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Winning and Other Determinants of Revenue in North America's Major Professional Sports Leagues

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Abstract

This study investigates recent determinants of revenue in North America's four major professional sports leagues. Estimates reveal that revenue is positively associated with winning in baseball (MLB), basketball (NBA), and hockey (NHL), but not in football (NFL). The returns to winning are not diminishing as commonly assumed, which casts doubt on the uncertainty of outcome hypothesis, and differences across leagues are consistent with revenue sharing arrangements. Estimates also indicate a strong negative relationship between stadium age and revenue, which is consistent with observed rapid replacement of sports stadiums. The results have several important implications for economic models of sports leagues. (Z21)

1. Introduction

A common assumption in economic studies of sports leagues is that profit-maximizing owners seek to increase revenue generation through winning. Within this literature, researchers have commonly assumed that the revenue returns (R) to winning (W) are positive ($\frac{\partial R}{\partial W} > 0$), with additional wins generating positive returns a diminishing rate ($\frac{\partial^2 R}{\partial W^2} < 0$). These assumptions are put forth in several seminal studies of the economics of professional sports and have continued to be employed in subsequent studies.

These assumptions have their origin in Rottenberg (1956), which provides the first economic analysis of the professional labor market for baseball players. The author notes the positive returns to success, but places emphasis on the diminishing returns to winning due to the erosion of competitive balance within the league.

> "At first sight, it may appear that the high-revenue teams will contract all the stars, leaving the others only the dregs of the supply; that the distribution of players among teams will become very unequal; that contests will become less uncertain; and that consumer interest will flag and attendance fall off. On closer examination, however, it can be seen that this process will be checked by the law of diminishing returns, operating concurrently with each team's strategic avoidance of diseconomies of scale" (p. 254).

Through anecdotal examples of dampening fan interest for the dominant 1950s New York Yankees teams and the 1961 San Diego Chargers, Neale (1964) implies that the returns to winning are diminishing, consistent with Rottenberg (1956). Following the lead of these seminal works, other economists studying sports leagues have used these assumptions in their models (e.g., Fort and Quirk 1995), and will likely continue to do so in future studies given that these assumptions remain largely unchallenged. Within the sports economics literature, the posited positive relationship between the fan interest and competitive balance is referred to as the uncertainty of outcome hypothesis (UOH).

Despite the importance of these assumptions in the analysis of the economics of sports leagues, the relationship between winning and revenue in professional sports is a surprisingly understudied topic, empirically. This paper seeks to remove this gap in the literature using the experience of North America's four "major leagues" of professional sports teams during the past decade to estimate the actual relationship between on-field success and financial returns. With one exception (NFL), the results indicate support for the positive returns to wins, but not for diminishing returns. In addition, the estimates reveal the importance of stadium age on revenue in all leagues and identify other factors that are important to specific leagues. The findings serve as a guide for future economic analyses of sports leagues.

2. Empirical Estimates

North America's four major sports leagues are quite similar in their organization—they are natural monopoly cartel sellers of a major-league sport, monopsony employers in a bilateral monopoly relationship with a labor union, and have a similar number of teams spread throughout North America's largest population centers. They differ in terms of revenue-sharing rules that generate differing incentives to win, frequency of play (ranging from weekly to almost-daily), season of operation, geographic concentration, and typical stadium size.

In order to measure the impact of winning on team revenue, I estimate a basic empirical model that can be applied to teams in all sports leagues, with minimal adjustments across leagues, to generate league-specific estimates. The generalized model (expressed in Equation 1) is based on factors previously identified as important for generating revenue, estimating total team revenue as a function of market size, stadium quality, and team performance. Other factors considered during the analysis, but not included in the final model, are discussed below.

$$(1)\quad \text{Revenue}_{it} = \alpha + \Phi\mathbf{Winning}_{it} + \chi\mathbf{X}_{it} + \varepsilon_{it} + \nu_{i}$$

Revenue is the total revenue generated by franchise *i* in year *t* estimated by *Forbes* in its annual financial valuations of sports franchises from 2006-2015, excluding the 2011-2012 NBA and 2012-2013 NHL seasons, which were shortened or cancelled by lockouts, respectively.[1] All dollar values are converted to 2015 dollars for each league in order to consistently gauge the returns to winning over time, as league revenue demonstrates a consistent pattern of increasing over time.[2]

Winning is a vector of variables that measure team successes as it relates to winning. Following Bradbury (2010), rather than use winning directly, I use the score differential between runs, points, or goals scored and allowed to measure winning. This proxy has several advantages over raw win totals or winning percentage while being highly correlated with winning—the correlation (r) between score differential and winning in leagues ranges from 0.92 to 0.96. First, wins are discrete, and reflect a large range of team quality as it is likely to be perceived by fans; thus, when making comparisons across leagues with different lengths of seasons, changes in wins do not reflect the differences in team quality in the same manner. For example, nine and ten wins in the NFL are equivalent to winning 91 and 101 games in MLB in terms of winning percentage. In the former league, such teams are considered marginally to moderately better than average, while in the latter, the teams are considered to range from good to exceptional. Using score differential to proxy for winning also allows for distinguishing quality among teams with a similar number of wins at a more granular level. Wins, especially in close games, are a product of luck as well as talent. Bad (good) teams that receive a few wins (losses) in close games mean that wins may not as closely reflect the quality of the team on the field as well as score differential. All wins are not equal, but a team that wins all its games by one point is likely to be worse than a team that wins the same number of games by ten points. Thus, score differential allows for a more precise estimate of team quality as it is likely perceived by fans than wins or winning percentage. Finally, the

