Journal of Sports Economics

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Journal of Sports Economics 2008; 9; 425 originally published online Mar 28, 2008;
DOI: 10.1177/1527002508316266

The online version of this article can be found at:
http://jse.sagepub.com/cgi/content/abstract/9/4/425

Published by:

http://www.sagepublications.com

On behalf of:

The North American Association of Sports Economists

Research Notes

Journal of Sports Economics
Volume 9 Number 4
August 2008 425-434

10.1177/1527002508316266
http://jse.sagepub.com
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http://online.sagepub.com

Fan Substitution and the 2004-05 NHL Lockout

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This study estimates fan substitution in sports using the 2004-05 National Hockey League (NHL) season-long lockout as a natural experiment. The authors find that NHL fans substitute minor league and junior league hockey for the NHL. Because this is not due to a change in the price of a substitute good, the findings point to pure substitution effects without income effects. The findings have implications for future work on fan demand, especially for those studying habit and loyalty, or sports policy.

Keywords: *sports attendance demand; pure substitution effects; lockouts; hockey*

In this study, we investigate the behavior of National Hockey League (NHL) fans during the 2004-05 season-long lockout. This leads to insights concerning the demand for sports as we estimate the impact of the lockout on the attendance demand functions of minor and junior hockey league teams. We find that minor and junior league hockey teams had an increase in demand during the 2004-05 season. Because this observed switching did not happen because of a change in the price of a substitute good, these are pure substitution effects without income effects.

A further interesting result is that this substitution took decidedly different forms in each of the two types of leagues. Attendance at minor league teams increased during the lockout with no statistically significant difference attributable to the presence of an NHL team in the same standard metropolitan statistical area (SMSA). However, for junior league teams, there was an increase in attendance only in cities where there was an NHL team in the same SMSA. Only 25% of minor league teams with an NHL franchise in the same SMSA in 2004-05 were in Canada, whereas 80% for junior league teams with an NHL franchise in the same SMSA were in Canada. Because our data do not allow us to determine the marginal contribution of fan nationality, we are only able to say the following: If both U.S. and Canadian NHL fans are otherwise alike, the minor league alternative is a closer substitute than the junior league alternative for fans without an NHL team in their SMSA. Because it seems that fans without an NHL team in their SMSA would be mainly NHL television fans, this also suggests that having live alternatives really only matters if it is a minor league team rather than a junior league team.

Our work has implications for those studying sports fan demand, how substitution effects are best captured, the role of loyalty and habit in sports demand, and

policy as it relates to sports. Although there are many papers on the demand for sports attendance, few have specifically focused on the demand for the NHL and much of that focused on the impact of improved facilities (see the reviews in Fort, 2006a, 2006b). We also find no work on the substitute relationship between major and minor league teams either in hockey or other major league sports.

Past work also has not captured substitution effects very well (again, see all of the references in Fort, 2006a, 2006b). Some have used population to indicate larger access to alternatives, suggesting a negative sign in an attendance regression. But population itself is a demand determinant that is expected to increase demand at all prices; the sign should be positive. Others have actually included the presence of other pro teams, but not any alteration in their number and the accompanying impacts. Only Winfree, McCluskey, Mittelhammer, and Fort (2004) showed that there is a significant substitution between teams during expansion and team movement (in the Major League Baseball context). Here, we look directly at substitution behavior unclouded by untangling income and substitution effects of a price change.

This work also has implications for the role of loyalty (Depken, 2000, 2001) and habit (Owen & Weatherston, 2004) in sports demand. The asymmetric substitution depending on the presence of an NHL team in the same SMSA suggests that if the NHL product is habit forming, the habit is not generated in the same way for all NHL fans. Those studying habit and loyalty need to account for substitution possibilities. Fans may seem loyal when there are limited substitutes but may not actually behave that way when the consumption alternatives are changed.

Finally, our results also have policy implications. First, location choices by the NHL will have impacts on the attendance of other pro hockey teams in the same vicinity. Because these NHL location choices are made under conditions of market power, this suggests a basis for antitrust scrutiny of these location choices. Second, team moves and league location choices by the NHL also impact attendance at publicly financed facilities housing minor and junior league hockey teams. This should enter into the benefit and cost calculations made by public overseers when public subsidies are considered to draw NHL teams to a new location, or to keep them.

