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Why Are Americans Addicted to Baseball? An Empirical Analysis of Fandom in Korea and the U.S.

By

Young H. Lee and Trenton G. Smith

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An Empirical Analysis of Fandom in Korea and the U.S.

Young H. Lee
Hansung University

Trenton G. Smith
Washington State University

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Abstract

Theories of rational addiction posit that certain habit-forming goods—characterized by an increasing marginal utility of consumption—generate predictable dynamic patterns of consumer behavior. It has been suggested that attendance at sporting events represents an example of such a good, as evidenced by the pricing strategies of commercial sports interests. In this essay, we provide new evidence in support of rational addiction for the case of Major League Baseball, but fail to find such support in data from the Korean Professional Baseball League. We then review the scientific literature on sports fans from the perspective of human behavioral ecology and propose a theory of endogenous habit formation among sports fans that could explain our findings.

Contact Information:
Trenton G. Smith
School of Economic Sciences
Washington State University
Pullman, WA 99164-6210
trentsmith@wsu.edu

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Men's natures are alike; it is their habits that separate them.

-Confucius

1. Introduction

Static microeconomic theory predicts that profit-maximizing monopolists will price in the elastic range of demand. The recurrent finding that many (perhaps most) professional sports teams—local monopolists all—choose ticket prices in the *inelastic* range has therefore been a persistent puzzle.[1]

One commonly offered explanation for this finding is that the ticket price does not capture the full cost of attending a game (Fort 2003, Krautmann and Berri 2006). In this view, the ticket-price elasticity of attendance should be low because teams that set prices higher would suffer revenue losses from parking, concessions, and merchandise sales. In other words, the standard theoretical prediction (that monopolists set price in the elastic range) should properly be tested with respect to *total cost* of attendance rather than ticket price alone. However, we provide an indirect test of this hypothesis using fan cost data from Major League Baseball (MLB) in Section 3 below, and nevertheless find support for inelastic pricing.

An alternative explanation for the inelastic demand phenomenon is the possibility that inelastic pricing might serve to maximize profits in a dynamic framework in which attendance meets the economic definition of a habit-forming good. Ahn and Lee (2003) show in a simple two-period model that inelastic pricing is consistent with profit-maximizing behavior if attendance is habit-forming and fans' intertemporal elasticity of substitution (IES)

[1] For reviews of the literature on the demand for attendance at sporting events, see Fort (2004) and Krautmann and Hadley (2005).

is small. The intuition behind this finding is as follows: just as teams would be well-served to consider non-ticket (but attendance-dependent) revenue in setting price, they would also do well to consider the dynamic effects of ticket price on future attendance. In other words, even if setting a lower price decreases current revenue, it is possible that this loss might be more than offset by increased revenue in the future. From the perspective of the fan, if future (i.e., next season) attendance is a poor substitute for current attendance (IES is small) and the marginal utility of future attendance is an increasing function of current attendance (attendance is habit-forming), then increases in current ticket prices are likely to have a negative affect on both current and future attendance. These are precisely the conditions under which a forward-looking team owner would set ticket prices below the level predicted by static microeconomic theory.

One shortcoming common to most economic theories of habit formation (also known as "rational addiction") is a lack of endogeneity—that is to say, for the most part theories of rational addiction fail to offer *ex ante* predictions about which goods are likely to be habit-forming, under what conditions they will be habit forming, or which consumers might be expected to be susceptible to such habits. We demonstrate the empirical relevance of such questions in Section 3, where we provide estimates of the strength of habit formation among baseball fans in the U.S. and Korea, and—after finding important differences between the two countries—proceed in Section 4 to propose a theory of endogenous habit formation applicable to attendance at sporting events.

2. Empirical Model

We consider a rational expectations model of lifetime consumption that can be used to estimate both the IES parameter and the extent to which baseball attendance is habit-forming. Our econometric model follows Dynan (2000), which departs somewhat from the specifications of Becker and Murphy (1988) and Becker, Grossman and Murphy (1994).

Unlike the assumption of perfect foresight on the part of the consumer employed by these authors, Dynan's model allows for future uncertainty.

Following Dynan, we assume that fans are rational and maximize constant-relative-risk-aversion (CRRA) utility functions; that is, a representative sports fan chooses how many games to attend in the current period (ATT_{t_0}) by maximizing lifetime expected utility:

$$\max_{ATT_{t_o}, ATT_{t_o+1},\ldots,ATT_{t_o+T}, Y_{t_o}, Y_{t_o+1},\ldots,Y_{t_o+T}} E\left(\Sigma_{t=t_o}^{T} b^t \exp(x_t' q)\left\{\frac{(ATT_t - a\,ATT_{t-1})^{1-1/g}}{1-1/g} + v(Y_t)\right\}\middle|\Omega_{t_o}\right) \quad (1)$$

subject to the intertemporal budget constraint:

$$A_t \le (1+r)A_{t-1} - p_t ATT_t - q_t Y_t.$$

where A_t denotes the value of assets and x_t is a vector of observable variables that can shift the fan's intertemporal utility function at time t; Y_t and q_t are a composite of consumption goods and services other than baseball games and the price of this composite, respectively; Ω_{t_o} is the information set available to the sports fan at time t_0; p_t is the ticket price at time t; and g is the IES parameter. Note that in this specification $ATT_t - a\,ATT_{t-1}$ can be interpreted as the consumption service flow from baseball at time t, the real interest rate r is constant over time, and we assume ß = 1/(1+r).

