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Do You Get What You Pay for? Salary and Ex Ante Player Value in Major League Baseball

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Abstract

The last few years have seen a resurgence of very long, very expensive guaranteed contracts in Major League Baseball. Commentators who examine the outcomes of earlier long-term contracts generally conclude that teams greatly overpay in these situations. These assessments suffer from the use of perfect hindsight, however. In this article, we estimate the economic gain that could be anticipated at the time of signing of a contract. We forecast the player's expected future productivity in terms of winning based on recent performance at the time of the contract signing and adjusted for player aging. We translate this expected performance into a stream of expected marginal revenues using estimates of the team-specific value of a marginal win and discount these to present value at the time of signing. The economic cost of the contract to the team is measured by the discounted stream of guaranteed future salaries across the contract horizon. Comparing these benefits and costs indicates that teams overpay on average and more so for longer contracts. Some part of this is likely explained by benefits beyond the effect of games won.

Keywords

contracts, salary, productivity, baseball

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It is difficult to make predictions, especially about the future.

Old Danish saying but often attributed to Yogi Berra

Long-term contracts (LTCs) are written with incomplete knowledge of the future. As a result, the *ex post* results of a contract are uncertain at the time the contract is written. Contingent contracting solves some of this problem, but not all contingencies are foreseen, and contingent contracts can give rise to moral hazard problems (see Perloff, 2018, Ch. 20). Forecast errors, broadly defined, often determine the ex post distribution of the gains (and possibly losses) from the contract.

One market in which these issues are particularly discernable is the market for players in Major League Baseball (MLB). As an alternative to a series of single-year contracts, an LTC should provide benefits to one or both sides of the transaction that can be shared by the parties.[1] In baseball, LTCs are primarily arrangements to share risk between the player and the team. A risk-averse team benefits from LTCs by enabling it to control which players are on its roster. Such control is valuable because teams wish to avoid the uncertainty of being in the market for a specific position or type of player at a point in time when such a position is in short supply and therefore expensive. Thus, an LTC allows the team to lock in its future costs.[2] Furthermore, a risk-averse player who signs an LTC insures against the risk of diminished performance or injury. This is the result of two distinctive features of the market. First, LTCs between MLB teams and their players are guaranteed, meaning the player receives their contractual salary for the length of the contract regardless of performance. Second, as the result of agreement between the league and the players' union, that contractual salary cannot be contingent on performance.[3] Hence, a player who signs an LTC for a given sequence of annual salary payments is ensured that he will receive those payments, irrespective of future performance. Beyond the risk-sharing benefits, an LTC may be efficient if it saves the team and player a significant amount of transaction costs compared to negotiating a series of single-year contracts. Since longer contracts involve more years of avoided transaction costs, one might expect to find larger savings associated with longer contracts. Thus, both the team and the player have something to gain from an LTC.[4]

Due to the guaranteed and noncontingent nature of salaries in MLB, there is essentially no difference between the *ex ante* and ex post values of the payments received by the player; there are no forecast errors on this side of the transaction. Against these benefits to the player, a profit-maximizing team owner or general manager must weigh the expected marginal revenues (MRs) that the player's performance brings to the organization. Recent signings of record-length and dollar value contracts have led many commentators to examine the outcomes of previous LTCs and generally conclude that teams overpay in these situations by very large amounts. Often offered up for consideration among the worst contracts from their teams' perspectives is that of Alex Rodriguez, who signed a 10-year contract with the New York Yankees in 2007 worth US$275 million for the 2008-2017 seasons . Due to a variety of injuries and a 1-year suspension for the use of performanceenhancing drugs, Rodriguez averaged fewer than 80 starts (of a possible 162) per season between 2011 and 2015. He was released midway through the 2016 season and did not play at all in 2017, with the Yankees still owing him over US$27 million for the remainder of his contract. Other similar examples are available.

Cases like Rodriguez stand out as bad deals for their teams; clearly, a guaranteed contract that ends up paying for multiple years of literally no performance at all is not profit-maximizing ex post. It is more complicated to evaluate an LTC when the player performs through the length of their contracts. The issue is how to value that performance in order to compare it with the cost paid by the team. This is typically done by using some measure of wins generated over the length of the contract and valuing each win by the marginal value of a win. Not all LTCs appear unprofitable: Lampe (2015a, 2015b) estimated Rodriguez's contract lost approximately US$130 million in (undiscounted) profits for the Yankees' owners, while Evan Longoria's contract with the Tampa Bay Rays (2008-2016) was one of the most profitable for a team to that point, generating roughly US$252 million in profits.

