

Signaling in the Labor Market: A Natural Experiment in Major League Baseball

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Abstract:

Injuries by Major League Baseball players provide a unique natural experiment by which to compare the relative value of signals sent in this particular labor market. In analyzing 3,491 injuries from 2002 to 2009, players that will file for free agency at season's end spend roughly five more days on the disabled list as compared to non-free agent players. Pitchers also spend additional time on the disabled list as compared to non-pitchers; these results are evidence of the increased value in sending signals of health relative to signals of productivity as contract renegotiation nears.

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1 Introduction

While economists have long been interested in labor markets and exogenous events, in recent years their attention has shifted to the realm of athletics. At the intersection of these three areas is free agency, a system which emerged in 1976 in Major League Baseball via an arbitration ruling by which players, after six years of tenure at the highest level of professional baseball, are free to negotiate contracts with any team they wish.

Considering the many studies investigating the macro effects of the emergence of the free agency system upon Major League Baseball and the players' labor market as a whole (see Section II), there is a surprising paucity of studies looking at the micro, or player level, effects. What can be said of the actions of individual players in light of the existence of free agency?

A handful of previous studies have attempted to classify the micro-level, on-field effects attributable to free agency. Krautmann (1990) notes that there is an incentive for a player to shirk after signing a multi-year contract, and Grad (1998) and Holden and Sommers (2005) describe the incentive for a player to put forth additional effort prior to being a free agent in order to earn a more lucrative contract. These incentives, however, were difficult to verify empirically. Papps (2010) finds that free agency provides for younger players the possibility for a large increase in income, and that this opportunity improves performance amongst younger players. In addition, she finds that players perform better when in the last year of their contracts.

This study looks to isolate the nature of tradeoffs faced by Major League Baseball players who will become free agents during the upcoming offseason by exploiting a natural experiment. Injuries in athletics are largely random events.ⁱ Given that soon-to-be free agents want to send (at least) two broad signals in the labor market—one of performance and one of health—can we

discern any difference in the reaction to injuries by those who will be free agents at the end of the season to those who will not be free agents?

The paper continues as follows. Section II offers a literature review focused primarily on studies that have examined free agency. Section III provides the theoretical justification. Section IV presents the data and the framework of the empirical analysis. Section V explores the results. Section VI concludes.

2 Literature Review

The academic literature concerning signaling in the labor market is broad. Of greatest applicability to this analysis is the well-cited analysis by Spence (1973), which characterizes the nature of employer/employee dynamics during the hiring process. Since complete information concerning the true productivity of a potential employee is not available, all hirings are necessarily an investment made under uncertainty. In light of this fact, employees look to express their potential productivity through acquiring costly signals; education is the typical example. Spence's general framework allows for a wide range of models and applications to emerge; this analysis looks not to provide a comprehensive overview of this research. For a summary of the phenomenon of signaling, see Riley (2001).

Existing literature concerning free agency in professional sports leagues can be grouped into two broad categories. The first group examines the nature of free agency to affect the relationship between a player's salary and their marginal impact on team financial performance, or marginal revenue product (MRP). Predictably, Scully (1974) finds that Major League

Baseball players were paid well below their MRP during the reserve clause periodⁱⁱ, while a number of subsequent studies (see, for example, Zimbalist 1992, MacDonald and Reynolds 1994, and Krautmann 1999) using a similar methodology find that Major League Baseball free agents are paid their MRP. As these studies assume only demand-side effects determine the MRP of a player, Rockerbie (2009) considers the supply of free agents and finds a range of outcomes depending upon the specific position of the player.

The second category of analysis concerns the emergence of free agency as, effectively, a shift in property rights over the services of a Major League Baseball player. Naturally, property rights analyses of Major League Baseball and free agency have gravitated towards the Coase Theorem (Coase 1960). Simply put, the shift to free agency, which transferred property rights over players from the franchises to the players themselves, should do nothing to the observed economic outcomes. Part of the difficulty comes in accurately characterizing these outcomes; studies have examined player mobility (see, for example, Daly and Moore 1981, Drahozal 1986, Besanko and Simon 1985, and Hylan, Lage and Treglia 1996), talent concentration (see, for example, Horowitz 2000 and Depken 2002) and competitive balance (see, for example, Quirk and Fort 1992, Horowitz 1997 and Depken 1999). The wealth effects of such a shift in property rights have been discussed as well (see, for example, Cassing and Douglas 1980, Scully 1989, Fort and Quirk 1995, and Surdam 2006).

Lehn (1982) and Lehn (1984) examine the nature of injury and free agency within Major League Baseball. Due to free agency, multi-year contracts steadily replaced single-year contracts. With this result, he hypothesizes that players therefore have less incentive to prevent injury. Lehn supports this claim by analyzing 155 players during the 1980 season and finds that

the average amount of time spent on the disabled list is greater after a free agent contract when compared to the pre-free agency period.