The paper proceeds as follows. We first discuss the general approach to sports demand estimation, present the explicit specification used to assess both minor and junior league attendance, and discuss the data. Next, we present the empirical results; NHL fans clearly substituted minor and junior hockey in significant but different ways. Implications and conclusions round out the paper.

The General Setting for Analysis

We adopt the basic model of attendance demand described by Rottenberg (1956; detailed in Fort, 2005):

$$\text{Attendance} = \text{A (Price, Income, Population, Preferences, Substitutes).} \quad (1)$$

The independent variables are attendance price including travel cost, income, population, preferences, and closeness and availability of substitutes. Because attendance quantities demanded depend on price (including travel cost), the rest of the variables are demand shifters, including the object of our analysis, substitutes. Preferences for outcome uncertainty and team quality are testable hypotheses for sports demand.

The special situation characterizing our estimation of minor and junior hockey attendance is the 2004-05 NHL lockout. This lockout is the first work stoppage in history where the entire season of a major professional sports league was lost. The regular season of the NHL begins in October and ends in April. The next best hockey alternatives are the minor and junior leagues. Many NHL players played in these leagues during the labor lockout. Although many players moved to European hockey during the lockout, minor league players complained about the increase in domestic labor supply during the NHL lockout. So, perhaps some fans moved to minor leagues because the level of talent increased.

Minor league hockey consists of NHL affiliates, whereas junior league hockey is amateur hockey with players that are 21 or younger. Both types of hockey have teams in the United States and Canada, and attendance can rival that of some NHL teams. However, minor league hockey is almost the exclusive domain of the United States (about 95% of all minor league teams were located in the United States in 2004-05), whereas Canada is home to the majority of junior league teams (about 55% in 2004-05). Attendance and team statistical data are available for all teams in the NHL minor league system as well as junior hockey leagues for selected years (see Table 1).

Table 1 documents the recent history of NHL, minor league, and junior league hockey attendance. We note that NHL attendance was, in general, on the rise over the period 1992-93 to 2005-06. During the lockout season 2004-05, both minor league and junior hockey attendance increased where, in general, attendance had been falling since the 1999-2000 season for minor leagues and since the 1997-98 season for junior leagues. For minor league hockey, the lockout season 2004-05 showed the largest percentage increase in attendance over the tabled period for that league.

Turning to a regression analysis of Expression 1, for minor league hockey there are 707 observations from the 1998-99 to the 2004-05 season. For junior league hockey there are 531 observations from 1996-97 to 2004-05. The empirical specification of the general form in Expression 1, above, for both minor league and junior league hockey, is as follows:

$$\ln(\text{APG}_{i,t}) = \beta_0 + \sum_{i=1}^{N} \beta_i(\text{Team}_i) + \beta_{N+1}\, T + \beta_{N+2} \ln(\text{PPG}_{i,t}) + \beta_{N+3}(\text{NonNHLTeams}_{i,t}) + \beta_{N+4}(2004-05) + \beta_{N+5}(\text{NHL}_i) + \varepsilon_{i,t}, \quad (2)$$

Table 1
National Hockey League (NHL), Minor League, and Junior League Attendance per Game, 1991-92 to 2004-05

Year	NHL	% Change	Minor	% Change	Junior	% Change
1991-92	14,511	—				
1992-93	14,046	−3.2				
1993-94	14,749	5.0				
1994-95	14,798	0.3				
1995-96	15,987	8.0				
1996-97	16,548	3.5			3,939	—
1997-98	16,196	−2.1			3,481	−11.6
1999-99	16,262	0.4	5,000	—	3,296	−5.3
1999-2000	16,376	0.7	5,007	0.1	3,443	4.5
2000-01	16,555	1.1	4,498	−10.2	3,470	0.8
2001-02	16,759	1.2	4,597	2.2	3,605	3.9
2002-03	16,591	−1.0	4,457	−3.0	3,183	−11.7
2003-04	16,533	−0.3	4,341	−2.6	3,383	6.3
2004-05			4,484	3.3	3,466	2.5
Average		1.13		−1.70		−1.33

Source: Author calculations from data at www.kenn.com.

where the dependent variable $APG_{i,t}$ is the yearly attendance per game for team i in year t, measured in natural logarithms, and β_0 is the constant term.

