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The Effect of Distance from NHL Affiliate on AHL Fan Attendance

Stephen Picard

Assumption College

Honors Program Honors Thesis

Dr. Brian Volz

Introduction

As National Hockey League (NHL) contracts grow out of control, American Hockey League (AHL) teams experience greater pressure to account for their own expenses. Prior to the development of the National Hockey League Player's Association, team owners paid the majority of their organizations' expenses with revenue from the top team. However, the NHL expenses have grown exponentially in recent years as the Player's Association advocates for more appropriate salaries. Therefore, the organizations rely on contributions from all levels of their franchise, including the minor league levels. In order to minimize costs at the AHL level, teams are relocating AHL teams closer to their NHL affiliates. Logistically, when affiliates are located closer to each other, they can transfer players from the minor league team to the major league without spending as much on transportation costs. In this study, I analyze the change in ticket sales as AHL teams move to regions dominated by fans of their NHL affiliates.

From lawyers fighting to prove someone's innocence in criminal defense cases to car salesmen trying to move inventory as fast as possible, it seems that almost every profession draws out a competitive nature on which humans can thrive. Winning often does not come easily. Winning requires people to make sacrifices and to remain patient. Specifically, professional athletes, sports teams, and dedicated fan groups will endure years of failure in order to secure top prospects, develop young talent, and eventually win a championship. Just one championship win can be enough to justify years of defeat.

Unfortunately, because of the hierarchy within sports organizations, year after year, minor league sports clubs often suffer many losses. Management primarily focuses on winning at the highest level, rather than at the minor league level. Instead of creating equal success throughout all teams in an organization, the elite team experiences all the fame, while the lower

teams work toward the future success of the top team. Although all coaches and players on a team are focused on winning as many games as possible, often times, the undeveloped players found on minor league teams face a tough learning curve that limits their immediate success. While these players develop into more mature contributors in the organization, the minor league team suffers. Ultimately, minor league organizations and their players sacrifice high winning percentages in favor of gaining experience for up and coming players. Minor league organizations lose money by not focusing on winning because studies have shown that fan attendance at all levels is positively and significantly affected by increased winning percentages (Paul and Chatt, 2011). Therefore, more wins would generate more revenue for organizations. The increase in revenue could then be reinvested in future player development.

For many reasons, minor league hockey is beginning to take notice of lost revenue. The premier minor hockey league in North America is the American Hockey League. The AHL is directly below the National Hockey League and each team in the AHL is affiliated with an NHL team. Beginning in the 2015-2016 season, six AHL teams moved westward, closer to their NHL affiliate and formed the Pacific Division. Largely, this decision was made for player development reasons because the minor league teams are looking to be more cost effective when the organization exchanges players from the NHL to the AHL (Clinton, 2015). Also, management in the organization has the ability to follow player development more closely when the minor league teams are located in close proximity to the management team. In my opinion, the minor league teams will also see other benefits from moving their AHL teams closer to their NHL affiliates. Specifically, I predict that the minor league teams will experience an increase in ticket sales. Because NHL teams already have established fan bases in their regions, the newly

relocated AHL teams will automatically have a group of fans, which will have the opportunity to watch the future stars of the NHL for a discounted price.

According to *The Hockey News* reporter, Jared Clinton, hockey organizations plan to continue the trend of relocating their minor league teams to facilities closer to the rest of the organization (Clinton, 2015). At this point, these organizations only see the potential for increased player development opportunities with the transfer of location (Clinton, 2015). This study analyzes the distance between affiliated NHL and AHL teams in order to determine its effect on fan attendance at the AHL level. Hopefully, my results will offer an additional benefit for AHL teams as they minimize travel costs. With a quick glance, the six teams that relocated for the 2015-2016 season sold, on average, nearly two thousand more tickets than during the previous season—an increase of over twenty percent.

In order to conclude that the relocation alone generates this increase in ticket sales, I must control for other variables that can affect the increase in attendance. Consequently, I research and account for several variables in this study that focus on team performance, stadium quality, other attractions in the city, affiliation history, and age of the team. By controlling for other variables, I isolate the variable of interest, distance between NHL and AHL teams. After determining the impact of increased fan attendance, I hope to provide an additional incentive for more AHL teams to relocate closer to their NHL affiliates. For this to be true, my statistical analyses must show a positive and significant relationship between AHL teams' fan attendance and their proximity to their NHL affiliates.

Literature Review

Minor league sports have always served to prepare players for major league participation. Within the last 15 to 20 years, however, profit generation seems increasingly important to minor

league sports franchises, as shown by several relocations and promotional events. Unfortunately, a dual focus on player development and increased revenue is potentially contradictory. After all, in order to develop players, teams sacrifice winning percentage—a crucial factor in determining fan attendance. Fortunately, many minor league organizations are experimenting with ways to generate more profit and improve players' skills simultaneously.

In this literature review, I highlight several articles that examine the American Hockey League. Many of the articles listed below emphasize various tactics that minor league hockey teams use in order to generate higher levels of ticket sales. This literature review is broken into three parts. The first explains the history of the American Hockey League AHL, the top minor hockey league in North America. The second section analyzes rates of attendance at various professional sporting events, emphasizing the impact of winning percentage, promotional events, and scheduling on ticket sales. Finally, the third section examines the recent relocations that have attempted to satisfy the bilateral goal of minor league hockey teams. These articles have shown me which variables I must control in my regression analysis.

I. History of the American Hockey League

In 1936, with the combination of the Canadian-American Hockey League and the International Hockey League, the International-American Hockey League was formed. For simplicity reasons, the “International” would be dropped from the name in 1940 and the American Hockey League became the name of the minor hockey league immediately under the National Hockey League. Therefore, the 2015-2016 season marked the eightieth season in AHL history. Originally, the American Hockey League was created to develop players to reach the next level of competition in the National Hockey League. However, with the growing

importance of profit generation, the league has focused on generating additional ticket sales in recent years.

The NHL has experienced large increases in player and coach salaries over the past thirties years, as outlined in Wladimir Andreff and Stefan Symanski's *Handbook on the Economics of Sport*. In 1989, the creation of the National Hockey League Players' Association began to assist players in negotiating higher salaries and greater benefits. Consequently, "salaries [of NHL players] quadrupled within a period of six years," leaving less money for player development at the AHL level (Andreff and Symanski, 2006). This increase in NHL players' salaries forces AHL teams to generate profits independently through ticket sales.