These assessments, however, suffer from a major problem: They are based on historical performance. Hindsight is proverbially 20/20; the relevant economic question is not whether a player's ex post performance justifies his salary, but whether his ex ante (expected) performance did so at the time the contract was signed. In this article, we attempt to measure the ex ante value of the player's productivity to estimate the difference between the anticipated benefits of the player's contribution to winning games and the costs of the stream of guaranteed annual salaries, both reduced to expected present value at the time of signing. To this end, we begin by gathering information on the free-agent contract history of any player appearing on an MLB roster in 2010. We evaluate the economic benefits to the team of an LTC by calculating a player's *expected* future productivity across the contract horizon and translate these expected wins into a measure of performance-based MR. The expected future productivity is based on recent performance at the time of the contract signing, adjusted for the recognized relationship between player age and performance using results from Fair (2008). The economic cost of the contract to the team is measured by the discounted stream of future salaries across the contract horizon.[5]

In an analysis of 152 free-agent LTCs, we find that the expected benefits generated by these players typically fall short of the costs incurred by the team. In fact, the average LTC implies a loss of more than US$4.1 million per season. But there is considerable variation in the economic value of contracts of differing lengths; the longest contracts have the greatest economic deficits. About 89% of all contracts yield negative returns, both in total and on a per year basis, with a few involving deficits exceeding US$70 million (e.g., based on his anticipated performance, Alex Rodriguez's 7-year contract signed in 2001 cost the New York Yankees US$76 million). An unknown fraction of these deficits, however, is likely the result of benefits beyond winning games that are generated by the player and shared with the team but which are difficult to measure.

Related Literature

Salary determination models in professional sports have been used to investigate a number of labor market phenomena. Monopsony power is revealed by examining the salaries paid to indentured players (Scully, 1974; Zimbalist, 1992). These studies find that young players typically receive much less than what they are worth. For example, arbitration-ineligible players are paid about 20%–30% of their estimated market value, while arbitration-eligible players are paid about 60%–70% of their marginal revenue product (MRP).

LTCs, especially those which are guaranteed, have numerous economic implications, which have been explored in the literature. One direction explored is the role of employment security on the propensity to shirk. Here, the interest focuses on how length of contract affects a player's incentive to expend effort, particularly after signing a new long-term guaranteed contract. Krautmann (1990) argues that contract negotiations often occur immediately following a year of an exceptional performance. Since productivity is stochastic, we would expect an above-average performance to be followed by a regression to the mean. Because players tend to sign new LTCs immediately following a strong performance, we should not be surprised to observe a decline in performance in the period immediately following a new LTC. Krautmann and Solow (2009, 2015) proposed a dynamic model of productivity that looks at performance across the entire duration of LTCs. This approach was used to look at the player's productivity, both in terms of the player's offensive performance and his propensity to spend time on the disabled list. In particular, the authors look at whether effort varies as the player approaches, then reaches, the final year of a contract (or "walk year"). A player expecting to sign another contract would want to maximize his performance in the final year of his contract because that would improve his value in subsequent negotiations. The authors found evidence that shirking was most prevalent in that subset of players who are more likely to retire and end their professional careers and therefore are less concerned about future contracts.

Modeling Considerations

It is important to recognize that a player's MRP may exceed the value that their immediate on-field performance has on winning games. The ability of a player to attract fan attention both in the stadium and in media, while clearly related to performance, may also have an independent value to a team beyond the effect of games won. MLB teams earn a significant amount of fixed revenues unrelated to their winning record—primarily broadcast revenues—which can range from about 45% to nearly 75% of total revenues based on the audited financial statements of six MLB franchises disclosed by Deadspin (2009). If players can extract a portion of those revenues in their contract negotiations, then their salaries will be higher than their value as measured solely by the value of their impact on the team's won–loss record. Thus, the player's salary can be thought of as depending on two sources of MR: that directly related to winning games, which we will call *direct* revenues (MRP^D), and that which arises from their broader fan appeal, which we will call *indirect* revenues (MRP^I). Thus,

$$SAL = f(\text{MRP}^{\text{D}},\ \text{MRP}^{\text{I}}).$$

In this article, we focus on measuring direct MRs, estimating the indirect MR of each player would clearly be a formidable task. In Solow and Krautmann (2011), we presented a theoretical model of salary bargaining between a free-agent player and a team, which accounted for the player's next best offer and the difference between the player's value to the team and the (net of salary) value of that team's next best alternative player. In the Nash bargaining equilibrium of that model, the player's salary is an increasing function of the difference between the player's value to the team (which would include both direct and indirect MRs) and the net value of the team-specific alternative player. Hence, each player's indirect MR is specific to the player/team pair that are negotiating and a function of unobservable data such as the player's next best offer and the net value of the team's next best alternative player.

Although estimating players' indirect MRs is beyond the scope of this article, we can offer one hypothesis about them. Although the bargaining model did not address negotiating the length of the contract, it seems more than likely that players whose value to a team (directly and indirectly) is larger would be able to negotiate for a longer contract. As a factual matter, the relatively few MLB players who have signed the longest contracts have been the superstars of their day. Hence, we can hypothesize that indirect MRs, and therefore the difference between salary paid and direct marginal revenue, should be increasing with the length of contract. We will explore this hypothesis in light of our empirical results below.

