properly Anticipated Prices

Fluctuate Randomly" showed that, under certain conditions, the prices of securities ought to fluctuate in a random walk (1965)[5]. The EMH is formulated various ways, but the central idea is that the price of each security fully and correctly reflects all information that is material to such price. Fama (1970)[6] summarized various tests of three forms of the EMH: (i) weak form: current price fully reflects any information embedded in past prices; (ii) semi-strong form: current price fully reflects publicly available information; and (iii) strong form: current price fully reflects all relevant information, public and private (insider trading cases demonstrate that this form of EMH doesn't hold). However, the first two forms of the proposition have been tested in several ways. Many studies have looked at the usefulness of historical price data in predicting future changes in prices; such studies support the idea that the securities markets are efficient in eliminating this technical factor from pricing. Other studies have looked at historical accounting data in combination with valuation metrics (such as price/earnings ratio); again, such studies generally support an efficient market for stocks. The performance record of money managers has been scrutinized on a risk-adjusted basis, and the overwhelming majority fail to outperform the market on a sustained basis (in fact, after taking account of transactions costs, most under-perform the market). This implies that investors cannot earn excess risk-adjusted returns over a sustained time using publicly available information.

On the other hand, the behavioral biases that call CAPM into question also raise questions for the EMH. EMH does not allow for persistent divergences of prices from

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[5] Samuelson, P.A. "Proof That Properly Anticipated Prices Fluctuate Randomly." Industrial Management Review, Vol. 6, No. 2 (1965): 41-49.

[6] Fama, E.F. "Efficient Capital Markets: A Review of Theory and Empirical Work." Journal of Finance, Vol.25, No. 2 (1970): 383-417

fundamental values (EMH says that the activity of arbitrageurs buying or selling mis-priced securities will quickly correct such divergences), yet bubbles in asset prices develop and persist for years. Indeed, the housing price bubble is the most recent glaring example. There is substantial evidence that the securities markets are efficient but, as Lo puts it (2004), there is "…reasonable doubt… that an aggregate rationality will always be imposed by market forces."[7] So, what does this mean for the efficiency of the market for baseball cards?

The type of tests for efficiency that have been applied to the securities markets have not been applied to the aftermarket for baseball cards, the challenge being the lack of the right kind of data. There are no mutual fund managers running funds that invest in baseball cards. There is no transaction-by-transaction time series data for secondary market prices. Consequently, the efficiency of the aftermarket can only be assessed using more subjective means. Begin with the availability of relevant information to market participants. Baseball statistics are well-understood, widely and freely available to market participants, and there is reasonable consensus about their meaning (that is, people may differ in the relative importance they attach to batting average versus, say, slugging percentage, but the vast majority accept both as a meaningful measure of a hitter's productivity). Therefore, it seems unlikely that card aficionados could gain an informational advantage over one another (at least with respect to baseball statistics). One possible source of informational advantage could be superior knowledge about the actual number of cards produced for a given player in a given year. This is a trade secret protected by the baseball card makers, and if there were a dramatic change in the

[7] Lo, A.W. "The Adaptive Markets Hypothesis." Journal of Portfolio Management, Vol. 30, No. 5 (2004): 19.

number of cards produced in a given year, that information could have great value to an investor. However, if a maker disclosed that number to favored investors, that maker would risk a disastrous blow to its reputation among its customers, so there is a powerful incentive for makers to keep production numbers secret (or else, disclose the data to the entire card-collecting public). Reasoning by analogy, if securities markets are reasonably efficient, and the baseball card market bears many similarities to the securities markets (many participants, good liquidity, easy availability at low cost of most publicly-available information about a standardized product), then it is likely that the baseball card market is also reasonably efficient.

Future Re-Sale Value of Cards

More than any other sport, the appreciation of baseball is inextricably linked to a grasp of its statistics. The average football fan may or may not know how many yards per carry his favorite running back gains, but the average baseball fan knows (at least in approximate terms) the batting average, runs-batted-in, and home runs of his favorite players, and probably many other players as well. Statistics shape the perception of a baseball player's productivity and so, logically, ought to be a key component affecting changes in the price of that player's baseball card over time. Other factors (scarcity, age, etc.) are also important determinants of prices and these will be addressed in formulating a model of baseball card pricing. Intangibles are easy to overlook because they can be hard to measure, but they also can affect the pricing of an asset. In the case of baseball cards, a potentially significant intangible is "Star Quality," that is, the aspect of a player's performance that statistics do not fully capture. For example, Cal Ripken is a Hall of Fame player whose skills and statistics were well above average during the beginning and prime of his career, however, even when his batting statistics declined with age to ordinary levels, the prices of his cards continued to increase. Perhaps it reflected admiration for his durability (he retains the all time record for consecutive starts with 2,632 games). This streak, along with innumerable memorable moments along the way, makes Cal Ripken's "Star Quality" very high, apparently causing an increase in the value of his cards beyond that otherwise indicated by his statistical accomplishments.