Under the above assumptions, Dynan (2000) shows that for large T, the first-order conditions for this problem reduce to:

$$E\left(\exp(\Delta x_{t+1}' q)\frac{(ATT_{t+1} - a\,ATT_t)^{-1/g} / p_{t+1}}{(ATT_t - a\,ATT_{t-1})^{-1/g} / p_t}\middle|\Omega_t\right) = 1, \quad (2)$$

which can be linearized to obtain a regression model:

$$\Delta \ln(ATT_{t+1}) = a\Delta\ln(ATT_t) - g\Delta\ln(p_{t+1}) + \Delta x_{t+1}' q + e_{t+1} \quad (3)$$

where e_{t+1} is a forecast error with mean zero. As noted in Ahn and Lee (2003), price elasticity is a function of both degree of habit formation (a) and IES (g): greater a and/or smaller g imply more inelastic demand for attendance.

The estimation of (3) is not trivial. Because our attendance data is comprised of the actual number of attendees in a given season, it does not distinguish between attendees at different classes of seats; in other words, there are likely to be important measurement errors. Dynan (2000) shows that this measurement errors problem induces MA(2) in the error terms, which implies that the lagged attendance growth rate $\Delta \ln(ATT_t)$ is endogenous. This will affect our estimation strategy, as discussed in Section 3.2, below.

3. Data and Empirical Results

3.1. Data

We employ two separate data sets (summarized in Table 1): one for Major League Baseball (MLB) and one for the Korean Professional Baseball League (KPBL). The MLB data consist of a panel covering the period from 1991 through 2000 and includes all teams except the Arizona Diamondbacks, Tampa Bay Devil Rays, Montreal Expos, and Toronto Blue Jays. This data set allows us to replicate the results of Ahn and Lee (2003), with the important difference being that we adjust for non-ticket fan expenditures. As noted above, a recent series of papers have appeared that attempt to explain inelastic attendance demand by recognizing the importance other revenue sources. Krautmann and Berri (2006) propose that lowering prices into the inelastic range allows the team to maximize profits by trading off gate revenues for additional concessionary revenue. By way of testing this hypothesis, we substitute a fan cost index (FCI) in place of ticket price.[2] As a proxy for fan income, we

[2] FCI is the estimated cost of MLB attendance based on a standardized bundle of tickets and concession goods at a given stadium in a given year. This bundle includes: four average-price tickets, four small soft drinks, two small beers, four hot dogs, two game programs, parking, and two adult-size caps. The FCI and attendance data were obtained from Rodney Fort's Sports Business Data Pages:

use average per capita personal income in the metropolitan statistical area in which the team is located. All price and income measures (p and INC) are adjusted for inflation. The win/loss records of MLB teams, *WPCT* (winning percentage) and *GB* (number of games back behind the leader of a division), were obtained from Baseballstat.net.

The KPBL data consist of a panel of all eight teams covering the period from 1982 through 2002. KPBL attendance has been analyzed empirically by Lee (2004, 2006), but only in the aggregate. The panel data analysis here is the first attempt of which we are aware to explain KPBL attendance empirically. Unlike the FCI available for Major League Baseball, we know of no comparable measure of fan cost in Korea, so we use average ticket price. Again, the income and price variables we use are adjusted for inflation.

In the regression equation (3), we allow for a vector of control regressors, x_t. In the MLB analysis, these include *WPCT*, *GB* and a "new stadium" variable, *NEWST*. A positive relationship between attendance and a new stadium has been unambiguously documented in the literature, and *NEWST* is designed to capture the effects of newly built or renovated stadiums on attendance. Capturing the aging effect we use a four-year reverse trend as employed by Ahn and Lee (2003) and Poitras and Hadley (2006); *NEWST* is equal to 4 in the first year of a new or renovated stadium, 3 in the second year, 2 in the third year, and 1 in the fourth year.

In the KPBL analysis, the control regressors include *WPCT*, a playoff dummy (*PO*), stadium size (*STDM*) and MLB effects (*PARK*). We use *PO* as a team performance variable in place of *GB* (used for MLB). Since the KPBL has only one league and one division, *GB* provides essentially the same information as *WPCT*. Moreover, *GB* in the KPBL does not represent playoff uncertainty as it does in MLB. In MLB stadiums, there is little variation in capacity (most are equipped with more than forty thousand seats), but significant variation in

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http://www.rodneyfort.com/SportsData/BizFrame.htm quality, so we use a new stadium variable to capture this quality effect. On the other hand, there are substantial variations in the capacities of KPBL stadiums; the largest stadium has more than thirty thousand seats while the smallest stadium has only 8,200. Therefore, we include *STDM* to capture stadium effects in the KPBL. In his analysis of KPBL attendance, Lee (2006) argues that "the MLB effect" is a major source of the dramatic attendance decline in the late 1990s. The MLB effect is a function of the performance of native Korean players who have moved on to MLB teams. Since 1993, a steady stream of amateur players with star potential, as well as superstars already playing in the KPBL, has left the KPBL to join either MLB teams or the Japanese Professional Baseball League. The success of Korean players in MLB, such as Chan Ho Park, drew the attention of many KPBL fans to MLB games, with the result that Korean broadcasters have begun to air MLB games nationally. Though initial attention was focused primarily on the performance of Korean-born MLB players, eventually these broadcasts seem to have drawn fans (who now paid greater attention to MLB games, even when they lacked Korean players) away from the KPBL. Lee (2006) used *PARK* (innings Park pitched in a season) to capture the MLB effects, since Korean national TV broadcast only those MLB games in which Park started until the end of the 2002 season, for the simple reason that he was a regularly scheduled starter and predictable programming element. Following Lee (2006), we also include *PARK* as a control variable.

3.2. Empirical Results

3.2.1. Major League Baseball

In our regressions, we treat the price growth rate ($\Delta \ln(p_{t+1})$) and the utility-shifting variables in x_{t+1} as weakly exogenous with respect to the forecasting error e_{t+1}: that is, $E[\Delta \ln(p_{t+1})e_{t+1}] = 0$ and $E(x_{t+1}'e_{t+1}) = 0$. In so doing, we are assuming that the MLB fans have full information about prices one period in the future. We estimate equation (3) with and without individual team dummy variables. We assume the fixed effects model since our sample covers most of the MLB teams and all of the KPBL teams. As discussed in section 2 above, OLS estimates are inconsistent if the attendance data include measurement errors. The Generalized Method of Moments (GMM; see Hansen, 1982) estimation results reported in Table 3 validate this concern. The two-step GMM controls for autocorrelations in the errors by the Newey-West method (1987), setting the bandwidth parameter at two. In order to control for time-specific fixed effects, we include time dummy variables in our MLB specifications (see Ahn and Lee, 2003 for more details).