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[1] Berri, Leeds, and von Allmen (2015) and Bradbury (2010) also use *Forbes* revenue data, which are compiled with information provided by team officials, bankers, consultants, and other knowledgeable officials. Poitras and Hadley (2006) uses data from *Financial World*, which compiled revenue data prior to *Forbes*. Data gathered from various issues of *Forbes*'s "The Business of Baseball" (http://www.forbes.com/mlb-valuations/list/), "The Business of Basketball" (http://www.forbes.com/nba-valuations/list/), "The Business of Hockey" (http://www.forbes.com/nhl-valuations/list/), and "The Business of Football" (http://www.forbes.com/nfl-valuations/list/). The web addresses listed link to the most recent yearly estimates, but the publisher has changed the web location of its estimates over time and replaced previous estimates. Estimates for previous seasons were culled from internet searches of cached pages using the Internet Archive: Wayback Machine (https://archive.org/web/).

[2] A simple inflation adjustment is inappropriate, because sports league revenues have grown faster than the economy over time. Therefore, a league-specific deflator based on annual revenue is used to adjust revenues to the 2015 equivalent.

differing frequency of ties across leagues complicates the value of winning when comparing the estimates across leagues. In any event, alternate models estimated using winning directly produced results similar to those reported using score differential.

Preliminary analysis of the relationship between the score differential and revenue using univariate fractional polynomial regression estimation, which does not presuppose a functional form of the relationship, indicated potential non-linear relationships for the leagues. For the multivariate regression analysis, estimates were generated that included higher-order polynomials until the coefficient of the highest order estimated was no longer statistically significant (at the standard five-percent threshold), and the final model includes only the statistically-significant coefficients. In all cases, adding a squared term was the highest-order polynomial needed to capture the non-linear relationships. Where squared terms were not statistically significant—NFL and NBA—the presented estimates are generated using a linear functional form.

Winning not only affects fan demand in the current season, but it also may affect revenue in the following season—an idea first suggested by Scully (1989). Fans purchase season-tickets or premium broadcast packages prior to the season of observation, and they likely use the previous season as a proxy of the quality of the upcoming team. Therefore, the previous season's run-differential is also included as a determinant of revenue.

X is a vector of other factors that have been hypothesized to affect revenue that includes the following variables. Previous estimates of the impact of stadium quality on fan attendance have found a novelty or "honeymoon" effect from new stadiums that boosts revenue for between five and ten years, because fans are attracted to updated amenities and a new experience (e.g., Coates and Humphreys 2005, Hakes and Clapp 2005, and Leadley and Zygmont 2006). Stadium Age is the number of seasons that a team has played in the stadium to capture the newness of the team-stadium experience to the market.[3] When conducting this

[3] For example, after relocating from Montreal, Quebec, the Washington Nationals played their first two seasons in Washington, DC at RFK Stadium, which was built in 1961, as a temporary home. Despite its age (and it had previously hosted the Washington Senators from 1962 to 1971), to the fans of the Nationals, it was a new stadium in terms of offering a previously-unavailable baseball experience and likely to generate the excitement of a new fan opportunity consistent with a honeymoon effect.

analysis, I estimated alternate models that included indicator variables and several non-linear transformations of stadium age to identify any honeymoon effects and their duration. I determined that transforming stadium age to its reciprocal provided the best fit of the impact stadium age on revenues for MLB, NBA, and NHL, and the natural log of stadium age provided the best fit for the NFL.

It is expected that larger populations are associated with greater revenue due to the larger market-size potential. MSA Population is the metropolitan population of the city that hosts the team. Estimates of U.S. cities are metropolitan statistical area estimates reported by the United States Census Bureau, and Canadian city estimates are census metropolitan area estimates reported by Statistics Canada. To control for the presence of multiple teams in a metropolitan area, which might dilute a market-size effect, I include an indicator variable denoting the presence of multiple teams in the MSA.

I include Income Per Capita to control for the affluence of markets served by teams. If sports are a normal good, then differences in wealth across cities may affect team revenue.[4] Three of the sports leagues include one or more teams in Canada—the NHL includes seven Canadian teams—therefore, I include a Canada indicator variable to control for this potential influence. ε is a standard error term and ν is a franchise-specific error term.

A Breusch and Pagan (1980) test for random effects rejected pooled ordinary least squares as an estimator, which indicates that a panel data estimator is needed. A Hausman (1978) specification test indicated that a fixed effects estimator is not needed and thus a random effects estimator is preferred. A Woolridge (2002) test identified the presence of first-order serial correlation in the data; therefore, I estimate Equation 1 using the Baltagi and Wu (1999) random effects estimator that adjusts for serial correlation in panel data. Table 1 lists the summary statistics by sports league.

[4] Income per capita by MSA is available from the Bureau of Economic Analysis for the United States. Income data by Canadian CMAs is reported only at the median family level and is not available consistently over the sample. Canadian observations are excluded when Income Per Capita is estimated for MLB, NBA, and NFL and the impact is not estimated for the NHL due to its large Canadian membership.