CHAPTER IV

DATA AND METHODOLOGY

This section presents a regression-based analysis to evaluate how certain players' statistics affect their baseball card value. The analysis builds on the work of Mullin and Dunn, who performed regressions using statistical data from players' careers. Mullin and Dunn divide their data set into two groups, batters and pitchers and use different statistics to assess the level of performance of each player in each group. Mullin and Dunn use baseball card prices as the dependent variable, and the corresponding player's statistics as the primary independent variables. They also added dummy variables to indicate whether a given player is or is not a star. Using a similar regression framework, this analysis examines how well player productivity explains card prices when applied exclusively to a different subset of players' cards, that is, only to the cards of star players.

DATA AND SOURCES

The literature review showed that player productivity is an important factor positively affecting baseball card prices, and demonstrated this using a variety of baseball statistics as a proxy for productivity. The literature also showed that there is residual variation in baseball card prices that is not explained by player productivity, and different researchers tested for the significance of various other factors, such as race, as potential determinants of baseball card prices. One dataset untested by other researchers is the extent to which player productivity affects baseball card prices for those players whose productivity is most exceptional, that is, the stars. This analysis hypothesizes that, among stars, player productivity ought to be a more powerful factor in explaining differences in card prices because baseball aficionados focus more on differences in performance among stars than they do among ordinary players.

Now, by definition, the vast majority of players are not stars, so it is important to limit this analysis to a subset of players who are. Determining the criteria as to which players to include in the dataset could have included restrictions applying to certain teams, eras or positions – baseball has changed over time with respect to rules, equipment and other factors that affected what level of performance was attainable by superior players, and applying restrictions might be helpful in controlling for the differences in actual performance caused by such changes, and properly defining a subset of star players. However, the broadest test of the significance of "Star Quality" over time would be to use a group of players who represent all positions in the game, all eras of the game and who are well-accepted as proven stars. Based on these standards, the most sensible subset of players to use are those who have been admitted into the Major League Baseball Hall of Fame. There are many advantages to using these select players. First, this set of players are considered the best or fan favorites of all time; as a practical matter, this means their cards are most highly desired by the card-buying public. Secondly, because of the exclusivity of the Hall, the dataset becomes more manageable with fewer than 300 Hall of Fame players. Further refinement of the dataset requires that some Hall of Fame players be excluded from the analysis. Full career statistics had to be available in order for a player to be included in the dataset;

this eliminated many of the Negro league players that have been admitted in to the Hall of Fame, as well as players from the 19th century where complete documented statistics were unavailable. Given these stipulations, the batter data set constituted 107 batters, and the pitcher dataset contained 42 players. For both pitchers and batters, statistics were chosen that represent different positive attributes of their ability; these variables will be discussed later in this section.

REGRESSION AND VARIABLES

The regression model evaluates star players' card prices based on their performance statistics. Because the performance of pitchers and batters are measured by vastly different statistics, the players in the dataset are divided into these two sub groups. Separate regressions are done on the players in each sub group. For both regressions, the dependant variable is the current price for each player's rookie card, drawn from the Beckett online price guide for baseball cards in December 2010. Beckett defines their card value by stating

> "the prices reflected in the Beckett Price Guide are derived from reported secondary market sales and common asking prices of cards. We take many segments of the market into account such as retail card shop prices, card shows, print ads, mail order catalogs and online auctions. These prices reflect national trends… the guide reflect current retail rates just prior to the printing of the book. The price listings were compiled by the author from actual buy/sell transactions at sports conventions, from dealer catalogs and price lists, and discussions with leading hobbyists in the US and Canada, All prices are in US Dollars."[1]

Because the data is drawn from Beckett's online guide in December 2010, the price for each card is reasonably up-to-date. The data used for the independent variables are the

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[1] Beckett, J. Official price guide to baseball cards, 2007. House of Collectibles, 2007.

career statistics for each player, as listed in Baseball-Reference.com.

For the batters, the analysis uses statistics that represent a player's offensive batting attributes; while there are many players that are known for their defensive prowess, it is generally accepted that a player's offensive statistics have a greater effect on their popularity than their defensive statistics. The batter regression is a semi log model written as follows:

$$\text{Log (rcv)}=\alpha+\beta_1\text{allstargames}+\beta_2\text{h}+\beta_3\text{hr}+\beta_4\text{rbi}+\beta_5\text{ba}+\beta_6\text{ops}+\varepsilon \qquad (4.1)$$