Estimating the Anticipated Direct Revenues of an LTC

As noted, an analysis of contract outcomes in MLB must recognize that these contracts are guaranteed, with the terms of the contract finalized before the realization of the player's productivity. Thus, we need a model of expected productivity across the contract horizon. Here, we develop such a model and link it to the present value of the direct MR from the contract. Our model accounts for differences in observed player productivity as of the date of the contract and predictable changes in future productivity over the length of the contract due to the beneficial impact of experience and the negative consequences of aging.

To this end, we employ the dynamic model of the age–productivity relationship developed by Fair (2008).[6] In Fair's model, performance is a function of age across two horizons: One estimated during the player's early career when performance is improving and the other in the player's latter years when performance is declining. Define δ as the peak-performance age (δ estimated to be 27 years), Y_t^j the jth player's

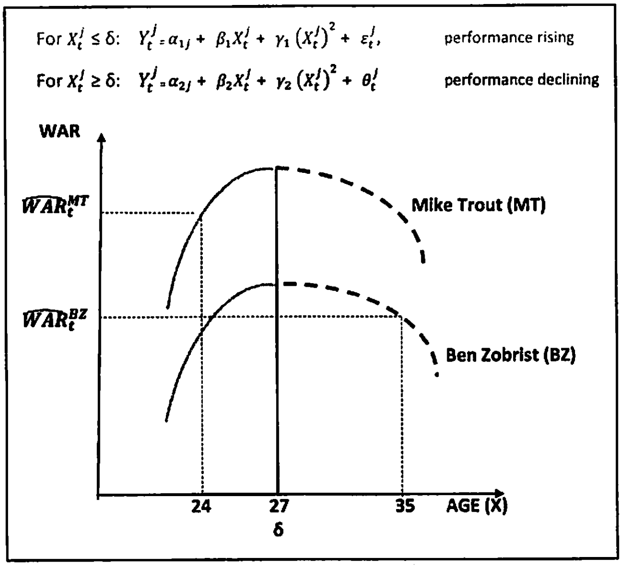

Figure 1. Example—Mike Trout versus Ben Zobrist. *Note.* Trout was 24 years old when he signed an LTC with the Los Angeles Angels. Zobrist was 35 years old when he signed an LTC with the Chicago Cubs.

performance at time t, and X_t^j the player's age in year t. Fair estimated two separate age–performance models, depending on whether age (X_t^j) is less than or greater than δ:

$$Y_t^j = \begin{pmatrix} \alpha_{1j} + \beta_1 X_t^j + \gamma_1 (X_t^j)^2 + \varepsilon_t^j & for\, X_t^j \le \delta \\ \alpha_{2j} + \beta_2 X_t^j + \gamma_2 (X_t^j)^2 + \theta_t^j & for\, X_t^j \ge \delta \end{pmatrix}. \quad (1)$$

Fair constrained, these two quadratic functions to be equal, and have a zero derivative, at $X_t^j = \delta$. As such, this model allows for the player's performance to rise quadratically up to the point, where $X_t^j = \delta$, and then decline quadratically thereafter—allowing for the improvement phase to progress at a different rate than the decline phase.

To get ex ante expectations of a player's productivity, one needs to specify a performance metric. Fair's model displayed a surprising degree of robustness across the performance metrics considered there. For example, using on-base percent (OBP) or slugging average + OBP yielded fairly similar results for position players. We applied Fair's methodology using a broader and richer metric called Wins Above Replacement (WAR).[7,8] Figures 1 and 2 below illustrate how Fair's model could be used to extrapolate two different players' expected productivity across their LTCs. For concreteness, we use as examples the Los Angeles Angel's Mike Trout and the Chicago Cubs' Ben Zobrist, two players at different points in their careers. At age 24 at the time of signing, Trout is on the rising section of his productivity path. Zobrist, 35

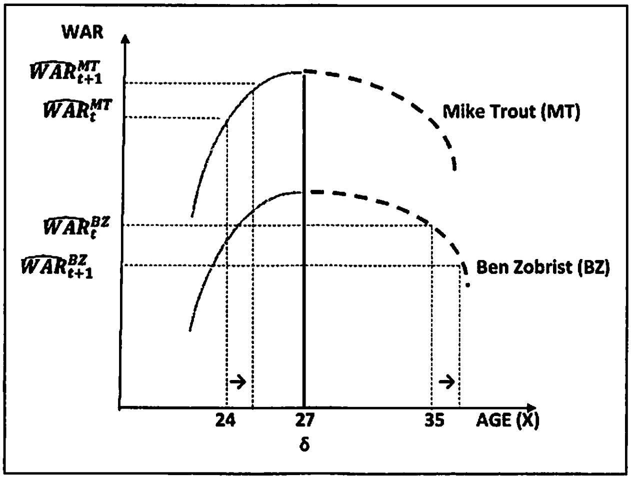

Figure 2. Example—Mike Trout versus Ben Zobrist.