Panel I in Table 2 reports the results from the regressions with both time effects and individual effects, while Panel II reports the results with time effects only. In the columns labeled "GMM (i)" and "GMM (ii)" we present the GMM estimates obtained from the regression without and with $\Delta\ln(INC_{t+1})$ as a regressor respectively. The lagged incomes in differenced log form and two-period log-level income ($\Delta\ln(INC_t)$ and $\ln(INC_{t-1})$) are legitimate instruments because they should not be correlated with future forecasting errors under the rational expectations assumption. Since income variables do not appear in the Euler condition (2) for the life-time utility maximization, equation (3) should not depend on income variables if it is a good approximation.

First, we test the null hypothesis of the equality of individual (team) effects. The c^2 test statistic is 26.34 and it is not rejected (p=0.39). Moreover, the GMM estimation and test results remain almost identical whether or not individual effects are included. Thus, we will henceforth focus on the results obtained from the regressions with time effects only.

The OLS results support the notion that MLB attendance is habit-forming, and the small and statistically insignificant estimate of the coefficient on price implies a small intertemporal substitution effect. But the OLS estimates are inconsistent if the attendance data contain measurement errors. The GMM estimation results are reported in the next column of Table 2, along with some hypothesis tests. The c^2 tests for exogeneity soundly reject the hypothesis that the lagged attendance growth rate is exogenous with respect to model error terms. The Hansen tests (overidentifying restrictions tests) do not reject the legitimacy of our instruments and model specification. These results support the use of GMM instead of OLS. We also test for the exogeneity of the income growth rate and the result does not support that the variable is potentially correlated with model error terms. These results provide indirect evidence that the linearized condition (3) is a good approximation of the Euler condition (2).

Compared to the OLS results, our GMM estimation results reveal strong evidence that MLB attendance is habit-forming. The GMM estimate of the coefficient on $\Delta \ln(ATT_t)$ is 0.631 and its standard error is 0.107 (Column GMM (ii) of Panel II). This estimated habit effect is much bigger than the OLS estimate of 0.115. The estimated coefficient on price is negative but statistically insignificant, consistent with a low IES for MLB attendance. The GMM estimates of team performance and stadium quality effects are generally similar to those from OLS. GMM generates statistically significant estimates of the win percent effect as well as the new or renovated stadium effect.

It is well known that (linear) GMM and instrumental variables estimators could be substantially biased if the endogenous regressors and their instruments are only weakly correlated (See Staiger and Stock, 1997). Table 3 shows the regression results of the lagged attendance growth rate ($\Delta \ln(ATT_t)$) on the instruments and the other regressors in equation (3) to check the quality of our instruments. Lagged attendance growth rate is highly correlated with the instruments and other regressors, indicating that our GMM analyses are unlikely to suffer from weak instruments.

Our estimation results for Major League Baseball can be summarized as follows: First, we find strong evidence (in the form of positive and statistically significant coefficients on $\Delta \ln(ATT_t)$, which represent our estimates of a in equation (3)) for the "addictive" nature of MLB attendance. Second, the estimated intertemporal elasticity of substitution (i.e., the coefficients on $\Delta \ln(p_{t+1})$) is small and (mostly) statistically insignificant. These two results are precisely the conditions identified by Ahn and Lee (2003) as conducive to the pricing of tickets in the inelastic range of demand. These results also validate and extend the findings of Ahn and Lee (2003). That is, we obtain the empirical results of strong habit formation and small IES for MLB attendance demand even when we substitute a measure of total attendance costs (FCI) for ticket price. This is strong evidence that the trading off of gate revenues for additional concessionary revenue cannot by itself explain the observed inelastic pricing behavior of MLB teams. Third, winning percentage is an important factor that influences fans' attendance decisions, but we do not find strong games-back (*GB*) effects. Last, new stadiums are found to have positive effects on attendance.

3.2.2. Korean Professional Baseball League

Table 4 reports estimation results for the KPBL data. Panel I reports the results from the regressions with individual effects, while Panel II reports the results without team effects. We cannot include time dummies in the KPBL estimation, given our inclusion of the team-invariant variable *PARK*, which represents the MLB effect on the KPBL attendance. However, unlike the MLB experience during this time period (which included several work-stoppages), KPBL did not have any particular temporally specific events. As we found in the MLB case, the null hypothesis of the equality of individual (team) effects in the KPBL is not rejected, so we will focus on the results obtained from the regressions without team fixed effects. The price coefficient is statistically significant at 1% and its absolute value is greater than one. Again, the OLS estimates are inconsistent if the attendance data contain measurement errors.

According to the GMM estimation results in Table 4, the c^2 tests strongly reject the hypothesis that the lagged attendance growth rate is exogenous with respect to model error terms. The Hansen tests do not reject the legitimacy of our instruments and model specification. Moreover, our test of the exogeneity of the income growth rate is not rejected (p=0.383).

Table 5 provides validation for our choice of instruments: the lagged attendance growth rate is highly correlated with the instruments and other regressors, and the coefficient on lagged income is not statistically significant. These results indicate that our GMM estimates are unlikely to suffer from bias due to weak instruments.