Since the creation of players' associations, professional athletes have been obligated to report their salaries on a public level. Reporting salaries has created a false perception about professional sports and their impacts on the cities they inhabit. Specifically, the large salaries give the impression that franchises are generating large positive externalities for their cities. However, Kaveephong Lertwachara and James Cochran explain that the opposite effect occurs on a city. In "An Event Study of the Economic Impact of Professional Sport Franchises on Local U.S. Economies," Lertwachara and Cochran discover "strong economic evidence that a professional sport team does not have a positive impact on the local economy." Based off of these findings, it is difficult to understand why municipalities continue to exhaust their resources in order to provide tax incentives for franchises to stay. Many critics argue that these tax incentives could be directed toward other programs that might generate more positive economic effects. Continuing, "our results imply that on the basis of the incremental local per capita income they generate, professional sport franchises do not justify abatements, concessions, and incentives that are used to attract them to an metropolitan statistical area," Lertwachara and

Cochran argue that cities should only provide incentives for franchises to stay for civic pride reasons, not financial reasons (Lertwachara and Cochran, 2007). On top of civic pride, sports teams have also been speculated to generate positive externalities on the cities. For example, if fans attend a sporting event in Boston, they are likely to eat at the local restaurants too. Unfortunately, many of the positive externalities from sports teams are difficult to capture with before and after data.

Working on her Capstone Project for the Martin School of Public Policy and Administration, Jesse Stephenson supports Lertwachara and Cochran in her “Letting Teams Walk.” Piggybacking off of earlier findings on the economic impacts of sport franchises, Stephenson ventures further to study the impact of a franchise leaving a particular metropolitan statistical area. Concluding, “[a] professional sports team leaving an area has no observed positive or negative effects on the local economy when measuring per capita income and unemployment,” Stephenson believes municipalities should not fear the economic repercussions of franchises leaving cities. On the other hand, Stephenson argues, “[i]f policymakers wish to offer public funding for teams to stay, they should do so for social reasons such as maintaining quality of life or civic pride, not under the guise of economic development” (Stephenson, 2013). Given the fact that sport franchises do generate positive externalities, municipalities will continue to support franchises with tax incentives as long as they generate ticket sales. Ticket sales will show municipalities that franchises are valued by the citizens and worth supporting. Ultimately, if franchises do not find ways to increase fan attendance then they will lose the incentives that cities offer because cities will be forced to allocate this money to other, more effective economic projects.

II. Analysis of Rates of Attendance

In order to isolate the impact of distance from NHL team on AHL fan attendance, I need to examine other variables that affect rates of attendance. Several variables, such as winning percentage, promotional events, scheduling, and fighting, influence rates of attendance at professional sporting events, including minor league games. I have focused much of my literature review to studies that have displayed effects from these main variables. Once I control these variables, the variable of interest, distance between affiliated teams, will more accurately show its effect on fan attendance.

Winning Percentage and Attendance in the NHL

In Daniel Peters' "Winning Percentage and Attendance in the NHL," he focuses on explaining the effects of winning percentage in the NHL on fan attendance. Similar studies have shown that winning percentage is a major determinant of fan attendance in all major and minor sports leagues. Several individuals critique bandwagon fans, but few will argue against their existence. Peters draws out more support for their existence and effect on the sport industry. While studying seasons in the NHL between the years of 2005 and 2011, Peters saw a major effect of winning percentage in respect to fan attendance during the tail end of the 2011 season. With these results, Peters determines that there is a 36.6% correlation between winning percentage and attendance across the league. However, through all five years of analysis, Peters generate a statistically insignificant positive relationship between fan attendance and win percentage. Since the variable is insignificant, the sign does not have as much value but it is promising that the coefficient remains positive as predicted. For example, the Boston Bruins have improved both their fan attendance numbers and their success on the ice. Ultimately, there are several examples to illustrate a positive connection between both variables but there is "no

true relationship between attendance and winning percentage,” in the NHL from 2005 to 2011 (Peters, 2011).

If the NHL and AHL experienced similar relationships between fan attendance and winning percentage, Peter’s findings would suggest that minor league teams less focused on winning are actually not in jeopardy of losing ticket sales. However, the relationship between win percentage and fan attendance in the AHL differs from the relationship in the NHL. Therefore, minor league teams must find other ways to increase attendance figures without winning percentage in their favor. Given this necessity, several studies have been conducted on the fan culture in the AHL as well as other leagues that resemble the American Hockey League.

Fan Culture in the AHL

Studying fan culture in the American Hockey League gives organizations a better understanding of what fans want and how organizations can provide for the fans. In her essay, “Fan Culture in the American Hockey League,” Julie Mros analyzes responses to a survey distributed to fans of an AHL team in order to determine the motives behind fan attendance. According to Mros, four possible psychological motives drive fans to attend AHL games: self-esteem, family, economics, and escape. She defines the self-esteem motive as “fans relat[ing] to their team’s success and achievements as if it were their own success, which creates an increase in their self-esteem.” The family motive applies to fans that attend games in order to spend time with family members. Mros considers the economic motive to be synonymous with gambling. Finally, when she states, “people use sport as an escape because they are unhappy with some aspect of their home life,” she outlines the significance of the escape motive (Mros, 2014). Mros claims that such psychological motives transcend the typical factors outlined in other articles analyzing fan attendance, such as population, income per capita, promotions, and winning

percentage. Psychological motives can cause not only diehard fans, but also people outside a team's typical fan base to attend games.

In 2011, Robert Chatt and Rodney Paul wrote "Regional Differences in Fan Preferences for Minor League Hockey: The AHL," analyzing the 2008-2009 season. Taking a more technical approach to analyzing fan attendance, Paul and Chatt employed linear regression models when examining fan preferences for minor league hockey. They found that weekend games were more popular than games held during the week, and that games held later in the season were also more popular. As the size of the population increased, game attendance also increased. Relating to Peters' findings, Paul and Chatt declare, "[w]in percentage and total goals per game were found to have large positive and significant effects on attendance." Additionally, some promotions, specifically, dollar beer and hot dog nights, proved more popular with statistically significant increases in fan attendance. Income per capita apparently had no significant effect on fan attendance in minor league hockey games. During the examined season, they also found that fighting had an overall negative effect on fan attendance. Significantly, they realized that regional differences created variation in their results. Specifically, certain regions across the nation appreciated different aspects of the minor league hockey game than other regions. For example, the Northeast region did not appreciate fighting while the West region responded favorably to fighting. In their research, fan preferences vary across the nation but overall preferences resemble similar research elsewhere on fan attendance in hockey (Chatt & Paul, 2011).