years old at the time of signing, on the other hand, is beyond δ and thus on the declining section of his productivity path. Second, Trout's entire productivity path is "higher" than Zobrist's, which is the result of initializing each player's age–productivity path using player-specific average performances over the three seasons prior to the signing of each player LTC. Equation 1 is used to construct a forecasted time path of WAR for player j across the n periods of his contract horizon:

$$\left\{\widehat{WAR}^{j}_{(t+1)}\widehat{WAR}^{j}_{(t+2)}, \cdots \cdots, \widehat{WAR}^{j}_{(t+n)}\right\}. \tag{2}$$

To translate these incremental wins into direct MRP, we need an estimate of the signing team's MR function. As is standard in these types of revenue models, a win at time t has a contemporaneous and a lagged effect on team revenues. As such, we estimated the following log-linear model of team revenues:

$$ln(REV_{it}) = \alpha + \beta_1\, WINS_{it} + \beta_2\, WINS_{i(t-1)} + \beta_3\, POP_{it} + \beta_4\, STADAGE_{it}$$

$$+ \beta_5\, (STADAGE_{it})^2 + \varepsilon_{it}, \tag{3}$$

REV_{it} is the total real revenues (US$2010) of team i in season t (using the data reported in Forbes "Business of Baseball" for the 2010 through 2016 seasons[9]), $WINS_{it}$ is the number of regular season wins of team i in seasons t, POP_{it} is the metropolitan population of the team's city at time t, and $STADAGE_{it}$ is the age of the stadium of team i in seasons t. The summary statistics are presented below in Table 1, while the regression results from estimating Equation 3 are given in Table 2.[10]

Table 1. Summary Statistics for Marginal Revenue Regression Variables.

Variable	Number of Observations	Mean	SD
Total revenue (US$ million)	210	250.1	75.3
Real total revenue (US$ million)	210	235.1	67.8
Population (million)	210	5.91	4.63
Wins	210	81.0	10.9
Stadium age (years)	210	23.3	24.3

Table 2. Huber–White Estimates of (Real) Team Revenues (Robust Standard Errors). Dependent Variable: ln (REV).

Variable	Coefficient	t Statistics
Constant	4.732**	47.4
WIN_{it}	0.0027**	2.3
$\text{WIN}_{i(t-1)}$	0.0046**	3.6
POPULATION_{it}	0.026**	7.2
STADAGE_{it}	−0.0064**	−3.6
$(\text{STADAGE}_{it})2$	0.0001**	5.3
Number of observations	210	
F statistics	38.1**	

*Significant at 10% level. **Significant at 5% level.

Using the regression estimates in Table 2 (and discounting the lagged effect at a long-run real interest rate of 3%), we calculate the MR associated with one extra win as:

$$\hat{MR}_{it} = \left[(\widehat{REV}_{it}) \times \left(\hat{\beta}_1 + {}^{\hat{\beta}_2}\!/_{1.03} \right) \right]. \tag{4}$$

Team-specific MRs are listed below in Table 3. The estimates in Table 3 imply that the league-wide average MR is US$1.65 million—that is, each *additional* win yields the typical team an additional US$1.65 million in revenues.[11]

The benefit to team i of signing player j to an LTC in season $t(B^j_{it})$ is the discounted *incremental* revenue stream generated by the player's on-field performance (over and above that of a "replacement player"). Using a long-run, real interest rate of 3% to discount the stream of MRPs, this incremental revenue is calculated by multiplying the time path of extra wins generated by player j (i.e., $\hat{WAR}^j_{(t+s)}$ in Equation 2) above, with team i's extra revenue associated with these wins (i.e., MR_i in Equation 4):

$$B^j_{it} = \sum_{s=1}^{n} \frac{\left(\widehat{WAR}^j_{(t+s)}\right) \times (MR_i)}{1.03^s} = \text{incremental revenue associated with } LTC^j_{it}. \tag{5}$$

Table 3. Team-Specific Marginal Revenues (US$2010 in Millions).

Arizona Diamondbacks	1.469	Milwaukee Brewers	1.415
Atlanta Braves	1.605	Minnesota Twins	1.490
Baltimore Orioles	1.425	New York Mets	2.320
Boston Red Sox	2.185	New York Yankees	2.546
Chicago Cubs	2.309	Oakland Athletics	1.490
Chicago White Sox	1.661	Philadelphia Phillies	1.640
Cincinnati Reds	1.476	Pittsburgh Pirates	1.449
Cleveland Indians	1.390	San Diego Padres	1.460
Colorado Rockies	1.360	San Francisco Giants	1.599
Detroit Tigers	1.596	Seattle Mariners	1.421
Houston Astros	1.451	St Louis Cardinals	1.630
Kansas City Royals	1.357	Tampa Bay Rays	1.479
Los Angeles Angels	1.922	Texas Rangers	1.666
Los Angeles Dodgers	1.971	Toronto Blue Jays	1.524
Miami Marlins	1.543	Washington Nationals	1.676
		League average	1.651