The log was taken of the dependent variable rcv in order to help the regression be more normally distributed. Transforming the dependent variable into log form will improve the overall fit of the model. The independent variables are defined as: All Star games (allstargames) represents the number of times the player participates in the annual fan and player nominated game; hits (h) are the number of times a player reaches base via a hit; home runs (hr) are the number of times a player hits a home run; runs batted in (rbi) are the number of runs scored as the outcome of a player's at-bats; batting average (BA) is the ratio of hits to at-bats; and "on base" plus slugging percentage (OPS) is a statistic that calculates the sum of a player's on base percentage and slugging percentage. "On base" percentage is a measure of how often a batter reaches base for any reason other than errors and interference. "Slugging" percentage measures the power of a hitter by dividing the batter's total bases by his number of at bats. Some baseball experts regard OPS as a more comprehensive evaluation of a player's offensive capability, combining statistics representing power and average into one statistic. In fact, there is a tremendous amount of discussion (and disagreement) among baseball experts as to which statistics best measure a batter's performance. Traditionalists favor statistics like batting average and number of home runs, while innovators inspired by Bill James and his "sabermetrics" approach focus on other measures like OPS that they believe are fuller expressions of what a batter accomplishes. This analysis adopts an agnostic approach that incorporates different statistics that each side embraces. On the one hand, this increases the likelihood of correlation among variables (for example, it could be argued that batting average and "on base" percentage are two statistics that essentially measure the same thing – the batter's success in getting on base – and therefore are likely to be highly correlated). On the other hand, just as there is heterogeneity among baseball experts concerning which statistics are most important, the same is likely true among baseball card collectors, which means that baseball card prices may reflect differences in the degree of reliance that buyers attach to one statistic or another. Excluding one statistic in favor of another would eliminate the regression's ability to capture such differences in explaining the variation of card prices.

The framework for the pitcher regression is very similar to that of the batter except for substituting in the equivalent pitcher statistics. The dependent variable remains Rookie Card Value (rcv), however the log is not taken because there is naturally a more normal distribution within the pitcher's dataset.

$$rcv=\alpha+\beta_1 allstargames+\beta_2 w+\beta_3 l+\beta_4 era+\beta_5 ip+\varepsilon \qquad (4.2)$$

The Pitcher's independent variables are not offensive but defensive statistics.

They include All Star Games (allstargames), wins (w) are the number of games won by the pitcher, losses (l) are the number of games lost by the starting pitcher, earned run average (era) is the mean of earned runs conceded by a pitcher per nine innings pitched, and innings pitched (ip). These are the most notable statistics to a pitcher's success. The previously discussed controversy over the importance of different statistics in measuring the performance of batters also applies to pitchers. For example, in 2010, Felix Hernandez won the American League's Cy Young award (the premier annual award for pitchers) despite having a won-loss record of only 13-12. Traditionalists emphasize wins, making Hernandez an undeserving winner, while others emphasize other statistics (like ERA) where Hernandez led the league. Again, this analysis uses different statistics that each side embraces, recognizing that similar differences in opinion probably exist among baseball card collectors.

There are many overlapping statistics in baseball and determining which statistics to use required experimentation. For example, in the pitchers regression, one option would be to use the absolute number of wins and losses, while another would be the win-loss percentage of each pitcher. Each option appears to measure similar things, but in reality, they don't. Running separate regressions using one statistic but not the other led to very different conclusions. Running the regression with win-loss percentage, the t-statistic showed no significance. However, when the regression was run with wins and losses as their own specific variables, wins became very significant and losses were insignificant but close. The most pertinent conclusion derived from the varied results is that the value of the card is increased with the number of wins but not negatively affected by the number of losses. In laymen's terms, this means that—at least for card collectors-- winning is more important than losing. The pair of variables, innings pitched and years played, provides another example of two statistics appearing to measure the same attribute of performance. In the same manner, when the regression was run with years played, the longevity of a players career showed no significance; however when the same regression was run replacing years played with innings pitched, the longevity variable does show a positive significant effect on the card value. The emergence of relief pitchers in the modern game has a great deal to do with the differing results. A starting pitcher in the modern game is expected to pitch five to seven innings with specialists coming in to close the game out. In this context, it doesn't matter how many years a pitcher played, but what does matter is the number of innings he pitched, which is a much better representation of a player's endurance than years played.

EXPECTED RESULTS

Based on previous research, it was expected that a substantial portion of the variation in card prices would be explained by the dependent variables in both regressions. Even though all of the players in the dataset are stars, not all stars shine equally bright, so it was expected that All Star Game nominations would affect both regressions in a statistically significant way. This variable is present in both regressions and will allow for variations in Mullin and Dunn's "star quality" among the players. For the batters, there are certain offensive attributes that hold more value for fans, including homeruns and batting average. These two variables are the foundation for the two major types of batters, power hitters and contact hitters respectively, thus, both of these variables are expected to be positively significant. For pitchers, the most significant variables are likely to be wins and ERA, since these statistics depict the pitchers ability to pitch effectively deep into the game (a pitcher must pitch at least 5 innings with a lead to receive a win), and shut down the other team's offense.