The analysis here differs from Lehn's analyses in several key areas. While Lehn's work focuses on player-level data, the dataset constructed here utilizes injury-level data. This dataset considers 3,491 individual injuries over eight Major League Baseball seasons. Aggregating injury information into a measure of pre- and post-free agency periods of disability, while useful in analyzing information asymmetries inherent in the market for free agents in Major League Baseball (as was the intent of Lehn's studies), is a decidedly broad measure by which to characterize decisions by the individual player. Empirical analysis at the injury level allows a more pointed examination of the incentives faced by players when confronted by injury. Given the simultaneous goals of a baseball player who will soon become a free agent of 1) maximizing performance measures and 2) signaling good health, and the potential tradeoff between these two goals, an injury-level analysis is more appropriate for the analysis herein.

3 Theory

During any season, professional baseball players naturally fall into two groups: those under contract for the subsequent season, and those who are not. This study looks to differentiate the actions between these two groups.

Baseball players want to earn higher salaries, play for winning teams, and secure other desirable perks when negotiating a contract. Like employees in all industries, players facing free agency look to send signals to their potential employers. While there are several margins by

which a player looks to signal his quality as an employee, this paper looks to examine the signals of productivity and health.ⁱⁱⁱ Baseball players, like all employees, are more valuable to employers when they are more productive. The best signal of productivity is on-field performance, easily characterized by a range of statistical measures. Further, like all employees, baseball players are more valuable when healthy. *Ceteris paribus*, teams would ultimately prefer more productive, healthier players.

This relationship—between health and productivity in Major League Baseball players—is worth discussing. In the long run, the two factors are likely positively related. Players that experience poorer health are likely less productive, though not all lesser performing players do so due to health reasons. To be certain, stories of a potentially productive player hampered by injuries throughout his career fill the annals of baseball history as evidence to what could have been. Further, holding inherent ability constant, healthier players should outperform less healthy players.

In the short run, however, there exists a tradeoff between productivity and health. Recall that players signal productivity through statistics; insofar that health can be a function of playing fewer innings or fewer games, players face a decision between securing health and accumulating better statistics in aggregate. The long-run advantages of health in terms of better performance do not accrue, or accrue to a lesser extent, in the short run. In fact, it is this tradeoff that classifies on-field statistics and health as viable signals; that the opportunity cost of signaling health is the foregone opportunity to accumulate better statistics—and the opportunity cost of amassing superior on-field performance measures is the foregone opportunity to pursue health—is not just a coincidence but a crucial characteristic of the labor market in Major League Baseball.

In essence, an injury to an upcoming free agent is a natural experiment as to the relative value of these two signals. Should a free agent become injured during the season, will he focus more on sending the signal of productivity (and, in doing so, spend less time on the disabled list so as to accumulate better statistics) or more on sending the signal of health (and, in doing so, spend more time on the disabled list so as to avoid repeat injuries or other indicators of non-health)?^{iv}

Casual observation would suggest that players may focus more on sending signals of productivity. Popular press reports are frequent in noting players who have performed abnormally well when facing the prospect of free agency, and, as noted above, Papps (2010) finds evidence that players perform better during such a contract year. However, a systematic analysis that isolates the choice between productivity and health would provide unique insight into the choices made by professional baseball players.

4 Data and Empirical Analysis

In order to isolate the relative importance of productivity signals as compared to health signals, this study considers the length of time that Major League Baseball players spend on the disabled list. The following is the general regression model:

(1)

where $DaysOnDL_i$ represents the number of days that a player spent on the disabled list for injury i , $FreeAgent_i$ captures whether the player incurring injury i will be a free agent at the end

of the season, and X_i represents the matrix of control variables for injury i , which are discussed below. ε_i is a random error term.

[Table 1 about here.]

Table 1 contains summary statistics for the variables of interest in this study. *DaysOnDL* comes from cross-verified wire and team reports of teams placing players on the disabled list. The data covers all disabled list transactions from 2002 to 2009, and yields 3,491 individual injuries. While all injuries in baseball do not necessitate using the disabled list, focusing on these transactions eliminates the potentially confounding effort of determining reasons for why players miss games. A player could conceivably not play in a game (or play less) due to injury, but also because the player required rest (perhaps proactively attempting to prevent injury), or simply did not play due to the strategic nature of the game itself. Extracting the exact reasons for each player's game-by-game experience would be a significant undertaking, of which there would be insufficiently aggregated historical information to make such judgments. Further, the reasons listed above need not be mutually exclusive; a player requiring rest could also have not been needed for strategic reasons in a particular game. Focusing on disabled list transactions provides a convenient natural dividing line by which to isolate the decisions associated with injury.