Table 1. Summary Statistics by League

		MLB	NBA	NFL	NHL
Revenue (in millions)	Mean	279.65	195.58	380.19	136.69
	SD	*70.69*	*51.31*	*65.37*	*35.59*
Score Differential	Mean	0	0	0	0
	SD	*98.80*	*387.02*	*104.39*	*36.87*
Stadium Age	Mean	23.34	16.58	18.93	17.58
	SD	*24.77*	*9.81*	*14.35*	*10.40*
Population	Mean	5,941,649	5,359,448	4,533,448	5,717,937
	SD	*4,646,447*	*4,863,076*	*4,336,950*	*5,526,489*
Multiple Teams in MSA	Observations = 1	80	36	40	45
	Observations = 0	*220*	*234*	*280*	*245*
Incomer Per Capita	Mean	51,537	45,888	47,042	
	SD	*8,689*	*8,606*	*8,816*	
Canada	Observations = 1	10	9	0	58
	Observations = 0	*290*	*261*	*320*	*212*

Table 2 reports the regression estimates for each sports league. The estimates reveal a positive and statistically significant relationship between relative team performance and revenue for all leagues, except the NFL. The positive coefficients of the squared terms indicate increasing returns to winning for both MLB and the NHL, but not for the NBA.

It is difficult to contrast the findings across leagues from the table due to the different scoring structures across sports; therefore, the regressions were also estimated using the standard deviation in scoring differential to create a normalized comparison. Figure 1 maps the estimated relationship between performance and revenue with changes in score differential estimated in standard deviations from the mean of zero. Each function is estimated using value of the current score differential and the discounted value of score differential in the previous year, based on the average revenue growth of the league.[5]

The graph highlights the distinct differences in the returns to winning across leagues in terms of relative shape and magnitude. Among the sports leagues, MLB experiences the strongest returns to winning, and the returns to winning are increasing at an increasing rate. The NHL also exhibits increasing returns to winning, but less so than MLB. Though the NBA's returns to winning are constant, they are greater than the NHL's

[5] Average annual revenue growth during the sample by league: MLB (5.7 percent), NBA (5.1percent), NFL (7.1 percent), and NHL (5.3 percent).

returns within the range of the score differentials. The returns to winning in the NFL are flat as indicated by the insignificance of the coefficient estimates.

Table 2. Determinants of Team Revenue

	MLB	NBA	NFL	NHL
Score Differential	0.0659351	0.0178314	0.0001619	0.1197696
	[6.12]**	[5.91]**	[0.02]	[5.70]**
Score Differential^2	0.0002178			0.0007262
	[2.86]**			[2.13]*
Score Differential (*t*-1)	0.0454197	0.0144292	0.0048389	0.0570572
	[4.09]**	[4.63]**	[0.51]	[2.86]**
Stadium Age†	49.10018	49.23013	-22.21963	19.38718
	[6.86]**	[4.20]**	[12.42]**	[3.43]**
Population	8.89E-06	6.19E-06	5.94E-06	5.50E-06
	[5.28]**	[5.33]**	[2.40]*	[3.56]**
Multiple Teams in MSA			-64.77839	-57.28133
			[1.97]*	[2.55]*
Income Per Capita			0.0007465	
			[2.07]*	
Canada				38.60923
				[4.60]**
Constant	219.3079	157.8007	419.1619	103.6832
	[17.05]**	[18.37]**	[28.69]**	[12.55]**
R^2	0.52	0.43	0.24	0.41
Observations	300	270	320	270

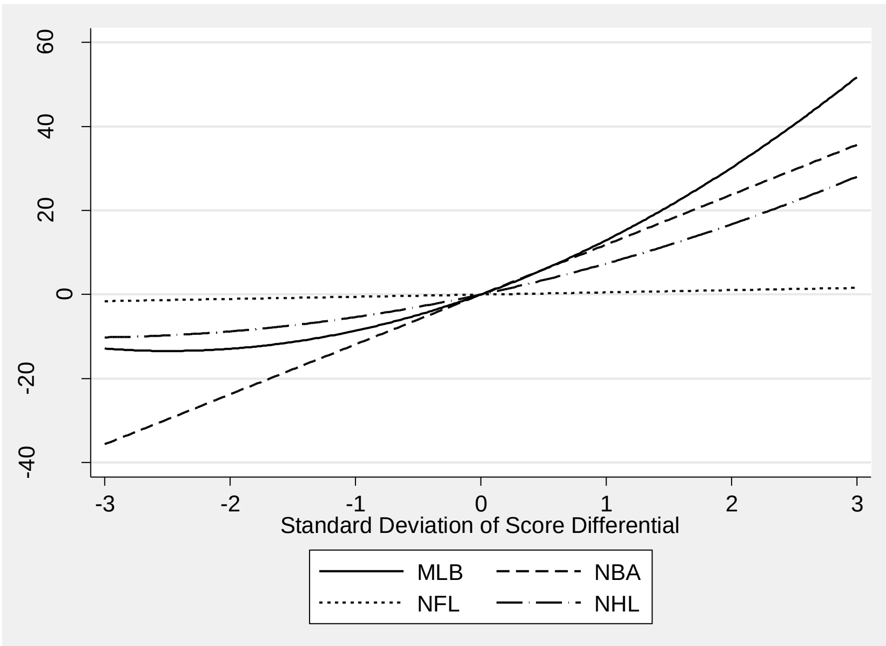
Absolute value of z-statistics in brackets. **p<0.01; *p<0.05; † MLB (1/Stadium Age), NFL (ln(Stadium Age)), NBA(1/Stadium Age), NHL(1/Stadium Age)

As expected, there is a positive relationship between market size and revenue. In an attempt to measure the potential differing impacts of winning related to market size, I also estimated specifications for each league that included an interaction term of score differential and population. The estimates were not statistically significant; thus, I do not report the estimates from these alternate specifications.[6] While financial returns are

[6] The interaction term coefficient in the NHL approached the standard threshold of statistical significance (p = 0.053), but the estimated effect was small—one-standard-deviation increases in both goal differential and population were associated with an increase in revenue of approximately $1.64 million (1.2 percent of mean NHL team revenue).