This chapter has described the dataset, its sources, and the methodology employed in the regression model. Chapter V will address the results from the regressions, and the implications and conclusions that can be drawn from them.

CHAPTER V

RESULTS AND CONCLUSIONS

After presenting the results of the regression, an analysis will lead to discussion of the implications and conclusions that can be drawn from the study, including: errors in methodology, application and limitation of the findings, econometric issues, and a direction for further research.

REGRESSION SUMMARY

Table 5.1 and 5.2 summarize the regression results using the equations explained in the previous chapter. The tables summarize the independent effect of each variable on their given equation. The first number is the coefficient of each variable, and next to it is the corresponding T-statistic. The batter regression requires additional computation in order to interpret the affect of the coefficient on the Rookie Card Value of the player. Because the log of the dependent variable was taken, the product of multiplying the coefficient by a given change in the corresponding explanatory variable does not equal the incremental change in the dollar value of the card. In order to understand how card value is affected by the variables, one must multiply the coefficient by the sample average for the batter data set. This calculation gives the Marginal Effect, measuring the expected instantaneous change in the dependent variable as a function of a change in a certain explanatory variable while keeping all others constant.[1] The Marginal Effect can tell us exactly how much a player's card value increases with a change in the performance statistics. Taking this one step further, the Elasticity at Means was calculated by multiplying the coefficient by the sample average for each explanatory variable. By finding the elasticity at means, one can assess the incremental effect on card price for a given change in each variable. The sample average was calculated by averaging the dataset by each variable. I have also included other pertinent information such as the Coefficient of multiple determination (R^2), the F statistic and skewness tests results.

[1] Werner, Frank, and IU N. Sotskov. Mathematics of economics and business. London; New York: Routledge, 2006.

TABLE 5.1

Ordinary Least Squared Regression Results
Card Value Determinants for Hall of Fame Batters

Batter Variables	Coefficient	T-Statistic	Marginal Effect	Elasticity at Means
ASG	0.029	1.09	32.82597	0.23026
Hits	-0.0002	-0.54	-0.226386	-0.466
Homeruns	-0.004	-1.29	-4.52772	-1.002
RBI	0.001	1.05	1.13193	1.207
Batting Average (BA)	-16.54	-0.98	-18722.1222	-4.902456
OPS	10.46	2.13*	11839.9878	8.74456
R-Squared	0.2249			
F-Statistic	6.29			
Sample Average of Card Value	1131.93			

* Indicates significance at the 95% level.

TABLE 5.2

Ordinary Least Squared Regression Results
Card Value Determinants for Hall of Fame Pitchers

Pitcher's Variables	Coefficients	T-Statistic
All Star Games	-1447.75	-2.68*
Wins (W)	345.65	-2.13*
Loses (L)	140.27	1.6
ERA	-20707.82	-2.9*
Inning's Pitched (IP)	-23.63	-2.01*
R-Squared	0.6336	0.6336
F-Statistic	2.12	2.12

* Indicates significance at the 95% level.

ECONOMETRIC ISSUES

There are many issues that can discredit a regression’s results; this section will evaluate their implications for the batter and pitcher regressions.

Heteroscedasticity

An important assumption of the regressions is homoscedasticity, meaning the error term in the model has a constant variance for all observations: when this assumption fails, the error is heteroscedastic. If heteroscedasticity is present, the least squares estimators become inefficient[2]. The reason OLS is not optimal when heteroskedasticity is present is that it gives equal weight to all observations when, in fact, observations with larger disturbance variance contain less information than observations with smaller disturbance variance. There are many methods to ascertain whether a regression is homoscedastic. To test for heteroscedasticity graphically, one must plot the fitted values of the dependent variable against their residuals. If this graph reveals a cone shape as opposed to an even spread, then heteroscedasticity may be present[3]. Using the data analysis program STATA, various tests for heteroscedasticity can be performed, including the White test and the Breusch-Pagan test. The Breusch-Pagan test for conditional heteroscedasticity was used in this regression analysis. The results from the Breusch-Pagan test for the Batters' regression contend that the regression is heteroscedastictic, with a chi2 value of 543.19. Likewise, the same test was run on the Pitchers' regression and it too shows evidence of being heteroscedastic with a chi2 value of 49.78. These values challenge the validity of the study. Heteroscedasticity indicates that the OLS estimates may not provide the smallest variance. OLS assumes that errors are both independent and identically distributed, but by employing robust standard errors, it is possible to relax either or both of these assumptions[4]. This analysis seeks to cope with the heteroscedasticity of the data by running the regression again using robust standard errors.