Measuring the Future Costs of an LTC

The incremental *Cost* (C^j_{it}) of the *j*th player's LTC with the *i*th team, signed at time *t*, is calculated by taking the discounted value of the series of annual salaries paid to the player across the contract horizon. Since the productivity measure imputes the contributions of the player *over and above the replacement player*, we subtracted the major league minimum salary of US$500,000 (about what a typical replacement player was paid over the past decade) from the annual salaries paid to the player across the contract horizon.[12] This annual net salary is converted into constant US$2010, and discounted at 3%, to get the real discounted cost across the contract horizon:

$$C^j_{it} = \sum\nolimits_{s=1}^{n} \frac{Sal_{j(t+s)} - \$500,000}{(1.03)^s}. \tag{6}$$

To analyze the marginal value of LTCs, we define the *i*th team's surplus (SURPLUS) associated with signing the *j*th player to an LTC as the difference between B^j_{it} in Equation 5 and the C^j_{it} in Equation 6:

$$SURPLUS^j_{it} = B^j_{it} - C^j_{it}. \tag{7}$$

Since both B^j_{it} and C^j_{it} are measured relative to the replacement player, $SURPLUS^j_{it}$ is the marginal value to the team of player *j*'s LTC. If $SURPLUS^j_{it} > 0$, then the team's expected revenues from the player exceed what the team paid out in guaranteed salaries. A positive value for SURPLUS is consistent with the player's willingness to pay a risk premium to avoid the risk of future falloff in productivity and/or injury. If, on the other hand, $SURPLUS^j_{it} < 0$, then the team is on the hook to pay out more in salary to the player than what it should have expected to receive back in terms of wins (hence revenues). We recognize that during contract negotiations, the team knows the costs of the LTC with certainty. The player's productivity, however, is inherently subject to forecast error, making the benefits side of the analysis more uncertain.

Empirical Results

We restrict our data to LTCs that were signed by players who were free agents to avoid the limitations on players' bargaining power that the MLB's collective bargaining agreement imposes during the first 6 years of their careers. Link and Yosifov (2012) find that the average free-agent contract length has remained relatively constant from 1984 to 2006 at between 1.58 and 1.89 years. While an LTC could in principle be any contract longer than 1 year, we choose to restrict our analysis to contracts that are at least 3 years long. Various authors have found that the average career of an MLB player is between 5 and 6 years long (see Abel & Kruger, 2006; Baker et al., 2013; Witnauer et al., 2007), so a 3-year contract is already a significant part of the typical player's career. This leaves us with 152 contracts, which are all the LTCs for any player on an MLB roster during the 2010 season (Cot's Baseball Contracts, various years). A few players on a 2010 roster appear multiple times because they were on their second or third LTC of their playing career (e.g., Alex Rodriguez sign three LTCs in his career: a 4-year contract in 1997 and 10-year contracts in both 2001 and 2008[13]). In total, our sample consists of sixty-two 3-year contracts, forty 4-year contracts, twenty-three 5-year contracts, eleven 6-year contracts, eight 7-year contracts, and eight contracts with lengths greater than or equal to 8 years. Table 4 summarizes the present values of the estimated benefits, costs, and annual surplus associated with LTCs of various contract lengths, and Figures 3 and 4 below illustrate the benefits and costs, while Figure 5 illustrates the annual surpluses, at different contract lengths.

Our estimates imply that the "worst" LTC (from the New York Yankees' point of view) in our sample is that associated with Alex Rodriguez's 2001 7-year contract with a total deficit of US$76 million; the "best" LTC was Jim Edmond's 1996 4-year contract, which provided the Anaheim Angels a total surplus of US$27 million. Finally, there are 135 contracts with negative surpluses, whereas only 17 contracts with positive surpluses. Because longer contracts will inevitably have higher costs and anticipated benefits, a better view of LTCs is provided by examining the annual surplus, derived by dividing the surplus by the length of the contract. A plot of the distributions of these annual surpluses by contract length is illustrated below in Figure 6. Across the entire sample, this annual surplus averaged about −US$4.1 million, with the greatest deficits again coming from those LTCs of 8 years or longer. The contract that generated the worst average annual deficit was the Houston Astros' 6-year contract with Carlos Lee in 2007, which had a negative US$11.9 million per year; the best annual contract was that of was again Jim Edmond's 1996 contract with a positive US$6.7 million.

Table 4. Summary Statistics for Present Value of Contract Benefits, Costs, and Annual Surplus by Contract Length.