Paul continues his research on fan preferences in the AHL with his study, "American Hockey League: A Study of Fan Preferences for Fighting Team Performance, and Promotions." Weinbach and Robbins join Paul in 2013 to complete this study as they analyze the 2010-2011

season. In this article, the trio of authors originally investigates the impacts of fighting on the attendance figures in hockey. After Chatt and Paul discovered that fighting “was shown to have a negative and significant effect for the AHL” in the 2008-2009 season, Paul, Weinbach, and Robbins search to find additional support to eliminate fighting from the game of hockey (Chatt & Paul, 2011). Unfortunately, despite the recent tragic deaths of former hockey enforcers, “AHL fans were shown to be significantly impacted by fighting during hockey games as fights per game of the home team had a large positive and significant effect” (Paul, Weinbach, & Robbins, 2013). Therefore Paul and Chatt’s findings from the 2008-09 season differ from the results found in the 2010-2011 season. The difference in fighting preferences from 2008 to 2011 could be a sign that fans are maturing away from fighting in hockey as they enjoy other aspects of the sport.

Although fighting was the main variable studied, the authors also found that other variables greatly affected the ticket sales for American Hockey League teams. Specifically, “many types of promotions [post game concerts, fan appreciation nights, and opening and closing nights] were shown to have positive and significant effects” (Paul et al., 2013). In 2001, Pamela Kennett, Julie Sneath, and Steve Henson documented similar aspects of fan culture in the AHL with their study, “Fan Satisfaction and Segmentation: A Case Study of Minor League Hockey Spectators.” In this study, the analysts use a five-step process to examine fan satisfaction in the AHL. The steps are send a questionnaire to fans, collect data from the questionnaire, simplify fan responses into categories, examine the new categories closely, and finally, data must be collected and interpreted into marketing terms. From this approach, the authors are able to further develop determinants of fan satisfaction at AHL games. According to the authors, “research also shows a strong positive relationship between customer satisfaction

and performance measures such as revenues, profits, and market share” (Kennett, Sneath, & Henson, 2001). From this realization, it is important to break down studies into more specific impacts on fan satisfaction because fan satisfaction directly relates to ticket generation and profit increases.

The final study of the fan culture in the AHL is one by Jason A. Winfree and Rodney Fort, where they study the increase in fan attendance in the AHL as a result from the NHL lockout in the 2004-2005 season. Winfree and Fort determine that the NHL lockout is the prime time to study the substitution effect of AHL games because “it isolates pure substitution effects without any associated income effects.” They found that minor and junior hockey league teams had an increase in demand during the 2004-2005 season during which the NHL experienced a lockout. This means that AHL games are a substitute good for NHL games. Furthermore, AHL teams within a closer proximity to an NHL team exhibited higher levels of increase in fan attendance, suggesting that location influences fan attendance (Winfree & Fort, 2007). Therefore, if AHL teams relocate closer to their NHL teams then the two teams could compete for ticket sales as substitute goods.

Fan Culture in the ECHL and QMJHL

Since the AHL is one minor league for the fourth largest sport in the United States, I have researched other leagues that relate to the American Hockey League in order to further develop my analysis of fan attendance in minor league hockey. The Quebec Major Junior Hockey League is a professional junior hockey league based in both Canada and the United States that develops players under the age of twenty-one for the NHL. The East Coast Hockey League is another professional minor hockey league based in North America, which is directly below the AHL in terms of proximity to the NHL level. All three leagues, the AHL, the ECHL, and the

QMJHL are similar in respect to their relationship to the NHL; all three leagues are substitute goods for the NHL and the minor league games are secondary options to the NHL games.

Ultimately, the fan preferences for all minor and junior league games should be similar.

Paul, Weinbach, and Robbins join together again in order to develop an analysis of “Fighting, Winning, Promotions, and Attendance in the ECHL.” Similar to their goal in the AHL analysis, they are, “investigat[ing] the role of fighting as it relates to attendance at minor league hockey games (ECHL)” (Paul, Weinbach, & Robbins, 2015). To draw the reader into their analysis, the authors focus on the past fighters in the NHL and other professional hockey leagues that have suffered from physical and mental damages due to their passion of fighting on the ice. These players were specifically paid to protect the star players by fighting against the opposing teams’ fighters, this behavior inevitably excites the crowd. The authors use the tragic suicides of these enforcers as examples to provide incentives to eliminate fighting from the game of hockey, as they search for statistical support against fighting.

The authors collected data from the 2010-2011 ECHL season by examining the box scores on the league’s website. In 684 observations, the analysts collected the attendance figures, game results, goals for and goals against for the home team, and the amount of fights during competitions. The analysts also tracked promotional events as they did in the AHL to determine which promotions attracted the highest number of fans. Unfortunately for minor league teams less focused on winning, the trio found, “that win percentage and fighting are significant determinants of fan attendance for the ECHL...an increase in win percentage of 0.1 led to around an additional 100 fans in attendance...0.1 increase in fighting was found to increase attendance by 80-90 fans” (Paul et al., 2015). Obviously, the fact that fighting increases fan attendance by nearly as much as winning percentage is not a good sign for critics against

fighting. It is much easier for an owner to hire one fighter rather than pay five players to win more games. Fighting is clearly effective from a business perspective.

Aside from fighting and winning percentage, weekend games outsold weekday games, and merchandise giveaways were strongly advantageous. Ultimately, the findings in the AHL season directly relate to the 2010-2011 season in the ECHL. Fans respond well to fighting, winning, and free stuff. Writing a Sport Management and Physical Education Dissertation for the Florida State University College of Education, Brian Pruegger focuses on, "The Effect of Game Day Promotions on Consumer Behavior in the East Coast Hockey League." While studying the 2001-2002 season, Pruegger found "game day promotions were positively related to an attendance increase" (Pruegger, 2003). If minor league teams want to maximize revenue from ticket sales while still banning fighting, they can increase game day promotions significantly to retain some loses.