Contrary to our MLB findings, GMM estimation (and in particular, the small and statistically insignificant coefficient on $\Delta \ln(ATT_t)$) does not support the hypothesis that KPBL attendance is habit-forming: the GMM estimate of the coefficient is only 0.064 and it is insignificant even at 10% confidence (Column GMM (ii) of Panel II). The estimated coefficient on price is negative, has magnitude greater than unity, and is statistically significant even at 1% confidence. This also stands in contradiction to our MLB findings, and implies that the IES for KPBL games is located in elastic region.[3] The stadium size turns out to have a substantial effect on attendance. This result is not surprising, given the large variation in stadium capacity in our sample: Table 6 shows the four cases in which KPBL teams moved or constructed their stadiums. All four moves to larger stadiums drew more attendance than before movement even when (in two of the four cases) their team win/loss record worsened. Our finding of statistically significant (negative) effects of MLB airtime on KPBL attendance is also consistent with Lee (2006), who finds that the dispersion of MLB games has negative effects on KPBL attendance.

In comparing our MLB results (Table 2) with those for KPBL (Table 4), the differences are striking: we find that MLB attendance is strongly habit-forming, whereas KPBL attendance is not; and that while MLB fan behavior exhibits a small intertemporal elasticity

[3] Unfortunately, our empirical model does not generate estimates of the static price elasticity. We know of only one estimate of demand elasticity for the KPBL: Lee (2006) reports a negative but statistically insignificant coefficient in the inelastic region of demand.

of substitution, IES for the KPBL is large. These differences appear to reflect differing pricing strategies on the part of profit-maximizing team owners, which are presumably driven by fundamental differences in fan behavior.[4] In the next section we offer a review of the literature on the psychology, anthropology, and endocrinology of the sports fan; and sketch a formal model of fan behavior consistent with these literatures before discussing differences in the cultural environments or other factors that might explain our divergent findings for the U.S. and Korea.

4. Natural Addiction to…Baseball?

4.1. Endogenizing Addiction

Theories of rational addiction define a good as habit-forming if it exhibits *adjacent complementarity*—that is to say, if the marginal utility of consumption increases with experience. Although a number of authors have subsequently criticized the original theory of Becker and Murphy (1988) for lacking psychological realism[5], the origins of or reasons for intertemporal complementarities have received little attention. This is unfortunate, because a deeper understanding of the reasons for such complementarities is prerequisite to any attempt to make *ex ante* predictions about which goods or services in the economy are likely to be habit forming. Our approach, therefore, will be to take a step back and look more broadly at what the scientific literature has to say about the human phenomenon of spectator sports. In this enterprise we draw inspiration from the work of Smith and Tasnadi (2003),

[4] To be sure, there are other possible explanations for these differences—the Korean league is characterized by corporate ownership, for instance, and the corporate name is strongly associated with that of the team (e.g., the "Samsung Lions"; the "Hyundai Unicorns"); there is also the possibility of systematic differences in measurement error across countries. But it is not clear that such differences would generate the important differences in the dynamic structure of prices suggested by our results.

[5] See, for example, Bernheim and Rangel (2002), Gruber and Köszegi (2001), Gul and Pesendorfer (2001), Laibson (2001), O'Donoghue and Rabin, (2002), Orphanides and Zervos (1995), and Orphanides and Zervos (1998).

who study the problem of habit formation in dietary preferences. In addition to showing that the process of Bayesian learning can generate adjacent complementarity in an optimal foraging framework, the authors provide a review and synthesis of the biomedical literature as it relates to the neuroscience of dietary habits and drugs of addiction. As it turns out, these two subjects are intimately related: considerable evidence points to a role for the class of neurotransmitters known as the *endogenous opioids* in the learning of dietary preferences, and the endogenous opioids work in part by acting on dopaminergic neurons in the limbic region of the brain. These dopaminergic neurons have been identified, in turn, as both the physical locus of associative learning and a target of virtually every known drug of addiction (Yeomans and Gray 2002, Di Chiara 1999).

The take-home lessons from Smith and Tasnádi (2003), which will be taken to heart in the present study, are that i) habit formation has something to do with learning, or the evolutionary vestiges of learning, and ii) one method of verifying naturalistic explanations for habit formation (and thus pointing the way to a theory of endogenous habit formation) is to identify the natural function of the neuroendocrine systems underlying the behavior in question. In particular, once the natural function (e.g., the inference of nutritional properties of foods from environmental cues) of a neuroendocrine system (e.g., the endogenous opioids) has been identified, it can be interpreted as a physiological indicator of an internal information state, where information is taken to be subjective.[6]

[6] Subjectivity here is used in the sense of Savage (1954). That is, the information state or "beliefs" of the consumer in an uncertain world can be inferred from his behavior, even if the consumer professes an inability to explicitly characterize properties of the probability distributions involved. Because the simultaneous identification of utilities and subjective probabilities can be impracticable, and because subjective probabilities may diverge from objective measures of probability (particularly when the behavior in question is a vestige of human evolutionary history), it can be informative to resort to physiological or biochemical measures of information states. See Smith and Tasnádi (2003).

4.2. Whence the Sports Fan?

The first step in proposing a naturalistic theory of the sports fan is to identify the likely analogue of modern sports competition in human evolutionary history. From the perspective of the anthropologist, team sports are a modern example of intergroup aggression in which athletic prowess plays a prominent role in success. Idyllic neolithic fantasies notwithstanding, intergroup aggression (war) was in fact quite common in pre-industrial societies, as evidenced by both a growing body of archaeological data and an increasing number of empirical studies of extant hunter-gatherer groups (Ember 1978, Keely 1996). Intergroup aggression is thought to have resulted in the evolution of the "in-group" psychology—our tendency to classify our conspecifics as "friend" or "foe"—that generates, for example, a propensity toward racism in modern humans (Campbell 1965, Sidanius and Pratto 1999). In-group psychology need not be based on race, however: Kurzban *et al.* (2001), for instance, showed that when laboratory subjects were exposed to a conflict between two fictional basketball teams, race-based errors in identity recall declined dramatically when players were shown wearing team colors. Dedication to one's group in evolutionary history is thought to have been adaptive because it facilitated mutual aid, via both reciprocal exchange of foodstuffs (and other assets) among group members and an implied promise of defense against predation or aggression by out-groups (Wrangham 1986, Harcourt and De Waal 1992).