Major League Baseball provided a list of players who filed for free agency after the 2002 season through the 2009 season. The number of players that file for free agency ranges from 148 players (in 2007) to 210 players (in 2003), with a mean of 178 players per year. Player x who filed for free agency after season t are matched with any injuries the player x may have incurred in season t to generate the *FreeAgent* variable.

One possible shortcoming of the *FreeAgent* variable is that it fails to capture players who enter a season anticipating free agency at its conclusion yet agree to a contract during the season, thereby eliminating them from the subsequent off-season's free agent pool. With the appropriate information, the timing of mid-season contract agreements could be matched with the timing of injuries to possibly rectify this issue. However, note that a crucial assumption inherent in this analysis is the mindset of the player; player x , expecting free agency, behaves in a different manner than those players not filing, or not expecting to file, for free agency. The omission of mid-season signings would be crucial only if 1) player x in no manner expected to sign a midseason contract, thereby putting him in the mindset of expecting to be a free agent at season's end until the point where he signed a contract during the season, and 2) a large number of unexpected contractual agreements were actually reached. The first point seems unlikely as stated; moreover, short of ascertaining the exact mental composition of each player who signed a contract in midseason, speculating the mental nature of players at all junctures of a season prior to signing a contract is exactly that—speculation. Further, as the majority of contracts are signed during the offseason, the second point is not likely of significant concern. Overall, this concern, while theoretically feasible, is likely not affecting the analysis in any significant manner and is effectively impossible to resolve.

The analysis considers a range of control variables that may impact the length of time that a player spends on the disabled list for a particular injury. The player's age at the time of the injury is included in the regression; it might be reasonable to assume that older players respond to injuries differently than younger players. Each model also includes a dummy variable to capture whether injury i was sustained by a pitcher.^v As surgery greatly increases the amount of time needed to recover from an injury, as well as indicates a more serious injury in general, a

dummy variable is included to indicate whether injury i required surgery. As repeat injuries may require additional recovery time, a dummy variable is included to capture whether injury i is a repeat injury. Dummy variables are also added to some specifications to control for the body part injured (29 unique body parts), and a string of variables to capture year-specific effects are included in some specifications as well.

5 Results

[Table 2 about here.]

Table 2 presents the results of the estimations of equation 1. Free agents spend between five and six extra days on the disabled list as compared to players who will not file for free agency during the upcoming offseason, depending on the particular specification. This finding lends support to the notion that signals of health in the free agent market have more value to free agents as a whole than signals of productivity. This realization could match well with an increased focus by teams on player scouting. As teams evaluate players more intensely, the team's opinion of a player's future productivity may become less of a function of on-field performance and more of a function of the team's opinion of a player's potential based on a range of other scouting measures. If true, the value of sending a signal of health through spending more time recovering from injuries increases relative to sending a signal of productivity through on-field performance. The results here support this possibility.

Pitchers also spend more time on the disabled list. The value of the estimate for the pitcher variable shrinks considerably when dummy variables are included to control for the body

part injured; this deviation suggests that pitchers tend to have more serious injuries in terms of time required on the disabled list to return to playing health. Nonetheless, even after controlling for the body part injured, the lowest coefficient estimates that pitchers still stay on the disabled list for roughly six days longer than non-pitchers. This result suggests that sending a signal of health is relatively more important to pitchers. Given the volatile nature of pitching—pitchers account for 55% of the trips to the disabled list, yet only 11% of the player-innings in any baseball game—a signal of health may be particularly valuable to a pitcher as compared to a signal of productivity.

Interestingly, as players get older, they tend to spend less time on the disabled list. A one-standard deviation increase in age leads to a reduction in time spent on the disabled list of approximately three days. Logic would seemingly dictate that as individuals age, the human body would take longer to repair itself. While admittedly simplistic, the results refute this hypothesis. Instead, it may be the case that, within the labor market for players, as players get older teams are not as receptive to signals of health from older players. In other words, teams will naturally assume a degree of health risk when signing an older player. Given this rationale, older players would focus more on sending signals of productivity, and hence would spend less time on the disabled list.^{vi}

The variables capturing whether the injury required surgery and whether the injury was a repeat of a previous injury have the expected positive values, though the repeat injury variable does lose statistical significance when body part and position controls are added to the model.

The nature of the disabled list could create a distributional issue with the data. The minimum amount of time a player can spend on the disabled list is 15 days; therefore, the data

are left-censored at 15 days. As such, a Tobit model would be technically appropriate for analyzing the data, structured with a left limit of 15 days. The results of these specifications are presented in Table 2.^{vii} The Tobit estimates produce statistically and economically comparable results, thereby confirming the estimates derived using OLS. Furthermore, there also exists a right-censored point in the data, as a player cannot be on the disabled list for longer than the length of the season. Depending on the season, this point could range anywhere from 180 to 190 days; furthermore, the nature of various wire reports allow this value to rise even further, as the maximum value in the dataset is 221 days. Various right-censored points, corresponding to the lengths of the seasons, were tested under the Tobit framework along with the left-censored value of 15 days. These specifications are not presented, but produce similar estimates to the OLS and Tobit estimates in Table 2.