Following along the general specification in Expression 1, we use team fixed effects and trend variables because we could not find a consistent set of data for price, income, population, and outcome uncertainty for minor and junior league teams. The individual team fixed effects are the indicator variables $Team_1, \ldots, Team_N$, equal to 1 for the N teams in the league (e.g., $Team_1 = 1$ for one team in the league, zero for all of the other teams in the league). The time trend variable, T, increases from 1 to the number of years observed for each league. The remaining preference for quality is captured by final standings points per game, $PPG_{i,t}$. Final standings points are from the scoring system used in all hockey leagues to determine regular season standings. Hockey teams receive two points for a win, one point for a tie, no points for a loss in regulation time, but typically one point for a loss in overtime. So, $PPG_{i,t}$ accounts for team quality adjusted for the fact that season length varies for teams in different minor and junior leagues. Measuring in natural logarithms facilitates comparisons because the coefficient is interpreted directly as the elasticity of attendance with respect to team quality.

We attempt to capture the impact of substitutes using three variables. First, $NonNHLTeams_{i,t}$ is the total number of minor and junior teams in the same SMSA as team i in year t. Second, we use an indicator variable for the lockout season; 2004-05 equals 1 for that year and zero otherwise. Finally, NHL_i is an indicator variable

equal to 1 if there is an NHL team in the same location as team *i* for the 2004-05 season. No NHL team entered or left a market with a minor or junior league team during the time span of the sample.

It may also be important to consider other nonhockey sport alternatives. Given the fixed effects model, other sports teams must enter or leave a minor or junior league market in order to test these effects. However, as with the NHL, no Major League Baseball teams entered or left a market with a major or minor league hockey team during the sample period. There are two examples of minor league hockey markets where a National Football League team entered or left, Cleveland and Houston. There are also two examples of minor league hockey markets in which a National Basketball Association team entered or left a market, Charlotte and Memphis. These effects were tested in the model, but were found to be statistically insignificant. This may be due to the small number of such examples.

Descriptive statistics for all minor league hockey and junior league hockey variables are given in Table 2. Tests for heteroskedacticity and autocorrelation based on OLS versions of Expression 2 for each of the minor and junior leagues suggested that only autocorrelation was present. This led us to use generalized least squares (GLS) to estimate Expression 2 for minor and junior hockey. Unfortunately, the time frame of our sample is not long enough for an investigation of the time series properties of minor and junior hockey attendance beyond inclusion of the time trend variables.

Empirical Results

Table 3 gives GLS results for minor and junior hockey leagues. First, the general demand approach has solid empirical support. The R^2 statistic is right around 0.90 in each estimated equation and most independent variables affect attendance in an expected manner. The team fixed effects (suppressed in Table 3, available upon request) did show some variation across teams attributable to individual market circumstances. This suggests that price, income, population, and outcome uncertainty variables, if they were available, would be important variables for the demand for both minor and junior hockey. The availability of those data might also help explain the differences in the trends in the two types of leagues, negative in the minor leagues and positive in junior leagues.

Team quality clearly matters in both leagues. All else constant, as a team's points per game (PPG) increases, indicating a more competitive team, attendance increases. Because both attendance per game (APG) and PPG are measured in logs, the coefficient estimates are elasticities that reveal how responsive attendance is to team quality. A 1% increase in PPG leads to a 0.22% and a 0.15% increase in minor league and junior hockey attendance, respectively.

Table 2
Summary Statistics

Description	Name	Min	Max	*M*	*SD*
Minor league hockey					
Attendance per game	APG	623	12,123	4,509	1,840
Team fixed effects variables	Team	0	1	—	—
Trend	T (1998-99 = 1)	1	7	3.89	2.01
Final standings points per game	PPG	0.26	1.63	1.08	0.22
Minor and junior league teams in the same SMSA	NonNHLTeams	0	2	0.038	0.2
Lockout season	1 if 2004-05 0 else	0	1	0.13	0.34
NHL team in the same SMSA in 2004-05	NHL	0	1	0.006	0.075
Junior league hockey					
Attendance per game	APG	240	10,062	3,321	1,776
Team fixed effects variables	Team	0	1	—	—
Trend	T (1996-97 = 1)	1	9	5.93	2.37
Final standings points per game	PPG	0.09	1.77	1.05	0.27
Minor and junior league teams in the same SMSA	NonNHLTeams	0	2	0.028	0.19
Lockout season	1 if 2004-05 0 else	0	1	0.16	0.37
NHL team in the same SMSA in 2004-05	NHL	0	1	0.009	0.097

Source: Minor and junior hockey statistics are from www.kenn.com.
Note: SMSA = standard metropolitan statistical area; NHL = national Hockey League. Means and standard deviations for team fixed effects vary by season and are not shown.