greater for franchises in larger markets, this does not translate into higher returns to winning in larger markets. Market size and winning both affect revenue, but they do so independently.[7]

Figure 1. Standardized Returns to Winning by League



Though the returns to winning do not differ according to market size, the estimates indicate that the returns to winning can differ across teams in MLB and the NHL due to the non-linear impact of wins. This means that teams may value similar players differently according to each team's in-season performance. The same marginal player will be worth more to a team with more wins than a team with fewer wins, as the returns to winning are steeper in the former market. Better teams ought to be willing to spend more on free agents and give up more developing players to other teams in trades. This is consistent with the observed behavior of better teams acquiring players from weaker teams in return for long-run prospects during mid-season trades,

[7] The estimates in this study contradict the interpretation of Burger and Walters (2003), which estimates the impact of winning and market size in baseball using interaction terms. However, in that study, the interaction terms are statistically significant only when their components are excluded from the model, which makes interpretation of the interaction term coefficient impossible. Full specification results in that study do not produce statistically-significant estimates. In addition, the estimates do not appear to be generated with a panel data estimator or correct for imperfect serial correlation, which this analysis indicates are necessary. Therefore, the results do not appear to be robust and do not provide strong evidence of returns to winning differing with market size.

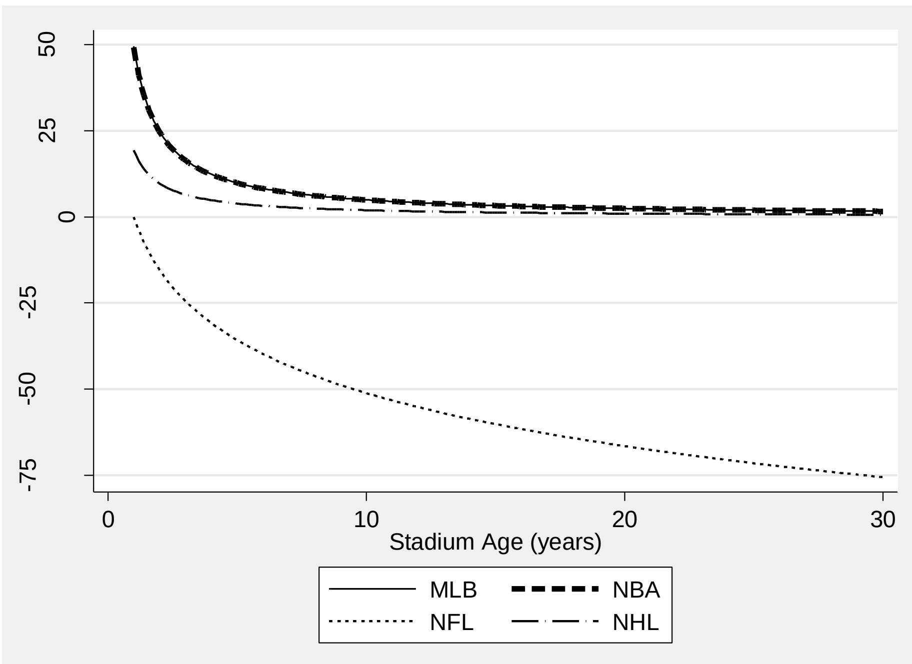
when performance quality is known. The increasing returns may be explained by increasing fan demand from a bandwagon effect as well as the growing expected share of post-season revenue.

The increasing returns to winning in baseball is consistent with Bradbury (2007) and Bradbury (2010), which also find a similar non-linear impact; however, the estimates do not find support for the disincentive for winning at lower levels identified in Bradbury (2010) as the "loss trap." The estimates reported here do not produce a loss trap, indicating that there are not positive returns to losing along any part of the win-revenue function; thus, the disincentive effects from revenue sharing are not sufficient to promote losing by inferior teams in MLB, NBA, or NHL.

Though the chief motivation of this analysis is to examine the relationship between winning and revenue, the estimates also reveal information about the importance of new stadiums on team revenue during an unstudied time period. Previous studies have identified a honeymoon effect which boosts stadium attendance in the short-term due to fan interest in a new stadium. Hakes and Clapp (2005) and Poitras and Hadley (2006) identify positive attendance effects that diminish with time from new stadiums in MLB. Leadley and Zygmont (2005) identifies a positive attendance effect in the NBA, and Leadley and Zygmont (2006) identifies a similar attendance effect in the NHL. Coates and Humphreys (2005) identifies attendance effects in MLB and NBA, but does not identify an effect in the NFL. All but one of these studies (Poitras and Hadley 2006) focus on attendance and do not estimate the effect of new stadiums on revenue. The estimates in Table 2 provide the opportunity to examine the honeymoon effect on revenue to examine the effect of new stadiums on revenue streams that are not dependent on higher attendance, such as sponsorship, naming rights, and attendance amenities (e.g., luxury boxes, premium seating, and associated restaurants).

Figure 2 maps the estimated relationship between revenue and stadium age by sports league over a 30-year stadium lifespan, based on the estimates in Table 2. The estimates show strong returns to a new stadium and a rapidly diminishing effect on revenue over time, consistent with studies from earlier time periods. The effects in the MLB, NBA, and NHL decay more rapidly than in the NFL, and nearly all the benefits are exhausted within a decade of opening, consistent with previous studies. In the NFL, the initial revenue bump diminishes at a slower rate; but rather than leveling off after a decade, revenues continue to decrease, resulting in a greater opportunity cost to not replacing an aging football stadium. Though Coates and Humphreys (2005) does not identify attendance effects in football, the analysis of revenue indicates that facility quality is an important determinant of revenue for NFL teams, which highlights the importance of revenue streams that depend on factors other than increased attendance.