6 Conclusion

This analysis considers the tradeoff between sending signals of productivity and signals of health by Major League Baseball players after they incur an injury. After controlling for a wide range of factors, players facing free agency in the subsequent offseason spend more time on the disabled list as compared to players who will not file for free agency. When faced with an injury, players will choose to send the signal that yields the highest return possible. The results herein suggest that sending signals of health—by virtue of spending additional time on the disabled list—are more valuable to the soon-to-be free agent compared to signals of productivity. While this is the first to attempt to exploit baseball injuries as a basis to compare relative values of signals, this type of analysis is by no means limited to the realm of baseball, or even athletics

in general. Injuries to employees are an economic reality in many industries; should the nature of contracting (i.e., the frequency of renegotiation) play a role in the behavior of the employee in response to an injury, potential gains stand to be captured by both sides of the market by understanding exactly this relationship.

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ⁱ Arguments could be made that players at particular positions are more prone to injury, and previously injured players are more likely to suffer additional injuries. The empirical analysis controls for both of these possibilities.

ⁱⁱ During the reserve clause period, players could not pursue free agency, and thus were prevented from a market process to determine their salary.

ⁱⁱⁱ Sending signals of health is a more subtle process than signaling productivity. Signals of health could include avoiding repeated injuries or passing physical exams performed by potential employers.

^{iv} Of course, the null hypothesis dictates that there is no specific impact upon time spent on the disabled list attributable to the player's contractual standing, and therefore free agency would have no statistical impact.

^v Some specifications incorporate dummy variables to capture every position in baseball; as a matter of empirics, the most interesting discrepancies in behavior emerge when comparing pitchers to non-pitchers.

^{vi} At face value, it would seem that age could cause collinearity problems in our model. Since players must have six years of experience before filing for free agency, problems may arise when including an age measure along with the *FreeAgent* variable. However, variance inflation factors for age and *FreeAgent* over the various specifications are within the range of 1.30 to 1.50, which falls well below the rule of thumb set forth in Kennedy (2003) of harmful collinearity when $VIF > 10$.

^{vii} Specifications 7 and 8 in Table 2 do not converge under a Tobit framework.

Table 1 - Summary Statistics

	<u>N</u>	<u>Mean</u>	<u>S. D.</u>	<u>Min</u>	<u>Max</u>
Days on Disabled List	3491	58.18	50.65	15	221
Free Agent	3491	0.20	0.40	0	1
Age, days	3491	10912.36	1651.93	7160	16736
Pitcher	3491	0.55	0.50	0	1
Surgery	3491	0.25	0.43	0	1
Repeat Injury	3491	0.20	0.40	0	1

Table 2 - Free agency's impact on time spent on the disabled list

Dependent variable - Days spent on the disabled list due to injury

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Model	OLS	Tobit	OLS	Tobit	OLS	Tobit	OLS	OLS
Controls	Year	Year	Year	Year	Year	Year	Year, body part	Year, body part, all positions
<i>Free Agent</i>	6.201*** (2.377)	7.304*** (2.638)	5.205*** (1.944)	6.120*** (2.154)	5.124*** (1.936)	6.019*** (2.151)	5.126*** (1.908)	5.128*** (1.917)
<i>Age</i>	-0.0028*** (0.0006)	-0.0035*** (0.0006)	-0.0020*** (0.0005)	-0.0025*** (0.0005)	-0.0021*** (0.0005)	-0.0026*** (0.0005)	-0.0018*** (0.0005)	-0.0019*** (0.0005)
<i>Pitcher</i>	18.188*** (1.647)	19.832*** (1.840)	14.545*** (1.363)	15.901*** (1.505)	14.131*** (1.370)	15.397*** (1.513)	6.257*** (1.544)	12.581*** (4.503)
<i>Surgery</i>			65.842*** (2.046)	68.885*** (1.708)	65.029*** (2.083)	67.880*** (1.740)	61.987*** (2.125)	61.971*** (2.128)
<i>Repeat Injury</i>					4.609** (1.892)	5.628*** (1.909)	2.520 (1.896)	2.513 (1.898)
R^2 / χ^2	0.04	146.22	0.36	1479.53	0.36	1488.21	0.39	0.39

Notes: Robust standard errors are in parentheses. For all specifications, N = 3491.

Tobit specifications include a left-censored value of 15 days.

*** (**) denote significance at the 1% (5%) level.