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[2] Darnell, A. C. *A dictionary of econometrics.* Aldershot, Hants, England; Brookfield, Vt., USA: E. Elgar, 1994.
[3] Gujarati, Damodar N. *Basic econometrics.* New York: McGraw-Hill, 1978.□Damodar Gujarati; : ill.; 25 cm; Includes indexes; Bibliography: p. 451-455

[4] Darnell, A. C. *A dictionary of econometrics.* Aldershot, Hants, England; Brookfield, Vt., USA: E. Elgar, 1994

Normality

Normality is another econometric issue that must be addressed before we can be confident in the regression results. The assumption of normality states that the error terms must be normally distributed in order for the t-statistic, R-squared and f-statistic to be valid. In the batter regression, the log of the dependent variable was taken to increase the normality of the model, while this transformation was not necessary for the pitcher dataset. Normality is graphically shown by an even bell curve, mathematically there are two tests that detect the distribution of a model. The Jarque-Bera test was run in STATA, and the results indicated that both the pitcher and batter regressions are not normally distributed. The second test is the skewness/Kurtosis test, and when run in STATA, this test supported the conclusion of the Jarque-Bera test. While this is a hindrance when it comes to drawing conclusions from the results of the regressions, it doesn't entirely invalidate the results, and understanding the dataset explains the lack of normality. In each era of baseball, the level of performance required to be a star varies: in mathematical terms, the statistics of star players are distributed around different mean values with different degrees of variation. Since the dataset samples from these distributions from different eras, the mean and variance of the composite distribution isn't normal, even though the distributions from the individual eras may themselves be normally distributed. Also when looking at the card values of Hall of Fame players, certain cards retain a significantly higher card value. For example, Honus Wagner's card is worth almost three million dollars. There are only a handful of cards valued at that level, but there are enough of these outliers that the dataset is naturally going to be unevenly distributed.

Multicollinearity

Because this regression is not time sensitive (that is, the dataset does not include card prices over time, but only at a single point in time – December 2010), there is no need to check for serial correlation, as it is dependent on time. However, multicollinearity can pose a problem for the regression because of the performance statistics. Multicollinearity exists when variables are similar to each other or represent the same data. This artificially raises the R-squared value and inflates the standard errors, causing the t-statistics to decrease. While there isn't a test that defines multicollinearity, evaluating the regression's correlation matrix can aid in determining if the variables are closely related. In the batter's regression, some of the performance statistics that were chosen measure similar things. The correlation of RBIs with hits and homeruns both were significant. This makes sense when thinking about the effect of certain statistics on others. If a player's number of hits increases, it is only logical that his runs batted in will also increase. Homeruns count as a run batted in, so, for every homerun a player hits, his RBIs increase. The regression does not differentiate these statistics, so they overlap a fair amount. The variable OPS is also heavily correlated with RBIs and batting average. The same logic applies to this duplication. The decision to include statistics that overlap one another was based on the idea that no single statistic could capture all the dimensions of performance in a game as complex as baseball. Removing several of these statistics may reduce multicollinearity, but would do so at the risk of over-simplifying the model.

RESULTS

Pitcher Results

As shown in tables 5.1, the coefficients of many variables are significant at a 95% confidence level. For the pitcher's regression the variables coefficients are as follows. The coefficient for allstargames is negative and significant at the five percent significance level. This contradicts the hypothesis stated in the previous chapter, where it was estimated that all-star games, a variable that represents a player's popularity, would positively increase the value of a player's card. This suggests that when a player is nominated to an all-star game, his player card value will decrease by $1447.75

The variable Wins follows the predictions stated in chapter IV with a positively significant value of 345.64. Implying that as a pitcher's number of wins increases by 1, their card value will also increase by $345.64. While this seems an astoundingly large number relative to the sample's average card value of $1131.93, it is a logical conclusion, when thought in real terms; in sports, winning is everything, and a pitchers' value is linked to his ability to win for his team. If he succeeds, his popularity will increase. This increase in popularity is shown by the increase in value of his player card. Surprisingly, Losses also have a positive effect on a pitcher's card value. While the loss variable is not statistically significant, it is positive, meaning that even if a player loses, his card value will increase slightly. While this seems counter intuitive, there is some logic to it. Remember that the only pitchers who get the opportunity to lose a large number of games are those who are otherwise successful over a long period of time. Since only star pitchers are included in the dataset, it makes sense that a large number of losses for a given pitcher will be accompanied by an even greater number of wins for that same pitcher. Moreover, large numbers of losses and wins for a given pitcher is another means of expressing longevity. So, the positive coefficient for losses makes sense in the context of a dataset comprising only star pitchers.

As predicted, the most statistically significant variable for pitchers is Earned Run Average. The coefficient for ERA was negatively significant with a value of -20707.82, and a t-statistic of -2.9. For a pitcher, lowering one's ERA is very important due to the fact that when the ERA is low the offense will have to produce fewer runs to win. If the coefficient were positive it would indicate that the number of runs scored would hold more power than winning or impressive pitching. Because it is negative, we can come to the conclusion that the most significant variable in the regression is ERA. If a pitcher were to increase his ERA from 2 to 3 runs per nine innings (more probable changes in ERA are in the .3 range) , being a negative change in performance, that players' card value would decrease by $20707.84, this also means if a player decreases his ERA by one unit his card value would increase by the same amount.