Next, we examine the effect of hockey substitutes. First, note that the presence of other minor league and junior league teams only negatively impacts attendance for minor league teams. This is interesting because the descriptive statistics for the NonNHLTeams variable are practically identical for the two types of leagues. For all intents and purposes, NonNHLTeams is an indicator variable (at most only a few teams had more than one other team in the same SMSA), so the coefficient estimates are approximately percentage changes; if the variable equals 1, the natural log of attendance increases by 100 times the coefficient estimate. Minor league teams with no direct non-NHL competition enjoy about 17% higher attendances than minor league teams facing that type of competition.

Finally, we come to our two variables intended to measure the additional impact of the 2004-05 lockout. For minor league teams, attendance increased directly by almost 5% during the lockout (measured by the indicator variable for the year 2004-05). However, this direct indicator variable was not significant for junior league teams. On the other hand, for junior league teams with an NHL team in the

Table 3
Generalized Least Squares (GLS) Regression Results Minor and Junior League Hockey: Dependent Variable = Ln($APG_{i,t}$)

Variable	Minor League Hockey	Junior League Hockey
Constant	7.899**	7.725**
	(0.121)	(0.108)
T	−0.041**	0.021**
	(0.005)	(0.005)
Ln(PPG)	0.223**	0.148**
	(0.034)	(0.032)
NonNHLTeams	−0.170**	0.080
	(0.055)	(0.122)
2004-05	0.047*	−0.018
	(0.023)	(0.026)
NHL	0.090	0.199*
	(0.120)	(0.089)
R^2	.905	.915
MAPE	1.114	1.568
MPE	−0.025	−0.052
RMSE	0.131	0.181
n	707	531

Note: NHL = National Hockey League; MAPE = mean absolute percentage error; MPE = mean percentage error; RMSE = root mean squared error. The individual team fixed effects are suppressed.
*Significant at the 5% level. **Significant at the 1% level.

same SMSA during 2005, attendance increased about 20%, but this variable was not significant for minor league teams. Given the small number of junior league teams located in an NHL SMSA in the first place, less than 10% of junior league teams playing in 2004-05 appear to have enjoyed attendance benefits due to the lockout (see the mean and standard deviation for the NHL variable in Table 2).

Returning to our data, we find only 25% of minor league teams with an NHL franchise in 2004-05 were Canadian, whereas the proportion jumps dramatically to 80% for junior league teams. So our results imply that U.S. fans substitute to the non-NHL live attendance alternative in a way that Canadian fans did not. Our data limit our ability to determine whether it is strictly some undetermined nationality factor driving this result. However, we can say that if both U.S. and Canadian NHL fans are otherwise alike, the minor league alternative is a closer substitute than the junior league alternative for fans without an NHL team in their SMSA. Because it seems that fans without an NHL team in their SMSA would be mainly NHL television fans, this also suggests that having live alternatives really only matters if it is a minor league team rather than a junior league team.

Even though the percentage increase seems small for minor league teams, the financial impacts are not. And the financial impacts on that small proportion of

Table 4
Revenue Impacts for Minor and Junior Hockey Teams

Item	Source/Note	Minors	Juniors
1. Attendance per game	Table 2	4,509	3,321
2. Percentage increase 2004-05	Table 2	4.7%	17.7%
3. Per game increase	1 × 2	212	589
4. Average number of home games		34.6	33.6
5. Total attendance increase	3 × 4	7,335	19,790
6. Ticket price range	Webpage review	$7-$50	$14-$21.50
7. Average ticket price	From 6	$20	$16
8. Gate revenue increase	5 × 7	$146,700	$316,640

Source: Ticket prices are from a review of posted webpage prices, December 2006.
Note: For average ticket price, the representative minor league is the East Coast Hockey League (ECHL) and the representative junior league is the Ontario Hockey League (OHL).