Figure 2. The Impact of Stadium Age on Revenue



The results explain why professional sports teams consistently push for new stadiums well before they have exhausted their useful lifespan for hosting games. For example, in Atlanta, both the MLB Braves and NFL Falcons replaced their respective stadiums for their 2017 seasons, despite playing in stadiums that were 20 and 25 years old, respectively. According to the estimates, replacing their stadium will generate $53 million more dollars for the Braves in 2017.[8] Assuming a 30-year lifespan of the venue and continued revenue growth at the league average, the new stadium is estimated to generate an additional $243 million over its life

[8] Expected Return $= \left(\text{Coefficient} \times \frac{1}{\text{Stadium Age}_{new}}\right) - \left(\text{Coefficient} \times \frac{1}{\text{Stadium Age}_{old}}\right)$; $(49.5 \times \frac{1}{1}) - \left(49.5 \times \frac{1}{21}\right) = 47.14$ in 2015 dollars. Assuming league-average revenue growth of 5.7 percent, this results in $52.67 million in 2017.

(relative to expected earnings from the vacated stadium as it aged), with a discounted present value of $186 million (assuming a four-percent return on investment). Using the same assumptions, the model estimates that the new stadium will generate an additional $88 million for the Falcons in 2017 and $2.24 billion over its lifespan, which has a discounted present value of $1.27 billion. The expected returns are reasonably close to the construction costs of the new stadiums borne by the franchises.[9]

The remaining factors examined are not associated with consistent impacts across leagues, and thus are reported only for the leagues in which the estimated effect is statistically significant. The presence of multiple teams in markets is negatively related with revenue in the NFL and NHL, with the presence of other teams associated with approximately $60 million less revenue. Income per capita is positively associated with more revenue in the NFL—a one-standard-deviation increase in income was associated with a $6.6 million increase in revenue—but not for any other league. Canadian teams were not associated with more revenue in MLB or the NBA, but were associated with $38.6 million more in revenue in the NHL. This change can be seen by the increase in revenue for the Thrashers/Jets franchise when it moved from Atlanta, Georgia to Winnipeg, Manitoba in 2011. Average normalized revenue increased from $102 to $118 million despite moving to a market nearly seven-times smaller.

3. Implications

a. Revenue Sharing

The most obvious implication from the empirical findings is the influence of differing revenue sharing arrangements on team revenue generation. Each league has unique structures and nuances that generate differing financial incentives, and each league has operated under multiple collective bargaining and revenue

[9]The Atlanta Braves committed approximately $315 million to the construction of SunTrust Park, with $230 million paid up front and the rest financed over the next 30 years. While this amount is less than the estimate here, the stadium also moved to the northwest suburbs in Cobb County, Georgia to be closer to its fanbase; therefore, the club expects new revenue from moving in addition to a honeymoon effect. The Atlanta Falcons have committed approximately $1.2 billion to the construction Mercedes-Benz Stadium, which is located next to the Georgia Dome it replaced.

sharing agreements during the time-period of analysis; however, the following general descriptions provide a guide to the range of revenue sharing agreements across North America's major sports leagues.

The NFL operates largely as a syndicate, with all 32 teams sharing 50 to 75 percent of revenue equally, and much its revenue derived from a league-wide national television contract that eschews local television broadcasting rights.[10] The NFL is the only league that does not give teams control over their local broadcasting rights. In the NBA, teams share approximately 50-percent of total revenue, which is derived from both local and central sources.[11] The NHL uses a complicated formula from which distributions to low-revenue clubs are allocated from the top-ten revenue-generating teams, 35-percent of playoff gate receipts, and centrally-shared revenue.[12] MLB teams share approximately 34-percent of net local revenue, which includes local broadcasting revenue, and sharing all national broadcast contract revenue equally.[13] The elasticities to winning differences across leagues are consistent with winning mattering less where revenue is shared greatly (NFL) and winning mattering more where a large share of revenue is generated and retained by each team (MLB).

MLB, NBA, and NHL teams can increase revenue by winning, and thus they benefit from devoting financial resources to facilitate winning. In the NFL, winning does not appear to provide any marginal financial gains and thus owners have no financial incentive to improve team quality. An NFL owner may seek better players for pride or out of civic duty to fans, but pursuing top-name free agents to improve team quality does not appear to produce financial gains similar to what can be expected in MLB, NBA or NHL.

b. Competitive Balance

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[10] Kaplan, Daniel. Change in NFL revenue sharing? Program offering subsidies for small markets likely to cease, *Sports Business Journal*, October 14, 2013 (http://www.sportsbusinessdaily.com/Journal/Issues/2013/10/14/Leagues-and-Governing-Bodies/NFL-revenue.aspx).
[11] Lombardo, John. Inside NBA's revenue sharing: How complex plan will shift $140 million to needy teams. *Sports Business Journal*, January 23, 2012 (http://www.sportsbusinessdaily.com/Journal/Issues/2012/01/23/Leagues-and-Governing-Bodies/NBA-revenue.aspx).
[12] Collective Bargaining Agreement Between National Hockey League and National Hockey League Players' Association, February 15, 2013 (http://www.nhl.com/nhl/en/v3/ext/CBA2012/NHL_NHLPA_2013_CBA.pdf)
[13] 2012-2016 Basic Agreement, December 12, 2011 (http://mlb.mlb.com/pa/pdf/cba_english.pdf).