The variable Innings Pitched was included to provide prospective to the longevity and endurance of a pitcher; contrary to the expected positive significance, innings pitched was negative and significant. The coefficient for innings pitched was -23.63 with a t-stat of -2.9. This implies that for each inning pitched the pitcher's card value would decrease by $23.63. It is not clear why this variable responds the way it does, but would be a good starting place for further research.

Batter Results

The results from the batter regression are shown in table 5.2 and are evaluated at the same significance level as the pitchers. A key technical difference between the pitchers and batters regressions is the form of the dependent variable rcv. In the dataset for Hall of Fame pitchers, the prices are distributed roughly in bell curve fashion, and so those prices themselves are used for the dependent variable. However, in the dataset for the hall of Fame batters, the prices are distributed over a wide range of values. In order to make the dependent variable more normal, the batters regression uses the log of the card prices, rather than the prices themselves. Doing this reduces values of the t-statistics, making them less significant, but increase the R-squared and F-statistic.

The first explanatory variable is the number of times named to the All Star team. This variable is included to provide a means of distinguishing degrees of "Star Quality" among the Hall of Famers, the idea being that the more All Star teams a player makes, the greater the star he must be and, hence, the more valuable his card should be. The coefficient obtained for this variable has a positive sign (as anticipated) but its value is nearly zero and, with a t-statistic of 1.09, the variable is not significant. In other words, this regression finds that All Star games are not helpful in explaining variation in the prices of Hall of Fame cards for batters. If the t-statistic had been high enough the coefficient is still so low that the card price would change very little as the number of All Star teams changed: the implication is that an increase of one more game during the course of a batter's career would only increase card price by $32.83 in a sample where the average card price is $1,132. Put another way, the value for the Elasticity at Means calculation says that a 1% change in the quantity of All Star games would lead to a

0.23% change in card prices – not much sensitivity. Of course, with the t-statistic being 1.09, it is too low to impute any meaning at all to the values obtained for the coefficient, marginal effect, or elasticity at means. What can be said is limited to this: the number of All Star games is not a meaningful factor in explaining differences in batters' card prices. Why this is so is unclear. Perhaps the answer lies in the composition of the dataset: with respect to cards of Hall of Fames players, since such players also tend to be perennial All Stars, it might be that card collectors focus on other attributes to differentiate values among the cards.

The second explanatory variable is the number of hits a batter gets over the course of his career. Once again, the results of the regression are surprising: the sign of the coefficient is negative (implying card prices decline as hits increase – an illogical relationship), and the value of the coefficient is nearly zero (implying card prices are insensitive to changes in the number of career hits). Since the t-statistic is –0.54, hits are not a significant variable. But even if the t-statistic value was high enough to be significant, hits would not matter much: the Elasticity at Means calculation indicates that a 1% increase in career hits would reduce card value by just 0.47%. Like All Star teams, the number of hits is not a significant factor in explaining variation in card prices. Perhaps when it comes to batting accomplishments at the extraordinarily high level of skill that Hall of Famers have, hits alone are not enough. Among these players, everyone has very large numbers of hits: what card collectors may care about is what happened as a result of such hits, which brings us to the third explanatory variable, home runs.

Contrary to expectations, home runs were also an insignificant factor, with a t-statistic of –1.29. Because the variable is insignificant, the coefficient obtained is meaningless, but if it were significant, it would be confusing because the sign is negative, the value is zero, and the Elasticity at Means calculation says that a 1% increase in home runs leads to a 1% decrease in card value. As in the case of All Star teams and hits, the low value for the t-statistic indicates the value obtained for the coefficient should be disregarded.

The fourth explanatory variable, RBIs, follows the pattern already seen. The t-statistic is 1.05, too low for the variable to be statistically significant. Here, though, if the variable was significant, then the value obtained for the coefficient makes sense: the sign is positive (more RBIs lead to greater card values), and the Elasticity at Means calculation says that a 1% increase in RBIs would increase card value by 1.21%, indicating that prices would be reasonably responsive to changes in RBIs. However, the low t-statistic precludes making such an interpretation of the variable's effect of prices.

The fifth explanatory variable, batting average, is consistent with the previous variables, that is, with a t-statistic of –0.98, it is insignificant, and if it were significant, the value of the coefficient would be puzzling, inasmuch as it is both negative and powerful. Elasticity of means indicates that a 1% increase in batting average leads to a 5% decline in card value, which is illogical if card collectors prefer better player performance. Once again, the low t-statistic precludes making such an interpretation. In fact, the low t-statistics for each explanatory variable considered thus far means that no conclusions can be drawn as to the effect that any of these variables have upon card values.