Variable	Number of Observations	Mean	*SD*
Benefits—real MRP (US$ million)			
Length = 3	62	US$13.0	US$6.4
Length = 4	40	US$24.2	US$11.5
Length = 5	23	US$35.0	US$11.2
Length = 6	11	US$48.6	US$20.0
Length = 7	8	US$84.0	US$38.9
Length ≥ 8	8	US$91.0	US$30.8
Costs—real discount (US$ million)			
Length = 3	62	US$22.6	US$9.4
Length = 4	40	US$37.4	US$11.3
Length = 5	23	US$66.0	US$12.4
Length = 6	11	US$77.1	US$24.0
Length = 7	8	US$126.5	US$24.8
Length ≥ 8	8	US$136.4	US$37.6
Annual surplus—real discount (US$ million)			
Length = 3	62	−US$3.2	US$2.9
Length = 4	40	−US$3.3	US$3.3
Length = 5	23	−US$6.2	US$2.8
Length = 6	11	−US$4.7	US$3.1
Length = 7	8	−US$6.1	US$4.9
Length ≥ 8	8	−US$5.5	US$2.9

Note. MRP = marginal revenue product.

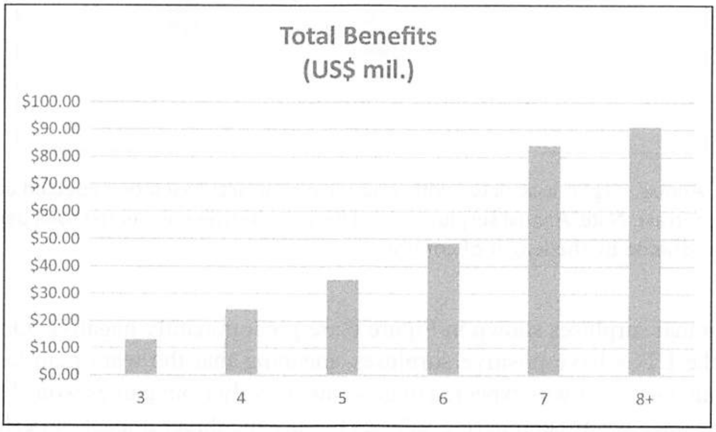

Figure 3. Expected benefits associated with long-term contracts by length of contract. *Note.* Total benefits (B^j_{it}) are the total expected addition to the team's revenues across the entire contract horizon.

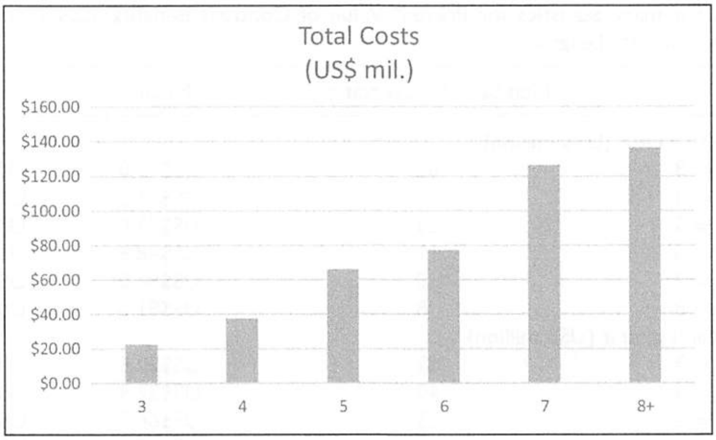

Figure 4. Costs associated with long-term contracts by length of contract. *Note.* Total costs (C^j_{it}) are the discounted value of the series of annual salaries paid to the player across the contract horizon.

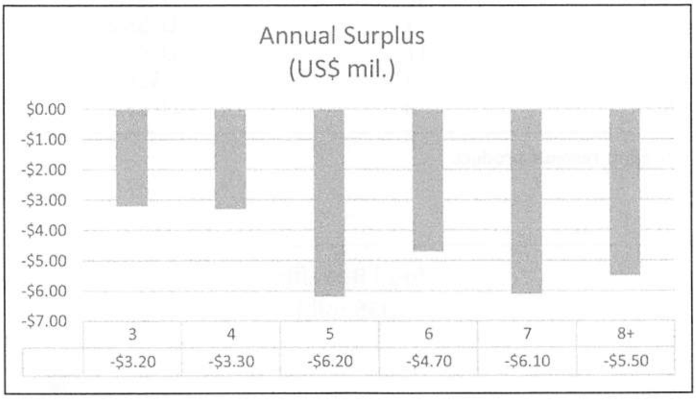

Figure 5. Annual surplus associated with long-term contracts based on expected benefits by length of contract. *Note.* Annual surplus is the difference between expected total benefits and total costs, divided by the length of contract.

The annual surpluses shown in Figure 6 are predominantly negative. Only about 11% of the LTCs have positive surpluses, meaning that the team paid less to the player than the player was expected to generate directly from games won. This is not surprising since we are comparing salaries to only the direct impact of performance on revenues and excluding whatever portion of indirect MRs, the player may be able to capture in contract negotiation. This means that those contracts for which SURPLUS ≥ 0 are in fact generating larger surpluses for their teams than measured here.