junior league teams are quite remarkable. Calculated gate revenue impacts based on our empirical results appear in Table 4, based only on the statistically significant substitution results in Table 3. Given an estimated ticket price, the 4.7% attendance increase generated an estimated $146,700 in additional revenues, on average, for a minor league team. Conservatively, even if we combine the nonsignificant 1.8% decrease in attendance for junior league teams in 2004-05 with the 19.9% increase for teams in an NHL market, those teams' attendance increased by 17.7%. This implies that junior league teams had an increase of $316,640 in additional revenues! Given that there were 95 minor league hockey teams during the lockout year in our sample and 5 junior league hockey teams in NHL markets, this translates into an additional $15,519,700. These calculations are only for changes at the gate. The estimates clearly understate the change in revenue for each type of team because attendance-related revenues, such as concessions and parking, would also be generated. Furthermore, the estimated financial impact does not include any possible increment to media (mostly radio) and postseason play revenues.

Implications and Conclusions

We examine the attendance impacts of the 2004-05 NHL lockout on minor and junior hockey in order to garner insight into the importance of proximity and availability of substitutes in sports attendance demand. This episode is especially enlightening because it isolates pure substitution effects without any associated income effects. The study also contributes to our understanding of hockey fans, an area which has not been heavily researched.

The general demand approach has solid empirical support. The R^2 statistic is large, and independent variables typically enter the model as expected for both minor and junior leagues. Our results suggest that there are, indeed, price, income, population, and outcome uncertainty effects. Unfortunately, data limitations allow us only to make this comment from the perspective of team fixed effects and trend variables.

On the topic of substitution, NHL fans appear to be hockey fans in general, as witnessed in the increase in NHL attendance documented from 1991-92 to 2005-06. And the general availability of substitutes for minor and junior hockey league teams reduces attendance. Finally, NHL fans also substituted toward minor and junior league teams in a statistically significant and financially meaningful fashion during the 2004-05 lockout season.

But there is a striking asymmetry in the substitution toward minor league and junior league teams. We find that minor league hockey teams enjoyed an increase in attendance during the lockout, but there was not an additional increase for teams in an NHL market. However, attendance increases for junior league teams only happened if they shared their area with an NHL team. Although the financial impact on junior league teams is larger in percentage terms than for minor league teams, the impact only occurred for the less than 10% of those junior league teams sharing their SMSA with an NHL team.

Coupled with the fact that 25% of minor league teams with an NHL franchise in 2004-05 were in Canada and the proportion jumps to 80% for junior league teams, this asymmetric substitution has two implications. First, if both U.S. and Canadian NHL fans are otherwise alike, the minor league alternative is a closer substitute than the junior league alternative for fans without an NHL team in their SMSA. Second, because it seems that fans without an NHL team in their SMSA would be mainly NHL television fans, having live alternatives really only matters if it is a minor league team rather than a junior league team.

We suspect this type of information is important to those developing habit and loyalty models of fan demand. For example, the vast majority of NHL fans could be exhibiting habit/loyalty. After all, average NHL attendance was 16,533 for the 2003-04 season (see Table 4). The minor league average (increasing only where there was an NHL team in the same area) only rose by 807, or about 4.9% of the displaced NHL amount. But if the NHL product is habit forming, asymmetric substitution suggests that the habit is not generated in the same way for all NHL fans. Those studying habit or loyalty need to account for substitution possibilities. Fans may seem loyal when there are limited substitutes but may not actually behave that way when the consumption alternatives are changed.

There are also implications for league policy. When hockey leagues are deciding upon the location of an expansion team, they should consider teams in other hockey leagues as part of the market, especially junior league teams. This suggests that there may be benefits to having payments or implicit agreements between leagues

when deciding the location of teams. Professional baseball recognizes this through the National Agreement, but to our knowledge hockey does not.

Two public policy implications also are clear. Actions by the NHL clearly have attendance impacts on teams in other hockey leagues in the same area. Thus, fan welfare is altered by the team location choices of the NHL. This suggests a justification for antitrust scrutiny of NHL team location decisions. The attendance impacts on other hockey leagues also affects the value to taxpayers from financing arenas either (a) for minor and junior league teams or (b) in order to draw NHL teams to their location. Fans of existing teams in other leagues bear a cost associated with NHL team location decisions.

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