Theorizing about the evolutionary origins of modern human behavior always carries with it the danger of generating "just so" stories, making it incumbent on the purveyor of such theories to cast a wide net when identifying supporting (or contradictory) evidence. One body of such evidence that is becoming increasingly available to the behavioral scientist is derived from studies of *endocrinology.*[7] Endocrine hormones are easily measured in saliva

[7] Endocrinology is the study of the body's molecular signals (e.g., hormones, neurotransmitters) and their influence on health, physiology, and behavior.

or blood plasma and typically induce a number of (often disparate) effects on physiology and behavior that suggest their function in evolutionary history. The most-studied endocrine signal in the realm of human competition is testosterone. It has been shown, for example, that testosterone levels go up in winners and down in losers, in competitive situations ranging from wrestling to soccer to crew to tennis to chess (Bernstein *et al.* 1974, Booth *et al.* 1989, Mazur *et al.* 1992, Neave and Wolfson 2003, Kivlighan *et al.* 2005).[8]

Before delving into the question of what testosterone tells us about competitive behavior, it is worth asking what it has to do with sports *fans*. As it turns out, sports fans respond to wins and losses much the same as the athletes themselves: avid fans watching a basketball game, for instance, exhibit higher self-esteem (as measured by subsequent self-evaluation of performance on an unrelated task) after a win than after a loss (Hirt *et al.* 1992), and the testosterone levels of basketball and soccer fans have been shown to increase after a win and decrease after a loss (Bernhardt *et al.* 1998). Indeed, even *imagined* success at competitive tasks can have a demonstrable effect on testosterone levels (Schultheiss *et al.* 1999). It might seem illogical for a spectator watching a competition—the outcome of which he cannot control, involving players he is unlikely ever to meet—to react with very real physiological adaptation and personal attribution. But this sort of irrationality is in fact a hallmark of evolved behaviors: because humans evolved in a world without television and anonymous or one-time interactions, we behave *as if* the characters in soap operas (who, it is worth noting, are not shy about revealing intimate personal details) were intimate friends, just as we behave *as if* the pitcher in the World Series can hear us when we shout at his image on the screen (O'Guinn and Shrum 1997, Eastman and Riggs 1994).

[8] In spite of the popular conception of testosterone as an exclusively male "sex hormone," testosterone levels in women (though much lower, on average, than those observed in men) are also affected by athletic competition (Edwards and Wetzel 2002, Edwards and Waters 2003,). Unfortunately, there are far fewer studies of testosterone in women, and most focus on gender-specific *differences* in testosterone response. For details see Cashdan (1995), Bateup *et al.* (2002), Wyner and Edwards (2002), and Kivlighan *et al.* (2005).

A common misconception holds that high-testosterone males are aggressive. A more nuanced view is that those with high testosterone are less apt to back down from a challenge. In some populations (e.g., prison inmates) where challenges are common, positive correlations between aggression and testosterone have been observed (Dabbs *et al.* 1995), but high-testosterone men in general are no more likely than other men to wind up in prison, and can be found in professions ranging from actor to trial lawyer to politician (Dabbs 1992). And more importantly, the response of testosterone levels to competition appears to be a function of *perceived causation*: increases in testosterone after a win, for instance, are greater when the victor views his performance positively and attributes the outcome to personal effort (Booth *et al.* 1989, Serrano *et al.* 2000, Gonzalez-Bono *et al.* 2000). This evidence, taken together, seems to suggest that testosterone is in some sense an (unconscious) internal barometer of one's likelihood of success in future conflicts. This hypothesis is supported by the fact that testosterone appears to simultaneously *prepare* us for such conflicts, not just by stimulating the growth of skeletal muscles but also by increasing our self-confidence and ability to focus on the task at hand (Knickmeyer *et al.* 2005).

So we have the beginnings of a naturalistic theory of the sports fan: humans have a universal tendency to form and join coalitions or groups; this tendency is a product of our natural history of intergroup conflict; and fans appear (if subconsciously) to react to competitive outcomes much as athletes do, as evidenced by the many parallels in psychological and neuroendocrine (testosterone) measures. It remains to be established that the state of being a sports fan is (or might be expected to be) habit forming, in the sense that the marginal utility of fandom increases over time. This is the subject of the next section.

4.3. Fandom as a Signaling Game

There are many reasons to expect spectator sports to be habit-forming: the longer one follows a team, the more he/she learns about the strategy of the game, the particular talents and personalities of the players, and the culture and nature of other sports fans. In the naturalistic counterpart of spectator sports, these accumulated bits of information would all have served an adaptive purpose, enabling the "fan" to better predict competitive outcomes and make judgments about when (and how) to offer assistance to fellow group members. But perhaps more importantly, participation as a fan would serve the purpose of cementing one's reputation as a loyal member of the group, worthy of trust and mutual aid. To see how concerns about reputation might lead to habit formation, consider the following decision problem:

An individual (i.e., a fan) is periodically presented with opportunities to participate in ("attend") a group activity. Other members of the group have incomplete information about the true degree of the fan's allegiance: a steadfast fan ("member") will attend any given event with probability p_M, while a lesser fan ("non-member") will attend with probability p_N, where $p_N < p_M$. In period *t*, the probability of the fan being a member (given prior beliefs p_{t-1} and current attendance att_t) is denoted p_t. The fan receives periodic income *m*, which can be spent on attendance at price *p* or on a composite numeraire good c_t. Fan utility in period *t* is a linear function[9] of p_t and c_t, yielding the optimization problem

$$\max_{att_t, c_t} p_t(att_t) + c_t$$

subject to

$$m \geq att_t p + c_t$$

$$\text{where} \quad att_t = \begin{cases} 0 \text{ if fan does not attend} \\ 1 \text{ if fan attends} \end{cases}$$

and the resulting (myopic) decision rule is "attend if and only if $p \leq f(p_{t-1})$," where $f(p_{t-1}) = p_t(1) - p_t(0) = \dfrac{(1-p_{t-1})(p_M - p_N)}{(p_{t-1}(p_M - p_N) + p_N) - (p_{t-1}(p_M - p_N) + p_N)^2}$ is the marginal