The estimated relationship between winning and revenue also has implications for understanding the demand for professional sports. The marginal returns to winning are not diminishing—in fact, the returns to winning are increasing in some sports—which contradicts a linchpin assumption often employed in economic models of sports leagues. The reasons for the expectations of diminishing returns hypothesized by Rottenberg (1956) and Neale (1964) are the result of competitive balance effects. However, empirical evidence indicates that, at best, competitive balance has a small impact on fan demand (Berri, Schmidt, and Brook 2007). As a part of this analysis, I included two measures of competitive balance as explanatory variables in the regression models, and the estimates were not statistically significant for any league.[14] While it is possible for a league to be composed of a few teams that are so dominant that the outcome of the games/season are rarely in doubt; in practice, the actual dispersion of team quality has not been so great. Also, Coates, Humphreys, and Zhou (2014) demonstrates that fan demand for sports as it relates to the uncertainty of outcomes is more complicated than fans valuing raw win uncertainty. The authors find that, under certain reasonable assumptions, demand can increase even as outcomes become more certain. While Solow and Krautmann (2007) reports finding a diminishing value of wins needed for the UOH in MLB using data from 1996 to 2001, the results represent one league in a past era and do not necessarily suggest diminishing returns.[15]

Thus, there are good reasons to believe that the classic argument for the diminishing returns to winning for competitive balance reasons does not conform to the real world. The findings here—the non-diminishing returns to winning and the lack of impact of traditional competitive balance measures—also cast doubt on the UOH as it has been traditionally applied in the sports economics literature. Fans do not appear to be particularly sensitive to competitive balance and continue to value additional wins from local teams; therefore,

[14] The competitive balance measures employed were the ratio of the actual to the ideal standard deviations of winning percentages (Quirk and Fort 1992) and the ratio of the within-team standard deviation over the sample and within-season standard deviations in winning percentages (Humphreys 2002).

[15] The reported estimated effects of winning on revenue are not statistically significant at the standard five-percent level, and the empirical model appears to be misspecified. The lone specification includes interaction terms of population and income with winning without the associated components as separate variables, rendering the coefficients of the interaction terms indecipherable. The estimator is simple OLS, which is inappropriate for addressing the panel structure of the data and serial correlation that is present. Using a recreated dataset of employed variables, I was unable to identify diminishing returns for this sample using appropriate methods.

leagues are operating in a range where no team should be discouraged from improving itself too much for fear of deterring fans.

c. Player Marginal Revenue Products

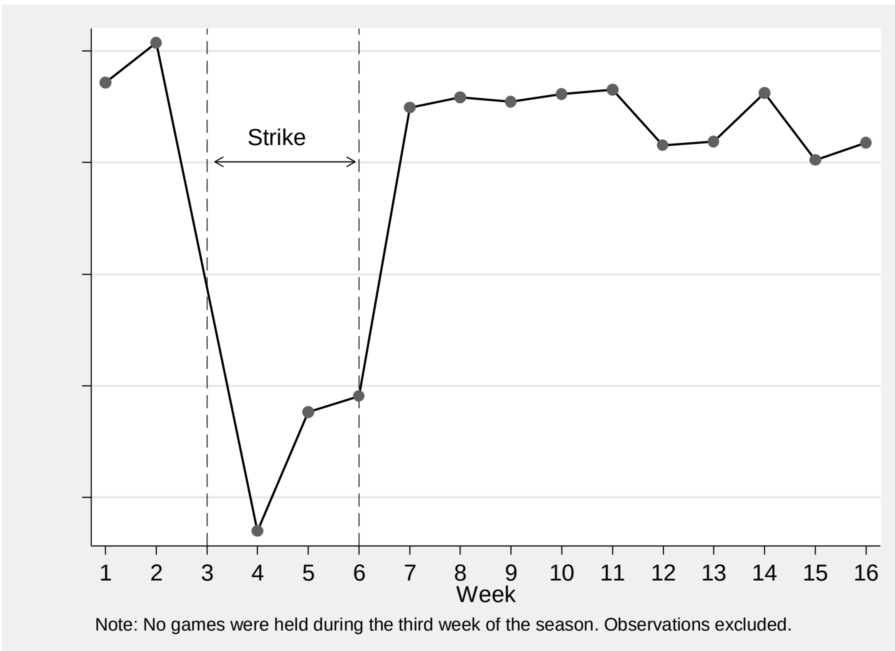
The findings also have an implication for how economists measure player marginal revenue products. Beginning with Scully (1974), economists have tied athlete productivity to winning, and used this contribution to measure player value. While winning affects revenue for most sports leagues, revenue is also determined by performance quality that is unrelated to winning. If one was to estimate the marginal revenue product of football players based on their contributions to winning as estimated in Table 2, their marginal revenue products would be $0; yet, the average wage for an NFL player in 2016 was over $2 million. After estimating the impact of winning on revenue using a specification like those reported above, Berri, Leeds, and von Allmen (2015) similarly finds that players are paid salaries above what their value from producing wins is estimated to be. Because of this finding, the authors declare standard measures of marginal revenue products to be meaningless and posit that player wages are instead tied to bargaining power. However, economists should not be too quick to abandon the marginal revenue product framework when valuing professional athletes. As Rottenberg (1956) notes, "it is undoubtedly correct that the player will not be paid more than he is worth to the team, his worth being determined by that part of the team's revenue which is attributable to his capacity to attract patrons to the ball park, net of the price paid for his contract to another team or the cost of his development" (p. 252).