Paul and Weinbach studied fan attendance in the Quebec Major Junior Hockey League during the 2009-2010 season. Weinbach and Paul found an "inherent cultural link of hockey to small-town Canada." Fans of the QMJHL actually responded negatively to fighting. One may attribute this reaction to the fact that fans of hockey in Canada respect other aspects of the game. Also, fans were more attracted to hockey for the pure cultural aspects of attending the games and they responded more favorably to the end of the season, playoff push than they did to an increase in fighting and physicality in the games. Weinbach and Paul speculate for the lack of appreciation for fighting, stating, "this could be due to the younger ages of these players (teenagers) who fans may not wish to see fight in these games" (Weinbach & Paul, 2011). Despite the fact that fighting has a positive relationship on fan attendance in the AHL, hockey leagues could still do away with fighting as seen in the QMJHL if fans become more attracted to

other aspects of the hockey nature. Franchises could also find other ways to increase fan attendance.

III. Relocations and Future Plans in the AHL

Over the past five to ten years, the American Hockey League has encountered a series of teams relocating to different parts around the country to cut costs and attempt to attract larger fan groups. Specifically, the 2015-2016 season encountered a brand new West Coast division that harbored several AHL teams affiliated with West Coast NHL teams. For instance, the Worcester Sharks (AHL) affiliated with the San Jose Sharks (NHL) moved to San Jose in order to minimize the travel time for players transferring between the NHL and AHL teams.

Jared Clinton determines, “the ability to move players freely between the two teams and the opportunity to watch over player development benefits the NHL clubs greatly” (Clinton, 2015). Basically these relocations have been centered around cutting costs, transferring players more easily between clubs, and finding a way to keep closer ties on player development. However, given the fact that AHL teams develop the future stars of the NHL game, one might even suspect a gradual increase in fan attendance at the minor league games. Since the NHL teams have already established a fan base in the given regions, the AHL teams could generate additional revenue by feeding off this fan base with cheaper tickets than the NHL games. A multitude of research has been conducted on all aspects of the fan attendance issue at minor league games. Finding a connection between fan attendance and physical relationship between NHL and AHL affiliates could generate additional profits for the organization as a whole.

Several studies have suggested that minor league teams should not compete with their major league affiliates, so minor league teams are stationed in small population markets (Winfree & Fort, 2007). Steve Fraser, an associate professor of finance and investments at the United

States Air Force Academy, studies whether or not minor league teams fit best in minor league cities. In this study, Fraser analyzes the ECHL and determines that teams are mostly successful in populations of 500,000 or less. At the same time, these cities also harbor less than two large Division I Universities (Fraser, 2006). Ultimately, this scenario allows for little competition for the minor league teams in the area. Given Winfree and Fort's realization from the 2004-2005 NHL lockout, NHL games are direct substitutes to the AHL games so the teams would compete in the same geographical area (Winfree & Fort, 2007). Rather than competing in the same city, AHL teams should find a suburban location outside of the highly populated city with the NHL team.

With this in mind, relocations of AHL teams should continue as long as they are relocating to areas that do not compete with their NHL teams. With this in mind, Andi Duroux, an *SB Nation* blogger, found a rather simple way to realign AHL and ECHL teams. Duroux analyzes the current AHL and ECHL teams for the most and least profitable throughout the nation. The most profitable teams are placed into the AHL league and they were assigned to the NHL teams closest to them. In this case, the fan base for the preexisting team will couple with the fans from the NHL team affiliate and the AHL teams will experience greater levels of fan attendance (Duroux, 2015). Duroux's system avoids establishing new teams in empty cities because it is difficult to develop immediate fan bases in new cities. Given the drastic realignment necessary to accomplish this task, one must also account for the economic effects from a professional sports team moving from a city.

In 1973, James Quirk actually accomplished the task of evaluating the effect of a sports team moving from a city. Quirk uses several Major League Baseball transfers in order to study the effects of teams leaving a city. In his analysis, Quirk realizes that baseball moves in the past

jeopardized the ability of small towns to lodge teams because teams typically move to more populated cities. However, Quirk notes that teams leaving a city did not jeopardize the overall economic situation in the city (Quirk, 1973). Rather economic situations either increased or remained the same after franchise relocations. According to Quirk's findings, one should not be tempted to avoid franchise relocations with the fear of harming the city left behind. Stephenson also agrees with Quirk by stating "Letting Teams Walk" can actually be beneficial for the long run state of the economy because cities can allocate resources for the team in other aspects that could develop the economy (Stephenson, 2013). Overall, AHL teams and other franchises rely on the civic pride to convince municipalities to offer incentives for sports teams to remain in the city. If cities see high levels of fan attendance at sporting events then they are inclined to offer support for franchises. Ultimately, municipalities are willing to look past the lack of economic support if fans attend the contests and show that they value the presence of the franchise in the city. Therefore, franchises continually attempt to increase fan attendance in order to draw out more support from the municipalities.

Description of Model

From 2007 to 2017, there were 297 observations in the American Hockey League. Each National Hockey League team had an affiliated AHL team throughout the ten years except for the Dallas Stars in 2008-2009 and the Anaheim Ducks in 2009-2010. The Stars were in a transition period as they added the Texas stars for the following season. During the 2009-2010 season, the Iowa Chops served a suspension as an affiliate of the Anaheim Ducks that year. Also, in 2007-2008, the Buffalo Sabres and the Florida Panthers shared their affiliation with the Rochester Americans. From the 2009-2010 season to the 2016-2017 season, there were thirty AHL teams each season. As a result, my model consisted of 297 observations over the ten

seasons. Since AHL team names and affiliations change each year, I use the AHL city as the identification in my regression analysis. The city of the AHL team does not change when the affiliations change or when the name changes, so it creates consistency when analyzing the behaviors of the fans in that city.

In order to analyze the results of my data, I combine all ten seasons into one regression analysis and run a few tests to identify the appropriate model to use. To determine whether or not I needed to use panel data, I outline the summary statistics of the independent variables as follows.