[9] Linear utility is employed here in order to better focus attention on the nonlinearities introduced by Bayesian learning about reputation. There is no *a priori* reason to expect linearity, but to our knowledge the anthropological evidence on the mapping of reputation and group membership into Darwinian fitness is not yet sufficient to suggest an alternative functional form.

increase (i.e., the increase attributable to period t attendance) in the fan's posterior probability of being a member. This decision rule is myopic in the sense that it excludes long-term dynamic considerations, but it underscores the importance of the function $f(p_{t-1})$, which is concave and (for low values of p_{t-1}) increasing in p_{t-1}. In other words, concerns about reputation generate marginal utilities that are increasing in attendance for new fans. This is, of course, the central behavioral postulate in the theory of rational addiction.

For our purposes, the value in considering the natural origins of fan behavior stems from the rich descriptive theory that results. Modeling fan behavior as a signaling problem is consistent not only with the evidence from anthropology and behavioral endocrinology reviewed above, but it also fits well with many of the idiosyncratic aspects of fan behavior, such as the tendency of fans to congregate in social settings (i.e., stadiums, bars, or living rooms) when viewing games, and to make their allegiances known via both verbal proclamation and the prominent display of team apparel. The importance of habit formation among fans is implicitly acknowledged by team owners not only in their pricing strategies (as suggested by the evidence presented in Section 3 above) but also in such widely used promotional strategies as product giveaways and group or organizational discounts. And if habit formation among fans is in part a function of reputational considerations, and we can identify the determinants of reputation (or their psychological analogues in the modern world), we can make predictions about the circumstances most conducive to habit formation. The next section considers some of the differences between the baseball cultures of the U.S. and Korea, how they might explain the divergent findings reported in Section 3 above, and how they may point the way to an endogenous theory of baseball addiction.

4.4. Baseball Culture in the U.S. and Korea

As noted above, there are many differences between Major League Baseball and its counterpart in Korea: size, ownership structure, and interaction between the leagues, to name a few. It is possible that these differences—or perhaps differences in the nature of the data employed in our empirical analysis of Section 3—can account for the very different results we obtain. But there are also important cultural and structural differences between the two leagues that—consistent with the evidence reviewed in Section 4—appear to act in concert to generate important differences in the fan environment that make habit formation less likely in the KPBL market. These differences fall into three categories: i) fan exposure to home-team commentary, ii) opportunities for conspicuous devotion, and iii) prevalence of alternative out-group categorization(s).

While most Major League Baseball teams in the U.S. enjoy a preponderance of local coverage, including radio and television broadcasts hosted by home-team commentators, this is decidedly not the case in the Korean professional league. Due in part to the limited geographical area of Korea, all television broadcasts reach the entire nation. This means that a baseball fan in Korea has more exposure to opposing teams, and generally does not watch games in the presence of biased commentary. Both these features of the fan environment are less conducive to the triggering of the in-group psychology discussed in Section 4.2 above (Sidanius and Pratto 1999). Even in the one outlet—local newspapers—where home-biased coverage might be expected, coverage is much less frequent than in the U.S. (see Tables 7 and 8), where the local sports page typically features extensive coverage of the home team on a daily basis.

There are also cultural differences between the two countries we study that influence the extent to which fans engage in conspicuous declarations of team loyalty. In particular, we have noticed that in our experience, it is very common for fans of Major League Baseball to wear caps or other apparel displaying team colors and logos (even when not engaged in sports-related activity) and to gather in bars or other social settings when watching games. This stands in stark contrast to the behavior of Korean fans, who rarely engage in such overt displays of devotion, and do not typically gather in bars to drink beer while watching games on television.[10] In other words, there is much less opportunity for the Korean fan to engage in the signaling behavior that the model presented in Section 4.3 above suggests might be a key to the fan-team bonding underlying habit formation among baseball spectators.

Last but not least, there is the important interaction between the KPBL and MLB in the Korean market. As noted above, Korean fans are often drawn to coverage of Major League Baseball when well-known Korean players are involved. A recent survey by Gallup Korea (2002), for example, found that while 36.1% of Korean fans reported watching KPBL games for at least one hour in the preceding month, fully 30.4% reported watching at least one hour of MLB games featuring Korean players. This is significant because—as demonstrated, for instance, by Kurzban *et al.* (2001)—it provides an alternative definition of the in-group with which fans identify. In other words, the Korean fan exposed to MLB is more likely to self-identify as a fan of successful Korean MLB players, which in turn could diminish self-identification with local Korean teams.

5. Conclusion

That habitual consumption is deeply engrained in human nature is beyond dispute. The science of the empirical identification and measurement of such habituation, however, remains the subject of considerable debate. In this essay, we offer a modest contribution to this literature, by documenting the dramatic differences in dynamic pricing strategies between two professional baseball leagues, and by proposing the beginnings of an explanation for these differences.

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[10] There are instances in which large crowds of Korean fans gather in the streets to watch a game on a big screen, but only for special events such as national team competition in FIFA World Cup or World Baseball Classic games.