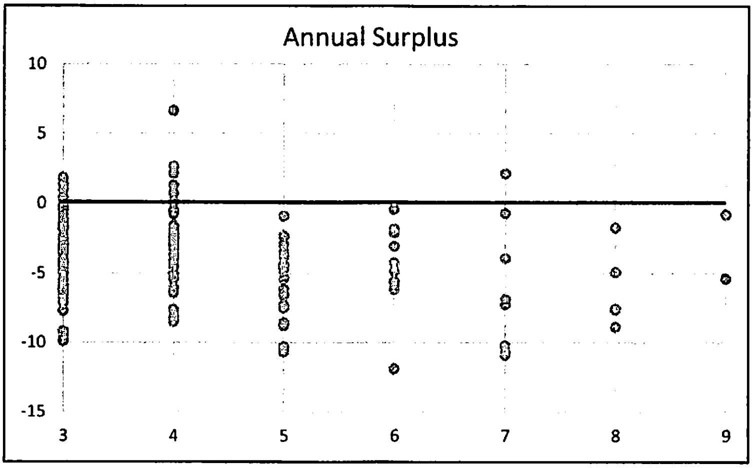

Figure 6. Scatter plot of the annual surplus by length of contract.

Some of the contracts for which SURPLUS < 0 may be still producing (direct) surpluses for their teams, depending on the size of MRP^I for that particular contract and the bargaining power of that player. We, however, cannot measure the size of the player's MRP^I, so we cannot disentangle these two benefit streams.

From Table 4, we see that the longer contracts have larger negative surpluses on average. In order to test whether these differences were the result of outliers, we examined the medians of the distributions at each contract length, but these are very close to the means. We also tested whether the means of the distributions of SURPLUS at different contract lengths are equal. Here, we could reject the hypothesis that the mean SURPLUS for 3-year and 4-year contracts was equal to the mean SURPLUS for contracts with length equal to 5 years or greater ($t = -8.2$) but could not further reject the hypothesis that the mean SURPLUS for 5-year and 6-year contracts was equal to the mean SURPLUS for contracts with length equal to 7 years or greater ($t = -0.18$). There appears to be a qualitative difference between 3- and 4-year contracts (over two thirds of our sample) and contracts of 5 or more years, with the former having an average surplus of –US\$3.2 million and the latter an average surplus of –US\$5.7 million. This is consistent with the idea that it is the best players who (1) bargain for the longest contracts and (2) generate the largest indirect MRs (of which they are only able to extract a fraction).

Conclusion

The trend toward long and expensive LTCs for superstar players in MLB is increasing. The last 3 years alone have seen a spate of record-setting deals (e.g., Mike Trout, 12 years, US$426.5 million; Bryce Harper, 13 years, US$330 million; Giancarlo Stanton, 10 years, US$325 million; Gerrit Cole, 9 years, US$324 million). And while many historically large long-term player contracts in MLB appear to be disappointments for the teams based on the players' ex post contributions, focusing on a player's ex post value is not a fair assessment since contracts are signed before the realization of the player's performances. We argue that a reasonable economic analysis of LTCs must be based upon the ex ante, or forecasted, value of the player. Given the trend, it is a bit surprising that we have not seen such an analysis of the payoffs to these deals.

In this article, we present an estimate of the player's expected future productivity in terms of winning based on recent performance at the time of the contract signing and adjusted for the recognized relationship between player age and performance. We translate this expected performance into a stream of MRs using estimates of the team-specific value of a marginal win and discount these to present value at the time of signing. The economic cost of the contract to the team is measured by the discounted stream of future salaries across the contract horizon. We evaluate the economic benefits to the team of an LTC by calculating the difference between value of the player's expected future productivity and the stream of salaries.

Our results indicate that, excluding any indirect monetary benefits associated with LTCs, teams appear to overpay on contracts 3 years and longer, and increasingly so the longer the contract. Clearly, an important topic for further research is to attempt to measure indirect MRs in order to determine what role they play in these results. Other possible explanations need to be considered as well; for one thing, the age–performance relationship we use to extrapolate wins produced may be misspecified, although it is the best alternative we can find and comports with generally held beliefs about player aging.

Another possible explanation is that team owners are either bad businessmen or nonprofit maximizers who overpay for superstars, either for personal aggrandizement or to maximize winning rather than profits. This "sportsman" hypothesis has been extensively discussed in the literature (Quirk & El Hodiri, 1974; Sloan, 1971; Szymanski, 2006; Vrooman, 1995). But given that MLB franchises are valued into the billions of dollars, this possibility seems somewhat unlikely.[14] Yet another possibility, particularly for the most valued players, is that a winner's curse may exist. The winning bid for a player may come not from the team with the highest MR of winning but from the team with the most optimistic expectations about his future performance. This introduces upward bias in the winning bids, which would result in the overpayments found here. If so, then we would expect this curse to be most pronounced in LTCs arising from free-agent bidding competitions than those associated with contract extensions, where the player's current team can be expected to have better information about his abilities.