In the context of the results for the other variables, the most significant and surprising variable was OPS (which combines on-base percentage with slugging percentage). When running the batter regression using the rcv values themselves (not the logs), the variable OPS was insignificant, but when run with the log transformation, OPS became very significant. With a t-statistic of 2.13, OPS is significant at a 95% confidence level. Moreover, the coefficient is large (10.46) leading to a powerful multiplier effect on card value: according to the Elasticity at Means calculation, a 1% increase in OPS increases card value 8.74%. Evidently, OPS captures more of a Hall of Fame player's overall batting performance than the other statistics included in the regression. This is plausible: unlike batting average, on-base percentage takes account of a player's ability to get on base through walks or getting hit by a pitch, and unlike home runs, slugging percentage takes account of the bases reached through any kind of hit. The combination of on-base percentage and slugging percentage into OPS is therefore a more comprehensive measure of the offense a batter generates.

Fit of the Model

In a standard linear regression model, R-squared is defined as the squared correlation between the observed values of Y (in our case RCV) and the fitted values[5]. More usefully put, R-squared represents the goodness of fit, by giving the amount of the total variation in the dependent variable that is explained by a single explanatory

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[5] Darnell, A. C. *A dictionary of econometrics.* Aldershot, Hants, England; Brookfield, Vt., USA: E. Elgar, 1994.

variable[6]. The R-squared values are .463 and .224 for pitchers and batters regressions, respectfully. These R-squared values only explain forty-six and twenty-two percent of the regression meaning there is still a large amount of variation in the dependent variable that is not attributed to the explanatory variables. Understanding the weaknesses of the model could help explain why the explanatory variables do not do a better job of explaining variation in card prices. These weaknesses will be discussed later in this section.

The F-statistic is used to test the null hypothesis to confirm that the OLS linear regression is in fact the best model possible. In other words, the F-statistic tests the joint significance of the independent variables. In the pitcher regression, the F-statistic has a value of 4.57, which is well above the critical value of 2. The batter F-statistic of 6.29 is also above the critical value. This supports the proposition that the explanatory variables do in fact explain, at least in part, why card prices vary from player to player. In the case of the batter regression in particular, this is an interesting result, since all but one of the explanatory variables were, on an individual basis, statistically insignificant.

CONCLUSIONS

There is clearly room for improvement in the regression model presented in this study, particularly in the case of the batters regression. While the variables used do help explain the changes in player's card value, there are aspects that need to be addressed and revised.

[6] Gujarati, Damodar N. *Basic econometrics.* New York: McGraw-Hill, 1978.

Weaknesses of the Regression

The foremost problem with this regression model is the lack of control for scarcity. Over time, cards suffer substantial attrition, thus when evaluating the prices of cards issued at many different moments over many decades (as is done here), scarcity is a critical factor affecting the current price of each card. Older cards command a significantly higher premium than do the cards of more recent inductees to the Hall of Fame, reflecting their greater scarcity, but with no data available on the actual number of each card that still exists, it is difficult to control for scarcity. Other researchers like Andersen and LaCroix dealt with scarcity by running separate regressions on groups dating from different eras, reasoning that cards having the same age probably have suffered similar attrition. Of course, Andersen and LaCroix had a much bigger dataset, encompassing all of the given players in any given year. If the dataset of Hall of Fame players used here were further subdivided into several different time periods, the number of data points in the regression pertaining to each time period would be fairly small, making it difficult to infer much from the results.

Correlation between player performance statistics is another weakness, particularly of the batters regression. As stated earlier, many of the batting statistics used as explanatory variables represent similar aspects of the player's offensive output. The number of hits is used as a stand-alone variable, yet each incremental hit also affects batting average and on-base percentage (and possibly home runs, RBIs, and slugging percentage as well). Likewise, the number of home runs is a stand-alone variable, but each incremental home run affects hits, RBIs, batting average, on-base percentage and slugging percentage. Using all these statistics may help capture some of baseball's complexity, but at the expense of a lot of multicollinearity. Using statistics that don't overlap this way could lead to stronger results. One example (following the example of Hewitt et al) would be to replace certain variables with Thorn's Total Baseball Statistic (TBS), which is seen as a more comprehensive evaluation of a player's ability.

Another issue to consider is whether the market for the cards of Hall of Famers is another market unto itself, with a vastly different set of dynamics than the market for cards of all the other players. Certainly, the prices for rookie cards for Hall of Famers are so high relative to prices for other players' cards that they fall into the extreme long-tail of the overall distribution of card prices. Certainly, the supply of rookie cards for Hall of Famers is tiny relative to all of the cards of all the other players that are available. In the micro-market for the cards whose prices are studied in this analysis, it is possible that only a small subset of collectors compete for such cards, seeing them as "luxury goods," the ownership of which confer prestige, exclusivity, even psychic validation. Rookie cards for Hall of Famers may be the card collector's equivalent of owning a Bentley -- if one has to ask the price, one can't afford it. In other words, the nature of these cards as a luxury good may make them –by definition – price-insensitive to variations in player productivity as measured here. If this is the case, then the parameters of a pricing model would be very different than one that would apply to the overall baseball card market.