Variable		Mean	Std. Dev.	Min	Max	Observations
distance	overall	827.9091	1027.827	0	4790	N = 297
	between	954.9841		0	3718.667	n = 43
	within	470.458	-1314.758	2617.076		T-bar = 6.90698
point	overall	55.52118	7.866516	32.9	76.9	N = 297
	between	4.483459		44.875	65.33	n = 43
	within	6.733112	37.76118	75.89618		T-bar = 6.90698
point2	overall	3144.276	875.6219	1082.41	5913.61	N = 297
	between	501.9286		2064.897	4277.69	n = 43
	within	752.1608	1259.548	5669.359		T-bar = 6.90698

The example above depicts three of the sixteen independent variables; but the remaining results represent the same outcome. When examining the standard deviations of the independent variables, I notice differences between the between and within estimators. For example, the between estimator for the distance variable is 954.98 and over 400 miles away from the within estimator of 470.46. Therefore, the differences in the standard deviations of the independent variables provide evidence that my data needs to be treated as panel data.

After determining panel data is necessary to implement in the analysis, I perform the Breusch-Pagan LM Test in an effort to rule out the pooled ordinary least squared estimator in favor of the fixed or random effects estimators. The Breusch-Pagan LM Test results are shown below.

Breusch and Pagan Lagrangian multiplier test for random effects

$$\text{attendance}[id,t] = Xb + u[id] + e[id,t]$$

Estimated results:

	Var	sd = sqrt(Var)
attenda~e	2835577	1683.917
e	818887.5	904.924
u	2363035	1537.217

Test: Var(u) = 0

$$\begin{aligned} \text{chibar2}(01) &= \mathbf{506.18} \\ \text{Prob} > \text{chibar2} &= \mathbf{0.0000} \end{aligned}$$

Since the probability of the Breusch-Pagan Test is less than the five percent significance level, the data favors the random or fixed effects models over the pooled OLS model.

However, one final test, the Hausman Test, decides between the random effects estimator and the fixed effects estimator.

Test: Ho: difference in coefficients not systematic

$$\begin{aligned} \text{chi2}(13) &= (b-B)' [(V_b - V_B)^{-1}] (b-B) \\ &= \mathbf{7.85} \\ \text{Prob} > \text{chi2} &= \mathbf{0.8531} \end{aligned}$$

For the Hausman Test, when the probability is greater than the five percent significance level, we fail to reject the null hypothesis and we support the random effects estimator.

Through this series of tests, I choose the random effects estimator over all other models. However, both the fixed and random effects estimators similarly capture the effects that separate each minor league hockey city from the rest of the group. Comparable to adding a dummy variable for each AHL city, the fixed effects estimator and the random effects estimator recognize differences in each city. Both estimators analyze the change in the dependent variable and the change in the independent variables over time as shown below.

$\Delta\bar{Y}$	$\Delta\bar{X}$
$Y_{10}-\emptyset\bar{Y}_1$	$X_{10}-\emptyset\bar{X}_1$
$Y_9-\emptyset\bar{Y}_1$	$X_9-\emptyset\bar{X}_1$
$Y_8-\emptyset\bar{Y}_1$	$X_8-\emptyset\bar{X}_1$
$Y_7-\emptyset\bar{Y}_1$	$X_7-\emptyset\bar{X}_1$
$Y_6-\emptyset\bar{Y}_1$	$X_6-\emptyset\bar{X}_1$
$Y_5-\emptyset\bar{Y}_1$	$X_5-\emptyset\bar{X}_1$
$Y_4-\emptyset\bar{Y}_1$	$X_4-\emptyset\bar{X}_1$
$Y_3-\emptyset\bar{Y}_1$	$X_3-\emptyset\bar{X}_1$
$Y_2-\emptyset\bar{Y}_1$	$X_2-\emptyset\bar{X}_1$
$Y_1-\emptyset\bar{Y}_1$	$X_1-\emptyset\bar{X}_1$

Where \bar{Y} = average Y or average dependent variable

\bar{X} = average X or average independent variable

$\Delta\bar{Y}$ = change in the average dependent variable

$\Delta\bar{X}$ = change in the average independent variable

\emptyset = coefficient

Y_t = actual dependent for that year

X_t = actual independent for that year

The coefficient is the main thing that changes from the random effects estimator and the fixed effects estimator. For the fixed effects estimator, the coefficient (\emptyset) is equal to one. Whereas, the random effects estimator has a coefficient (\emptyset) between zero and one. As the title suggests, the random effects estimator uses the changing coefficient to pick up on additional randomness in the minor league cities. In the results section, I use the random effects estimator and pooled ordinary least squared estimator in order to compare the results. Both estimators for heteroscedasticity and serial correlation.

Description of Data

With proper research on other factors that affect fan attendance in the American Hockey League, I compile a list of independent variables to include in my empirical results. For many of the variables I find data to support my theories. However, some variables like promotional events, local income levels, local population rates and cost of attending games are unavailable over the ten-year period. In order to test for multicollinearity, I run the correlation of all the independent variables and I perform the “estat vif” command to see if there are any glaring concerns. Fortunately, the squared variables are the only concerns that arise from the tests. Obviously these variables have correlations greater than 0.6 and “vif” results greater than 10

because they directly represent the squared value of other variables in the study. Therefore, I conclude that my data does not suffer from multicollinearity issues.

Since the 2017 season had not concluded by the time I needed to run the regression analysis, the 2017 statistics from the AHL and NHL teams are up to the 6th of March. On average each team had about fifteen games remaining by this date. However, since all in game statistics measure in per game figures, ending the season early in 2017 only has minor, unnoticeable effects on the results. The last stretch of the season experiences changes in attendance figures for teams in and out of the playoff contention. But trivial alterations for seven home games have no substantial effects on averages for forty home games. All in all, if I wait till the end of the 2017 season to run the regression, I do not suspect a major effect on my results.

I. Dependent Variable

In an effort to examine the change in ticket sales as American Hockey League teams move closer to their affiliated National Hockey League teams, my dependent variable is fan attendance. The fan attendance stands for a season long average. I found data for all ten seasons on the hockey dB website and the figures update daily.

II. Independent Variables

The distance variable is the main variable of interest in my regression analysis. I find the distance between National Hockey League and American Hockey League affiliates by mapping out the miles from the AHL team's arena to the NHL team's arena. For example, the Hartford Wolfpack play at the XL Center in Hartford, CT. Hartford's affiliate is the New York Rangers and the Rangers play at Madison Square Garden in New York, NY. The distance between the XL Center and Madison Square Garden is 115 miles. In some cases, AHL teams often played games at two different arenas; so I use the AHL arena that hosts more home games throughout

the year. I predict the distance variable will have an inverse relationship with fan attendance. As teams get farther apart, attendance will decrease because fewer fans of the NHL teams can attend their affiliates' AHL games.