As we note in the introduction, LTCs in baseball are primarily arrangements to shift risk between the player and the team. A basic result of finance holds that the longer the contract, the greater the risk, that is, we should see the variance of the surplus increasing with the length of contract. Interestingly, we do not find evidence of this; the standard errors of the distributions of direct surplus by length of contract shown in Table 4 are essentially constant. One possible explanation for this involves the finiteness of professional baseball careers and the endogenous choice of contract length. We expect teams to be willing to sign the longest free-agent contracts with younger players whose anticipated careers are likely to last long enough to justify guaranteeing them a salary, while mid-career and older players whose performance may soon be on the decline would be expected sign shorter contracts. If there is less variance in the performance of younger players and more variance in the performance of older players, the positive correlation of risk and contract length would be offset by the shorter contracts going to disproportionately higher risk players and the longer contracts going to lower risk players. Of course, this would also be complicated by need to measure indirect MRs in order to calculate surplus. This may also be a path for future research.

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Notes

1. There are many variations on long-term contracts (LTCs) in sports leagues, giving either players or teams or both options to extend, terminate, or renew. For example, in both American and European football, teams have the option not to continue a player's contract, notwithstanding that salaries may be specified for multiple years. On the European example, see Buraimo et al. (2015).
2. "Front-office executives like these sorts of arrangements (i.e., LTCs) because they give teams cost certainty for an extended period and access to a player's prime at a reasonable price" (Diamond, 2018).

3. Contracts can and do sometimes include clauses that provide bonuses for winning awards like most valuable player, but these are for amounts that are very small relative to annual salaries (e.g., an additional US$50,000 bonus to someone earning US$7 million per year).
4. Walters et al. (2017) look at how LTCs relate to risk-averse behavior on either side of the negotiation, finding evidence of risk aversion on both sides of the contract negotiation. Contrary to the common assumption, they find that owners may be more risk averse than players.
5. We measure the benefits (marginal revenue [MR]) and costs (salary payments) from the point of view of the team. Of course, from the point of view of the player, the salary payments are the benefit.
6. Fair's (2008) sample included essentially every rostered MLB player from 1921 to 2004 who played at least 10 seasons. He measured performance using earned run average for pitchers and on-base percent (OBP) and slugging average + OBP for position players. We applied Fair's methodology using Wins Above Replacement (WAR) as our performance metric. Improvements in training, conditioning, and nutrition might be expected to lead to players attaining their peak performance later in life, but Bradbury (2010) finds little evidence of this. While peak performance has increased over time, the age at which it is attained has not been changing.
7. WAR, as the name suggests, quantifies each player's value to their team offensively and defensively in terms of a specific number of wins above what would be produced by a replacement-level player (e.g., a minor league player or readily available fill-in). Because it adjusts for the player's position, comparisons can be made among players. Different sources (i.e., Fangraphs, Baseball-Reference, and Baseball Prospectus) calculate versions of WAR that differ slightly; we use the version from Baseball-Reference.
8. Although not without its critics, WAR has the advantage that it measures performance directly in terms of incremental games won, which can then be value in dollar term using the MR of a win. It is unclear how many of the other performance metrics would be translated into either added wins or dollars. Another metric that seeks to convert players' performance into games won is Bill James's *Win Shares* (see James & Henzler, 2002).
9. While there exists considerable debate as to the legitimacy of the Forbes sports data, we are quite confident using this data source. Before embarking on this revenue estimation, we did some spot checking on the accuracy of the Forbes data (relative to a few audited financial data sources). Deadspin (2009) leaked the audited financial data for the Texas Rangers, Seattle Mariners, Tampa Bay Rays, Los Angeles Angels, Florida Marlins, and Pittsburgh Pirates for various years between 2007 and 2009. In addition, the Blue-Ribbon Panel (BRP) revealed audited financial data for all MLB teams from 1991 to 2001. We used these audited data sources and compared their numbers to that reported in Forbes. The correlation between Forbes estimates of total revenues and Deadspin was .88, between Forbes and the BRP was .82, and between Forbes and both Deadspin and BRP was .86. These results suggest that we should be able to use the Forbes data with a reasonable degree of confidence.
10. Unlike many other estimates, our results do not show evidence of a positive impact of a new stadium on revenue.

11. While these computed MR values appear somewhat smaller than expected, one must realize that wins primarily affect variable revenues (i.e., gate revenues) and not fixed revenues coming from national broadcasting or the Commissioner's Central Fund. Fixed revenues, which are wins-inelastic, constitute about 50% of a team's total revenues. Thus, these MR values reflect the impact on *variable* revenues of each additional win.
12. As there is almost certainly a rookie player earning the Major League minimum playing at every position for at least 1 of the 30 Major League teams in any given year, this is also the lowest salary of a current player at each position.
13. As noted, Rodriguez opted out of final 2 years of the 2001 contract and renegotiated another 10-year contract with the Yankees in 2008.
14. The Miami Marlins, a team with a long record of performing poorly and having low attendance, nevertheless sold in 2017 for US$1.2 billion.

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