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TABLE 1

Descriptive Statistics for Sample Data

Major League Baseball

Variable	Mean	Standard Deviation	Maximum	Minimum
ATT: attendance (millions)	2.196	0.731	4.483	0.906
p: real Fan Cost Index	72.208	17.133	134.867	44.898
INC: real income ($ thousands)	19.498	4.036	42.250	12.845
WPCT: winning percentage	0.501	0.067	0.704	0.327
GB: games back	13.643	11.166	52.000	0.000

Korean Professional Baseball League

Variable	Mean	Standard Deviation	Maximum	Minimum
ATT: attendance (millions)	0.407	0.244	1.265	0.050
p: real ticket price	63.391	7.271	91.376	48.940
INC: real income (million Won)	6.069	2.022	12.535	2.195
WPCT: winning percentage	0.500	0.096	0.706	0.188
STDM: stadium size (ten thousands)	1.862	0.838	3.048	0.820

TABLE 2

Major League Baseball: OLS and Two-Step GMM Estimation

For the table below, all of the regressors except $\Delta \ln(ATT_t)$ are assumed to be weakly exogenous. Both differenced and level instruments are used. Standard errors are computed adjusting for autocorrelation and heteroskedasticity.

	Panel I			Panel II		
	Time and Team Effects			Time Effects Only		
Variables	OLS	GMM (i)	GMM(ii)	OLS	GMM (i)	GMM (ii)
$\Delta \ln(ATT_t)$	0.018	0.606^{*}	0.627^{*}	0.115^{***}	0.631^{*}	0.614^{*}
	(0.069)	(0.111)	(0.118)	(0.068)	(0.107)	(0.111)
$\Delta \ln(p_{t+1})$	-0.004	-0.363^{**}	-0.361^{**}	0.080	-0.261	-0.242
	(0.133)	(0.017)	(0.175)	(0.129)	(0.170)	(0.164)
$\Delta WPCT_{t+1}$	0.976^{**}	1.282^{*}	1.327^{*}	1.009^{*}	1.286^{*}	1.275^{*}
	(0.296)	(0.276)	(0.280)	(0.303)	(0.287)	(0.287)
ΔGB_{t+1}	0.000	-0.000	0.000	-0.000	-0.000	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\Delta NEWST_{t+1}$	0.038^{*}	0.035^{**}	0.036^{**}	0.040^{**}	0.034^{**}	0.030^{***}
	(0.016)	(0.017)	(0.017)	(0.016)	(0.016)	(0.016)
$\Delta \ln(INC_{t+1})$			-0.615			0.973
			(1.329)			(0.687)
Constant				0.128^{*}	0.165^{*}	0.141^{*}
				(0.037)	(0.037)	(0.040)
R^2	0.648	0.514	0.519	0.599	0.475	0.487
Hansen Test$^{\$}$		6.790	6.833		5.378	4.254
		[0.659]	[0.555]		[0.800]	[0.833]
Exogeneity of		15.817			15.405	
$\Delta \ln(ATT_t)^{\$}$		[0.000]			[0.000]	
Exogeneity of		1.599			1.555	
$\Delta \ln(INC_{t+1})^{\$}$		[0.206]			[0.212]	
Equality of		26.335				
team effects$^{\$}$		[0.390]				

* Significant at 1% level.

** Significant at 5% level.

*** Significant at 10% level.

$^{\$}$ c^{2} test.

The numbers in (.) are standard errors.

The numbers in [.] are p-values.

TABLE 3

Major League Baseball:

Testing the Quality of the Instruments

For the table below, the endogenous regressor $\Delta \ln(ATT_t)$ is regressed on other exogenous regressors and instrumental variables. All of the regressors except $\Delta \ln(ATT_t)$ are assumed to be exogenous. Both differenced and level instruments are used. Standard errors are computed adjusting for autocorrelation and heteroskedasticity.

	Panel I		Panel II	
Variables	Time and Team Effects		Time Effects Only	
$\Delta \ln(p_{t+1})$	0.275***	(0.160)	0.471*	(0.149)
Δ $WPCT_{t+1}$	0.079	(0.283)	- 0.079	(0.264)
Δ GB_{t+1}	- 0.001	(0.002)	- 0.002	(0.002)
Δ $NEWST_{t+1}$	- 0.006	(0.016)	- 0.006	(0.018)
$\Delta \ln(p_t)$	- 0.279**	(0.142)	0.040	(0.134)
Δ $WPCT_t$	1.518*	(0.374)	1.164*	(0.353)
Δ GB_t	- 0.001	(0.002)	- 0.002	(0.002)
Δ $NEWST_t$	0.032***	(0.019)	0.032	(0.020)
$\Delta \ln(INC_t)$	0.065	(0.493)	0.068	(0.459)
$\ln(p_{t-1})$	- 0.511*	(0.144)	- 0.168***	(0.089)
$WPCT_{t-1}$	1.035**	(0.458)	0.438	(0.326)
GB_{t-1}	- 0.001	(0.003)	- 0.002	(0.002)
$NEWST_{t-1}$	- 0.010	(0.013)	- 0.010	(0.014)
$\ln(INC_{t-1})$	- 0.094	(0.377)	0.011	(0.078)
Constant			0.308	(0.726)
R^2	0.723		0.683	
F-test for overall significance	702.48	[0.000]	725.19	[0.000]

* Significant at 1% level.
** Significant at 5% level.
*** Significant at 10% level.
The numbers in (.) are standard errors.
The numbers in [.] are p-values.

TABLE 4
Korean Professional Baseball League: OLS and Two-Step GMM Estimation

For the table below, all of the regressors except $\Delta \ln(ATT_t)$ are assumed to be weakly exogenous. Both differenced and level instruments are used. Standard errors are computed adjusting for autocorrelation and heteroskedasticity.