In game measures that I control in my analysis are American Hockey League winning percentage, goals scored per game, and penalty minutes per game. Winning percentage in the NHL and AHL is calculated by a point percentage because teams receive one point for overtime losses and two points for wins. Therefore, the most points a team can receive each game is two. So I calculate point percentage by taking the actual number of points a team earns and dividing it by two times the number of games that teams play. I predict AHL point percentage to have a positive impact on fan attendance in the AHL because fans will attend more games when the home team wins. I also square the point percentage for the AHL. I predict point percentage to increase attendance at a decreasing rate because fans lose interest when the games are too predictable and their teams are expected to win. So the squared point percentage illustrates the tapering off of fan attendance as teams win too frequently.

In several research papers on the AHL, fans have reacted favorably to more fighting and more goals scored, so I chose to include goals scored per game and penalty minutes per game for each team. The penalty minutes per game account for fighting because a player receives at least a five-minute major penalty for each fight and two-minute minor penalties for each roughing penalty. If I only incorporate number of fights per game, I lose the effects from incidences that do not end in a fight but still excite the crowd. I employ per game numbers instead of totals because the number of games per year varies from 68 games to 76 games. I predict both penalty minutes and goals scored to have a positive effect on fan attendance because fans historically enjoy hockey games with more aggression and more scoring.

Two variables that examine the AHL stadium quality are age of the stadium and stadium capacity. All team websites display details about the stadium that include the data I use for these two variables. I believe as stadium capacity increases, fan attendance will also increase because the team will have more tickets to offer and sell to fans. On the other hand, as age of the stadium increases, I anticipate the fan attendance will decrease because fans value the quality and technology associated with more modern venues. At the same time, I square the age of the AHL stadium and use that as another variable because the oldest stadiums may have history in them that fans appreciate more than the youth of a stadium. For example, Fenway Park and Wrigley Field are two of the oldest stadiums in Major League Baseball but fans appreciate the history associated with those stadiums, so they continue to attend games even though the stadiums lack the modern features. As a result, I predict the age of the stadium to decrease fan attendance at a decreasing rate and I predict the stadium capacity to increase fan attendance.

Continuing with age, I recognize age of the AHL team and the age of the affiliated NHL teams. Again, all of the team websites provide historical data that I use in my data collection. If the team changes names from one year to the next but remain in the city, then I considered that to be the same team. Also, if an affiliation changes from one year to the next, I consider that to be the same team. However, if an AHL team relocates to a new city, then I determine that to be a new team in that new city. I suspect the age of the AHL team will have a positive effect on fan attendance because more time in a city will attract more fans of the AHL. Older NHL teams should have more fans for the same reason. As a result, more fans should attend AHL games hoping to see young stars develop into roles at the major league level. I anticipate the age of the AHL team and the age of the NHL team to have positive relationships with the dependent variable.

In order to assess the substitution effect in the city, I apply variables for the 2013 NHL Lockout, the NHL fan attendance, and the other sports teams in the city. The 2013 NHL Lockout occurs for half the 2012-2013 season and it shrinks the NHL schedule from 82 games to 48 games. I use a dummy variable for that season. All hockey games are substitute goods, so I predict the lockout to increase fan attendance in the AHL during the lockout season because if fans cannot attend NHL games, they will choose the AHL games. Similarly, as the number of sports teams in the city increases, then the AHL team will have more competition and its fan attendance will suffer as a result. So, fan attendance will decrease as the number of teams in the city increase. Continuing, I find the NHL fan attendance numbers from 2007-2017 on the hockey dB website and predict as the NHL fan attendance rises, less fans will attend AHL games. If more fans attend the affiliates' games, then less consumption is leftover for AHL games. So the coefficients on NHL fan attendance and other sports teams in the city should be negative, while the dummy variable for the 2013 NHL Lockout should be positive.

During the studied seasons, several NHL teams change their AHL affiliations. In some cases, the name of the AHL team changes from one year to the next. In other cases, the AHL team changes all of their players as they associate with another NHL team. For instance, when the Springfield Falcons changed their NHL affiliates from the Columbus Blue Jackets to the Arizona Coyotes in 2015, all of the players with the Columbus Blue Jackets organization leave with the NHL team. Finally, the last change occurs when an NHL team uproots their AHL team and moves them to a completely different city. For example, in 2015, the San Jose Sharks migrate the Worcester Sharks to San Jose. Dummy variables for new name, new affiliate, and relocation capture these effects. I predict the new name and relocation coefficient to be positive as fan attendance sparks immediately after the change. I forecast the new affiliate will have a

negative coefficient because fans will not be interested in watching all new players that are viewed as rivals in previous seasons.

III. Variables Not Included

Unfortunately, the lack of information on AHL teams affects my results because more controlled variables help isolate the true effect of distance from NHL affiliate on AHL fan attendance. Specifically, I want to find a fan cost index or some sort of ticket price to include in my results. Simple economics teach that price can often change the demand of a product. So, if one AHL team has a higher price than another AHL team, then the demand for the higher price will go down, if all else is equal. So I predict fan attendance to be negatively affected by ticket price, but I am unable to find data on ticket prices. At the same time, ticket prices vary with the local income level in the community. Consequently, I cannot extract data on local per capita income for each of the cities at hand. I cannot find reliable income levels for Canadian cities after 2014, so I withdraw the variable.

Continuing with variables to isolate the differences in the city, I attempt to find statistics on population rates of each city. Population rates update every five to ten years; so I cannot include data if they do not have proper updates each year. I could find the population from one year and factor in the birth and death rates for the following years. However, this information does not include the number of people moving into and out of the city. Ultimately, the random effects estimator should capture changes from one city to the next; so missing data on population rates, and communal income levels does not affect the results.