The absurdity of paying multi-million-dollar contracts to zero marginal revenue product workers (as the results would indicate) points to a misunderstanding of the information contained in the estimates as they relate to the economic values of player quality. The problem is not with the decision-making of the teams, but with the interpretation of the estimates. Coefficients that estimate the returns to winning—via wins, winning percentage, score differential, etc.—provide information only about the value of performance *relative* to each other, but not about the value of absolute performance. Because winning reflects only relative performance-differences across teams, not how good the talent of the league is overall, the coefficients do not account for the value that fans place on overall competition being played at a major-league level. This idea has not been sufficiently addressed within the sports economics literature.

Sports fans do value winning and contribute more revenue to teams that win; however, fans also value the overall quality of performance in addition to winning. From amateur leagues to minor leagues to major leagues, the quality of performances increases with each level, and fans do not freely substitute between levels to accommodate a preference for winning—we do not expect baseball fans to transfer support from a losing MLB team to a successful minor-league team. The overall quality of the league itself is a strong determinant of fan interest, and that interest is not the result of an arbitrary declaration of a league being deemed a "major league" to which players contribute nothing. Rottenberg (1956) explicitly states that preserving the overall quality of the league is vital to generating revenue in a league with 100-percent revenue sharing, which somewhat describes the NFL, "It will pay for all teams, taken together, to play well enough, on the average, so that revenue will not fall off faster than costs. … A rule of equal sharing of revenue leads to the equal distribution of mediocre players among teams and to consumer preference for recreational substitutes" (p. 256). As league-wide talent-level diminishes, fans will consume more recreational substitutes; therefore, the revenue contribution from superior talent requires adequate compensation. A league that offered salaries in line with marginal revenue product estimates based solely on winning would be undervaluing its chief input and would open the door for entry by a rival league—something that has happened to the NFL three times in the past 60 years (American Football League, World Football League, and the United States Football League).

Measuring the value of being a major-league player is difficult in North American professional sports leagues because teams operate as territorial monopolies; thus, there is no counterfactual lower-tier to which attendance or revenues can be compared in the same geographic area. Minor leagues (baseball and hockey) and collegiate athletics (football and basketball) cover different geographic areas and are valued for reasons other than their high level of play (e.g., collegiate athletics serve as a focal point for loyal alumni). However, there was one instance in which a North American sports league fielded teams with non-major-league players, and its experience demonstrates the strong value that fans place on the absolute level of play. In response to the 1987 NFL players strike, NFL owners heavily stocked their teams with "replacement players" to play regular-season games for three weeks. Rosters were composted of players from the next tier of quality, who were deemed as unqualified to play major-league football previously. Figure 3 maps the significant decline in attendance during the weeks with replacement players (weeks four, five, and six) versus regular NFL players. On average, attendance dropped to 24,551 during the strike weeks from 54,873 during major-league player weeks—a 55-percent decline, which is statistically significant.[16]

Figure 3. NFL Weekly Attendance, 1987



Evidence of fan preferences for top-level talent is also observable in the differences in attendance and revenues following relegation and promotion in professional soccer, where teams generally play for the same fans but against different levels of competition when transitioning between leagues. Symanski (2015) reports an average 16 percent difference in attendance between teams switching between Premier League and the second division in English soccer, and a further difference of 13 percent between the second and third division (p. 92). Noll (2003) lists data for several English soccer clubs who were both relegated and promoted in the 1990s. The reported totals show an average 22-percent increase in attendance and 44-

[16] Attendance figures compiled from Carroll et al. (1999).

percent increase in revenue from promotion, and corresponding declines in attendance and revenue of 15 and 21 percent from relegation.

The massive differences in attendance between major- and non-major-league competition highlight the importance of the overall quality of play for generating fan interest. Major leagues feature the top talent in their respective sports to raise the overall level of play that drives fan interest. Though this revenue is a product of a quality that impacts winning, that same quality has an impact on revenue that is separate from winning. A marginal major-league player may not add significant value to winning, but he does offer value in the form of being sufficiently capable of providing high-quality output. Thus, the marginal revenue product of any major-league player remains positive even when the returns to winning are zero. Therefore, it is wrong to estimate the full marginal revenue product of players solely from their contribution to winning as has been done traditionally in the economics literature.

If marginal revenue product estimates derived solely from relative quality do not fully value players, then a method for incorporating absolute quality value into the estimates is needed.[17] Equation 2 presents a hypothetical equation for estimating a player's marginal revenue product that includes his contribution to the absolute performance of the league (*A*) in addition to his relative contribution to winning (*R*).

(2) $MRP = \alpha(pA) + R;$

where $0 < \alpha < 1$, and represents the contribution of the players' share of league value attributed to the absolute quality of play. For example, if 55 percent of revenues are generated by the league having major-league players (as measured by the 1987 NFL example above) then $\alpha = 0.55$.[18] Owner rents would then equal $1-\alpha$. If fans prefer the highest quality league, and there is free entry into a competitive or contestable monopoly league market, then the credible threat of rival league entry will drive α toward 1. If fans are loyal to the incumbent natural monopoly league, or entry by rivals is otherwise restricted, then α will approach 0. *p* is the percentage of the contribution of any player to the absolute quality (A) of the league. For example, a

[17] Cyrenne (2001) presents a model where fans value absolute and relative quality of play.

[18] Measuring α is likely more complicated than presented in than the 1987 strike example, and is used only for illustration.

pitcher who pitches ten-percent of his team's innings would contribute that same percentage of his team's major-league contribution to revenue. In sports where assignment of marginal contributions to players is difficult, such as the joint-product provided by football players, the value may be assumed to be 1/*n*th of A, where *n* is the total number of players/positions in the league. Equation 2 is meant as a general guide, serving as a starting place for future research on the topic.