	Panel I			Panel II		
Variables	With Team Effects			Without Team Effects		
	OLS	GMM (i)	GMM(ii)	OLS	GMM (i)	GMM (ii)
$\Delta \ln(ATT_t)$	- 0.238**	0.070	0.092	- 0.231**	0.064	0.067
	(0.096)	(0.099)	(0.101)	(0.097)	(0.097)	(0.098)
$\Delta \ln(p_{t+1})$	-1.151*	- 0.951**	- 1.192*	- 1.130*	- 1.127*	- 1.216*
	(0.410)	(0.331)	(0.355)	(0.385)	(0.340)	(0.352)
$\Delta WPCT_{t+1}$	1.704*	1.812*	1.893*	1.731*	1.824*	1.822*
	(0.410)	(0.347)	(0.347)	(0.420)	(0.326)	(0.328)
ΔPO_{t+1}	0.012	0.001	- 0.002	0.009	0.004	0.002
	(0.052)	(0.057)	(0.058)	(0.053)	(0.054)	(0.055)
$\Delta STDM_{t+1}$	0.414**	0.367*	0.401*	0.449***	0.315**	0.346**
	(0.211)	(0.118)	(0.112)	(0.252)	(0.138)	(0.141)
$\Delta PARK_{t+1}$	- 0.011*	- 0.008*	- 0.009*	- 0.010*	- 0.008*	- 0.009*
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
$\Delta \ln(INC_{t+1})$			-1.071***			- 0.543
			(0.568)			(0.620)
Constant				0.054	0.048***	0. 083***
				(0.033)	(0.025)	(0.048)
R^2	0.383	0.268	0.279	0.364	0.271	0.277
Hansen Test$		14.443	12.454		11.857	11.583
		[0.209]	[0.256]		[0.374]	[0.314]
Exogeneity of		3.290			6.922	
$\Delta \ln(ATT_t)$$		[0.070]			[0.009]	
Exogeneity of		0.380			0.760	
$\Delta \ln(INC_{t+1})$$		[0.538]			[0.383]	
Equality of		10.375				
team effects$		[0.168]				

* Significant at 1% level.
** Significant at 5% level.
*** Significant at 10% level.
$ c^2 test.
The numbers in (.) are standard errors.
The numbers in [.] are p-values.

TABLE 5
Korean Professional Baseball League:
Testing the Quality of the Instruments

For the table below, the endogenous regressor $\Delta \ln(ATT_t)$ is regressed on other exogenous regressors and instrumental variables. All of the regressors except $\Delta \ln(ATT_t)$ are assumed to be exogenous. Both differenced and level instruments are used. Standard errors are computed adjusting for autocorrelation and heteroskedasticity.

	Panel I		Panel II	
Variables	With Team Effects		Without Team Effects	
$\Delta \ln(p_{t+1})$	0.821	(0.510)	0.869***	(0.455)
$\Delta WPCT_{t+1}$	0.618	(0.395)	0.622	(0.406)
ΔPO_{t+1}	0.007	(0.071)	0.025	(0.069)
$\Delta STDM_{t+1}$	0.434	(0.329)	0.408	(0.307)
$\Delta PARK_{t+1}$	0.001	(0.011)	0.001	(0.009)
$\Delta \ln(p_t)$	- 1.539*	(0.442)	- 1.453*	(0.360)
$\Delta WPCT_t$	1.664**	(0.649)	1.664**	(0.686)
ΔPO_t	0.078	(0.116)	0.111	(0.118)
$\Delta STDM_t$	0.179	(0.254)	0.133	(0.207)
$\Delta PARK_t$	- 0.028*	(0.006)	- 0.029*	(0.006)
$\Delta \ln(INC_t)$	- 0.148	(0.734)	- 0.200	(0.740)
$\ln(p_{t-1})$	- 0.440**	(0.475)	- 0.277**	(0.319)
$WPCT_{t-1}$	- 0.015	(0.693)	0.026	(0.696)
PO_{t-1}	- 0.022	(0.128)	0.021	(0.136)
$STDM_{t-1}$	0.145	(0.183)	0.086	(0.059)
$PARK_{t-1}$	- 0.007	(0.004)	- 0.007**	(0.003)
$\ln(INC_{t-1})$	0.084	(0.156)	0.093	(0.104)
Constant			1.020	(1.315)
R^2	0.415		0.406	
F-test for overall significance	133.42	[0.000]	116.06	[0.000]

* Significant at 1% level.
** Significant at 5% level.
*** Significant at 10% level.
The numbers in (.) are standard errors.
The numbers in [.] are p-values.

TABLE 6

Stadium Movement and Attendance Change in the Korean Professional Baseball League

Team	Season	Stadium	Capacity	Win Percent	Attendance
Doosan Bears	1984	Dongdaemoon	22,706	0.59	137,785
	1985	Jamsil	30,265	0.47	252,731
Lotte Giants	1984	Gooduck	10,000	0.54	377,971
	1985	Sajik	30,154	0.49	523,082
LG Twins	1989	Dongdaemoon	22,706	0.42	427,678
	1990	Jamsil	30,265	0.59	768,329
SK Wyberns	2001	Incheon	11,465	0.46	178,645
	2002	Moonhak	30,480	0.47	402,732

TABLE 7

Local Korean Newspaper Coverage:
Frequency of Top Story in Local Sports Section, April 2005

Team	Host City	Local Baseball	Local Football	MLB & JPBL	Others
Hyundai Unicorns	Suwon	1	9	0	14
SK Wyverns	Incheon	7	4	0	15
Hanwha Eagles	Daejun	8	4	2	11
Kia Tigers	Kwangju	7	1	1	14
Samsung Lions	Daegu	18	5	1	1
Lotte Giants	Pusan	3	0	3	17

MLB covers Korean major leaguers news

JPBL covers Korean JPBL(Japanese Professional Baseball League) player news.

TABLE 8

Seoul Newspaper Coverage:
Frequency of Top Story in Sports Dailies, April 2005

Teams in Seoul	Sports Newspaper	Baseball	Football	MLB & JPBL	Others
LG Twins Doosan Bears	Sports Seoul	9(5)	4	7	6
	Sports Today	14(7)	2	5	5
	Sports Daily	17 (7)	2	5	2

Numbers in (.) are frequency of local (Seoul) baseball teams.

MLB covers Korean major leaguers news

JPBL covers Korean JPBL(Japanese Professional Baseball League) player news