Finally, my most discouraging search comes as I look for data to support promotional events in the AHL. As mentioned in my literature review, promotional events have positive effects on fan attendance in the AHL. So I attempt to recognize this effect and control it in my

analysis. I find that most AHL teams send out promotional events schedules for the current year. However, acquiring promotional events schedules online is not possible. While reviewing promotional events schedule's for this year, I notice that most AHL teams had twenty-five to thirty promotional events each year. The only team that had less promotional events was the Utica Comets. The Comets have a stadium capacity of 3,860, which is far below the league average. On top of that, the Comets sell out every game. So, in theory, if they sell all of their seats, they do not need to waste money on promotional events. If I had data on promotional events, I do not believe the results would be significant because aside from the Comets, each AHL team has similar amounts of promotional events. I wish I could find data on all of my theorized independent variables, but the American Hockey League lacks information.

Empirical Results

The following section outlines and compares the results from the pooled ordinary least squared estimator and the random effects estimator. The asterisks on the coefficients represent the level of significance for each of the independent variables in the charts. No asterisk means the variable has an insignificant effect on AHL fan attendance. One asterisk means the independent variable is significant at the 10 percent significance level. Two asterisks mean the variable is significant at the 5 percent significance level. Finally, three asterisks mean the variable is significant at the 1 percent significance level. First, the pooled ordinary least squared results are shown below.

Pooled OLS Estimator		
Variables	Coefficient	P-Value
Distance	-0.178576**	0.025
Point %	-85.24853	0.435
Point % Squared	1.013305	0.323
Goals	372.2866	0.367
Penalty Minutes	-41.3567	0.208
Stadium Capacity	0.0548824**	0.020
Age of Stadium	-22.65195	0.185
SA squared	0.0175772	0.939
NHL Fan Attendance	0.0364864	0.365
Other Sports Teams	109.2343***	0.005
Age of AHL Team	10.32862*	0.073
Age of NHL Team	-4.056515	0.366
DV New Affiliate	225.5933	0.450
DV Relocation	31.2585	0.933
DV New Name	-186.3292	0.848
DV Lockout	371.9467	0.184
Intercept	5565.238*	0.079

From the Pooled OLS estimator, the variable that represents distance from American Hockey League team to National Hockey League affiliate is significant at the 5 percent significance level. Furthermore, the distance variable also has the predicted sign on the coefficient. Therefore, as predicted, the distance from an NHL affiliate has a negative effect on AHL Fan Attendance. Holding all other variables equal, moving farther away from their affiliated NHL teams results in lower AHL fan attendance. When distance from NHL affiliate increases by 100 miles, AHL fan attendance is predicted to decrease by about 18 fans per game.

Other variables that have significant effects on fan attendance in the AHL include age of AHL team, stadium capacity, and other sports teams in the city. Age of AHL team is significant at the ten percent level and the coefficient is positive. As predicted, when AHL teams stay in their respective cities, they increase fan attendance because more time in the lead can lead to

more fan support. As the age of the AHL team increases by 1 year, fan attendance predicts to increase by over ten fans per game. So if a young team struggles with fan support, it should stay in the city and wait for support to develop with their age.

Stadium capacity has a positive effect on fan attendance in the AHL during the ten seasons from 2007 to 2017. Each additional 100 seats of capacity are predicted to increase fan attendance by over 5 fans a game. Obviously one might recognize that adding 100 seats may not be worth the expense if only five more fans walk through the door each game, but there is a positive relationship between fan attendance and stadium capacity that is significant at the five percent significance level. Originally, more sports teams in the city are anticipated to have a negative effect on fan attendance in the AHL because other sports teams are direct substitutes to the AHL team in that city. However, in the pooled OLS results, increasing the number of sports teams in the city actually increases the number of minor league hockey fans per game. Cities that have more sports teams might also have more sports fans. So, the more sports fans in the city outweigh the substitution effect of losing fans to other sports teams in the city. Holding all else constant, increasing the number of sports teams in a city is predicted to increase fan attendance by about 110 fans per game.

Unfortunately, all other variables that account for team performance, team history, affiliate's team history, stadium quality, and substitutions have insignificant effects on fan attendance in the American Hockey League from 2007 to 2017. The R squared of the pooled OLS estimator is 0.2427; therefore, the variation of the AHL fan attendance is explained by 24.27 percent of the variation in the independent variables. Also, the F statistic for the estimator is 6.73 and significant at the 1 percent level. However, the results from the random effects

estimator show different variables that have significant and insignificant effects on fan attendance in the American Hockey League from 2007 to 2017.

Random Effects Estimator		
Variables	Coefficient	P-Value
Distance	-0.0101305	0.909
Point %	-76.69332	0.104
Point % Squared	0.7750384*	0.068
Goals	-92.13182	0.611
Penalty Minutes	-19.12916	0.198
Stadium Capacity	0.1283022*	0.064
Age of Stadium	-48.14942	0.253
SA squared	0.7482679	0.158
NHL Fan Attendance	0.1167367***	0.000
Other Sports Teams	38.05839	0.782
Age of AHL Team	21.40693	0.105
Age of NHL Team	-14.49562***	0.003
DV New Affiliate	148.3768	0.395
DV Relocation	263.1847**	0.017
DV New Name	409.9775	0.234
DV Lockout	345.0868***	0.000
Intercept	4593.493***	0.010

With the random effects estimator results, the distance variable is no longer significant at any acceptable significance level. Obviously, since the random effects estimator accounts for more potential variables associated with the AHL city, I expect that other variables may lose significance. Despite the lack of significance, the distance from NHL affiliate still has the expected sign of the coefficient. Although the sign of the coefficient does not matter, as much, when the variable is insignificant, the results are still promising to see the coefficient has the expected sign.

The only variable that is consistent in both the pooled ordinary least squared estimator and the random effects estimator is the independent variable for stadium capacity. Stadium capacity is significant in the random effects estimator at the 10 percent level. Therefore, the new

results lose some significance, but capture the same sign and a higher coefficient. Holding all else equal, when stadium capacity increases by 100 seats, AHL fan attendance is predicted to increase by about 13 fans per game. Interestingly, the history of the NHL team matters in the random effects estimator. As the age of the NHL affiliate increases by one year, American Hockey League fan attendance is predicted to decrease by about 15 fans per game. The age of the NHL team is significant at the one percent level. I assume the age of the NHL team negatively affects minor league fan attendance because older NHL teams will draw more audience to their games and pull away from attending minor league games.

Moreover, the year after an AHL team relocates, the fan attendance is significant and is predicted to increase by about 263 fans per game. The dummy variable representing relocation is significant at the five percent level. Clearly, the year after relocations, teams experience a significant increase in fan attendance. The new communities that receive minor league teams display their support with this impressive increase in fan attendance.