4. Conclusion

Estimates from the past decade indicate that the returns to winning differ by sports leagues. The impacts range from no effect, in the NFL, a positive linear effect in the NBA, to positive and increasing effects in the NHL and MLB—with MLB experiencing the strongest returns to winning. The differing financial impacts to winning across sports leagues are consistent with league structures determined through collective bargaining and related agreements. The returns to winning do not appear to differ according to market size, but market size does have a separate positive effect on revenue. Multiple-team markets negatively impact team revenues in the NFL and NHL, but not in the NBA or MLB. The wealth of the host city has a positive effect in the NFL only, and Canadian teams generate more revenue in the NHL than teams located in the United States.

The results also confirm the importance of novelty or honeymoon effects of new stadiums on revenue in all sports leagues. The returns to stadiums are highest when they are new, which creates a strong incentive to replace stadiums even before they have exhausted their useful physical life. These results are consistent with past studies of attendance in most North American sports leagues; in addition, the estimates reflect a novelty effect in the NFL that previously had not been identified.

The findings have several implications for our understanding of sports leagues and how economists should model and evaluate related aspects of professional sports. First, increased revenue sharing lowers the marginal value of winning, which is consistent with incentives created by contributing and withdrawing revenue to and from a common pool. Second, the estimates do not support the common assumption that there are diminishing returns to winning in professional sports leagues. This finding supports the critique of

Coates, Humphreys, and Zhou (2014) that the UOH, as it is commonly used in the sports economics literature, does not conform with reality; thus, models based on these traditional assumptions need to be reformulated. Third, the findings also imply that because players are paid positive salaries, even when their revenue contributions to winning are zero, player marginal revenue product estimates should value absolute player quality in addition to their relative contributions made to winning.

References

Baltagi, B. H. and Wu, P.X. (1999). Unequally spaced panel data regressions with AR(1) disturbances. *Econometric Theory,* 15: 814-823.

Berri, D. J., Leeds, M.A., and von Allmen, P. (2015). Salary determination in the presence of fixed revenues. *International Journal of Sport Finance*, 10: 5-25.

Bradbury, J.C. (2007). *The baseball economist: The real game exposed*. New York: Dutton.

Bradbury, J.C. (2010). *Hot stove economics: Understanding baseball's second season*. New York: Copernicus.

Breusch, T. S., and Pagan, A.R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *Review of Economic Studies*. 47: 239-253.

Burger, J.D. and Walters, S.J.K. (2003). Market size, pay, and performance: A general model and application to Major League Baseball. *Journal of Sports Economics*, 4: 108-125.

Coates, D. and Humphreys, B.R. (2005). Novelty effects of new facilities on attendance at professional sporting events. *Contemporary Economic Policy*, 23: 436–45.

Coates, D., Humphreys, B.R., and Zhou, L. (2014). Reference-dependent preferences, loss aversion, and live game attendance. *Economics Inquiry*, 53: 959-973.

Carroll, B., Gershman, M., Neft, D., Thorn, J., and Elias Sports Bureau (1999). *Total football II: The official encyclopedia of the National Football League*. New York: HarperCollins.

Cyrenne, P. (2001). A quality-of-play model of a professional sports league. *Economic Inquiry*, 39: 444-452.

Fort. R.D. and Quirk, J. (1995). *Cross-subsidization, incentives, and outcomes in professional team sports leagues*, 33: 1265-1299.

Hakes, J. and Clapp, C. (2005). How long a honeymoon? The effect of new stadiums on attendance in Major League Baseball. *Journal of Sports Economics*, 6: 237-263.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, 46: 1251–1271.

Humphreys, B.R. (2002). Alternative measures of competitive balance in sports leagues. *Journal of Sports Economics*, 3(2): 133-148.

Leadley, J.C. and Zygmont, Z.X. (2005). When Is the honeymoon over? National Basketball Association attendance 1971-2000. *Journal of Sports Economics*, 6: 203–221.

Leadley, J.C. and Zygmont, Z.X. (2006). When Is the honeymoon over? National Hockey League attendance, 1970-2003. *Canadian Public Policy / Analyse de Politiques*, 32: 213-223.

Neale, W.C. (1964). The peculiar economics of professional sports. *Quarterly Journal of Economics*, 78: 1-14.

Noll, R.G. (2002). The economics of promotion and relegation in sports leagues: The case of English football. *Journal of Sports Economics*, 3: 169-203.

Poitras, M. and Hadley, L. (2006). Do new major league ballparks pay for themselves? *Journal of Business*, 79: 2275-2299.

Quirk, J. and Fort, R.D. (1992). *Pay dirt: The business of professional team sports*, Princeton: Princeton University Press.

Rottenberg. S. (1956). The baseball players' labor market. *Journal of Political Economy*, 64: 242-258.

Scully, G.W. (1974). Pay and performance in Major League Baseball. *American Economic Review*, 65: 915-930.

Scully, G.W. (1989). *The business of Major League Baseball*. Chicago: University of Chicago Press.

Solow, J.L. and Krautmann, A.C. (2007). Leveling the playing field or just lowering salaries? The effects of redistribution in baseball. *Southern Economic Journal*, 73: 947-958.

Symanski, S. (2015). *Money and soccer: A soccernomics guide*. New York: Nation Books.

Woolridge, J.W. (2002). *Econometrics analysis of cross section and panel data*. Cambridge: MIT Press.