The final weakness of this analysis (and all other analyses that rely upon baseball card pricing models) lies in the price data itself. Yes, card collectors use the pricing guides, and find them useful. But the data from the pricing guides emerge magically, as if from behind the Wizard of Oz' curtain, without any means of independent verification. They reflect someone's best guess as to current prices, as opposed to real-time data on real-time transactions. Then there is the larger issue of market efficiency. That is, even supposing the price guides correctly estimate current market prices, there remains the question of how well such prices fully reflect available information, and how much might they be distorted by behavioral biases? The point here is that regressions based upon card prices as the dependent variable are limited in what they can explain by the quality of the information imbedded in the underlying prices.

Implications

This study has produced a model that explains certain aspects of a card's value. It is interesting that the player performance statistics do not affect the batter and pitcher regressions in the same way. Understanding why the regression model for the pitchers explains more of the change in card value than the batters might be attributable to the exclusion of defensive statistics. Other studies such as Mullin and Dunn use dummy variables to include honors like the Golden Glove, a defensive award that this regression model ignores. The implication of this is that a player's value is not just determined by their offensive statistics. Whether it is the defensive statistics or the elusive "Star Quality," card value for batters is explained by attributes in addition to offensive statistics. On the other hand, the pitchers regression is more adept at explaining card value because of the lack of offensive contributions by the pitchers. The American League implemented the designated hitter rule in 1973 allowing American League teams to designate a player to bat in place of the pitcher each time he would otherwise go up to bat. The introduction of the designated hitter (DH) created an environment where offense was more important than defense. The American League is generally a higher scoring league and posts higher batting averages than the National League. Because of the DH, American League pitchers do not bat, eliminating them from producing offensive statistics. This may explain why the defensive statistics of pitcher's explain more of the card value than the batter model.

One of the interesting implications of this study for serious card collectors is the importance of having a handful of certain kinds of cards to the overall performance of a large portfolio. Prices of rookie cards become high over time, and rookie cards of Hall of Famers go sky high. A long-term investor who did not regularly collect rookie cards when issued would miss out on the extraordinary appreciation that some of these cards achieve over time. If an investor felt he could predict future Hall of Famers at the beginning of their careers, then buying only those cards when first issued might be a strategy to maximize returns. But the savvy investor who realizes his limitations at predicting the future would be better served by adhering to Modern Portfolio Theory and buying the market portfolio of cards, and holding onto them. The vast majority of his holdings will never be worth much more, but when the next Mickey Mantle emerges, he'll be richly rewarded.

In conclusion, this research provides a basis for understanding how player's performance on the field affects the secondary market of baseball cards for Hall of Fame Players. This study found that taken alone, player performance statistics affect the pitchers and batter differently. The pitcher's regression showed positive results while the batter dataset was less applicable. Further research with the inclusion of scarcity is necessary to understand the full effect performance has on card value.

APPENDIX A

TABLE A.1

STATA Batter Regression Summary

					Number of obs	107
					F(6, 100)	6.29
					Prob > F	0
					R-squared	0.2249
					Root MSE	1.3756
lrvc	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
allstargames	0.0299405	0.0275222	1.09	0.279	-0.0246628	0.0845439
h	-0.0002188	0.0004046	-0.54	0.59	-0.0010215	0.000584
hr	-0.0046692	0.0036257	-1.29	0.201	-0.0118625	0.002524
rbi	0.0014784	0.0014028	1.05	0.294	-0.0013047	0.0042615
ba	-16.54184	16.95808	-0.98	0.332	-50.18618	17.10251
ops	10.4611	4.906356	2.13	0.035	0.7270307	20.19517
_cons	0.904492	1.737963	0.52	0.604	-2.543577	4.352561

TABLE A.2

STATA Pitcher Regression Summary

Number of obs	42
F(5, 36)	2.12
Prob > F	0.0849
R-squared	0.6336
Root MSE	7661.3

RCV	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
allstargames	-1447.75	540.6239	-2.68	0.011	-2544.186	-351.3136
wins	345.6477	162.4533	2.13	0.04	16.17719	675.1182
loses	140.2766	87.58269	1.6	0.118	-37.34929	317.9026
era	-20707.82	7141.213	-2.9	0.006	-35190.88	-6224.772
ip	-23.63459	11.74604	-2.01	0.052	-47.45666	0.187470
_cons	55351.84	17782.34	3.11	0.004	19287.59	91416.09

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