In terms of the substitution effect, the random effects estimator provides mixed results. The dummy variable representing the 2012-2013 NHL Lockout shows that AHL fan attendance increases at the one percent significance level during the lockout year. As previous research shows, NHL and AHL games are direct substitutes. So, when the NHL is in the 2012-2013 lockout, minor league hockey games become more demanding as fan attendance is predicted to increase by about 345 fans per game. On the other hand, the variable representing NHL fan attendance is significant at the one percent level and the sign of the coefficient is positive. Interestingly, the positive relationship between NHL fan attendance and AHL fan attendance indicates that NHL popularity helps bolster ticket sales for their minor league affiliates. More popular NHL teams also increase the level of attraction for their AHL teams. Specifically, as

NHL fan attendance increases by 100 fans per game, AHL fan attendance is predicted to increase by about 12 fans per game. Therefore NHL and AHL games are direct substitutes when NHL games are not available to hockey fans, but they also have a positive relationship when both games are provided to the fans.

With a p-value of 0.104 and a significant squared term, win percentage has an effect on fan attendance in the random effects estimator. Obviously, most economists do not accept anything greater than 0.1, but this mere excess shows that win percentage still affects the dependent variable. Interestingly, win percentage actually has a negative coefficient with a positive squared term. Therefore, win percentage decreases fan attendance at an increasing rate. This negative relationship shows that fans do not favor games when the home town team wins. Statistically, the R-squared of the random effects model is 0.1038. So, about 11 percent of the variation in AHL fan attendance is explained by the variation in the independent variables.

Conclusion

Originally, this research set out to connect minor league fan attendance with distance between minor and major league affiliates. As National Hockey League player salaries swell out of control and municipalities restrict government support, the National Hockey League struggles to support the entire organization with their revenue. American Hockey League teams are left to make up more of their expenses. Finding a way to increase fan attendance will help AHL teams afford their expenses without relying on NHL revenue streams. Theoretically, I predict minor league hockey teams will have higher fan attendance figures when they locate closer to their major league affiliates. In my research, I find little support of my theory, but I do find alternative characteristics of minor league hockey fans.

Some of the empirical results directly explain how to increase fan support. For example, increasing stadium capacity positively and significantly increases fan attendance. Also, more NHL popularity leads to more support of the minor league affiliates. At the same time, AHL fan attendance increases the year after relocations and during NHL lockouts. Fan attendance actually decreases at an increasing rate when AHL team winning percentage increases. I am shocked to see win percentage negatively effects fan attendance at the minor league level. However, people that attend minor league games might root against the home team because they know that team affiliates with an NHL rival. I predict if AHL teams relocate closer to their NHL affiliates than win percentage will have a positive effect on fan attendance because the local fans will want to see the minor league teams win and show promise for the future of the NHL team.

Even though some findings do not directly support a way to increase fan attendance at American Hockey League games, the results reveal characteristics of minor league fans. Furthermore, understanding these fans leads to potential ticket maximization techniques. Even insignificant variables detail patterns of fan attendance during the examined period from 2007 to 2017. With an examination of all the results, AHL fans represent a group of disloyal fans looking for an event to pass their time on the weekends.

In order for fan attendance to increase when minor league hockey teams relocate closer to their major league affiliates, fans must acknowledge the existence of the affiliations. While some devoted hockey fans recognize the affiliations between major and minor league teams, many people attend minor league games without recognizing the affiliations. For instance, the Springfield Falcons changed their NHL affiliation three times from 2007 to 2017 and the results speculate that fans do not even acknowledge the changes. The year after the Springfield Falcons changed affiliates in 2010, their attendance rose by 88 fans per game, which is a very

unsubstantial amount. Then in 2014, the next change actually decreases attendance by 165 fans per game. Together, both years show that the affiliation changes have little effect on fan attendance in the AHL. Since the dummy variable for change in affiliations is insignificant in both estimators, the results conclude that fans do not recognize changes in affiliations.

I anticipate fan attendance effects after affiliation changes because players on the teams also change with the affiliates. Therefore, years following affiliation changes may attract more fans as they grow eager to see the new talent. However, previous fans may also lose interest after their favorite players depart with the old affiliates. At the same time, careers in the AHL are much shorter than careers in the NHL because teams constantly develop new talent. Players in the AHL either move on to the next level or they retire if they cannot manage to reach the next level. As a result, AHL fans are accustomed to player changes. Ultimately, the changes in affiliations have no significant effects on fan attendance. If fans do not react to changes in affiliations then migrating to affiliates has no effect on fan attendance at the minor league level.

Minor league hockey fans not only do not react to affiliation changes, but also do not respond to the in game measures. Neither estimator displays significant effects from goals scored per game. Moreover, none of the team performance variables are significant at the 5 percent level. Winning percentage and goals per game show significant effects in previous research; however, this study does not find the same. A lack of significance in performance measures illustrates that fans are not concerned with the outcome of the games. Since penalty minutes per game is negative and significant at the ten percent level in the pooled OLS model, I predict more families attend minor league hockey games. In this case, families attend games when parents believe teams will not represent bad influences on the children.

With a closer examination of the results from both the pooled ordinary least squared estimator and the random effects estimator, I understand the minor league hockey fan more clearly. Minor league hockey fans choose to attend hockey games similar to the way they choose to attend the movies. Sometimes, movies dates are selected for a certain film that is in theaters. Similarly, fans attend hockey games for certain promotional events or opponent matchups. Primarily, these activities are randomly selected as something for families and friends to do to pass the time. Instead of attending a minor league hockey game to see a fight, a goal, or a win, fans occasionally attend games for the excitement and ease of attending the local team.

Now that I understand the minor league hockey fan is not a dedicated supporter of the local minor league, I still believe fans can benefit from relocating closer to their major league affiliates. Distances from NHL and AHL teams are decreasing in recent years as teams relocate to cut down on travel costs. I predict a few years after these relocations, my theory will hold some value because teams will have more time to develop their relationships with the local minor league teams and broadcast their connections with the local major league teams.

Furthermore, if AHL teams take the name of their NHL affiliates in the same area, then they will see additional benefits because the local fans will recognize the connection more. As a result, teams should still relocate to minimize costs; but there is no statistical support at this time to connect American Hockey League fan attendance and distance from National Hockey League affiliate.

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