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PREDICTING THE FINANCIAL BENEFIT FROM RELOCATING STRUGGLING NHL FRANCHISES TO HIGH-DEMAND MARKETS

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ABSTRACT

This paper analyzes the factors determining demand for National Hockey League (NHL) franchises and examines the degree to which these factors affect financial success given hockey-related revenue as an indicator. Using data from nine seasons, the effect of several demand factors on hockey-related revenues was determined through regression analysis. For example, hypothesizing that financially successful NHL franchises are in areas with a high general demand for hockey, some NHL franchises are not optimally located for financial success. In the regression model, youth hockey participation rates are used as a proxy to determine an area's demand for hockey. Youth hockey participation rates are expected to have a statistically significant positive correlation with hockey-related revenues. Prior to determining optimal relocations, recent financial data is used to identify struggling franchises. Using the statistically significant coefficients from the regression results, optimal relocation areas are selected for the struggling NHL teams. Hockey-related revenues are then predicted for the new locations, using estimated demand factor coefficients obtained from the regression results and new location demand data. Columbus, Ohio; Raleigh, North Carolina; St Louis, Missouri; and Phoenix, Arizona were selected to relocate to Quebec City, Quebec; London, Ontario; Hartford, Connecticut; and Milwaukee, Wisconsin respectively. After considering relocation costs, all moves proved to be financially beneficial. The estimated demand factor coefficients, combined with the new location data, predict an average increase in hockey-related revenue, less relocation costs, of 17% for these moves.

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I. Introduction

Some National Hockey League (NHL) franchises are not located in optimal locations to produce financial success. Many franchises are suffering because they are located in areas with low demand for the NHL. There are many possible high demand locations without teams that could produce much more lucrative revenues and profits if the struggling NHL franchises relocated to these locations. Based on the Forbes' (2012) NHL revenue information, the Toronto Maple Leafs, New York Rangers, Montreal Canadiens, and Vancouver Canucks generated 21.5% of the gross revenue for the 30 teams in the NHL during the 2011-2012 season. These four teams also grossed $237.9 million in operating income, while the bottom thirteen teams grossed a $130.2 million loss during the 2011-2012 season (Forbes, 2012). During the 1990s and early 2000s, franchises relocated to Colorado, Phoenix, and Carolina and the NHL opened expansion teams in Tampa Bay, Ottawa, Florida, Anaheim, Nashville, Atlanta, Minnesota, and Columbus. Of the thirteen teams with negative net operating income during 2011-2012, eight were recently relocated or expansion teams.[1] In addition to these eight struggling teams, Atlanta relocated to Winnipeg prior to the 2011-2012 season. Colorado, Winnipeg, and Ottawa did well despite being franchises in new locations.[2]

The NHL envisioned that relocating and expanding franchises to new areas during the 1990s and early 2000's would generate demand for hockey in these markets. By tapping into these markets, the NHL hoped to generate additional profits. However, the moves failed to generate a demand large enough to outweigh the costs and teams did not make a positive profit in the majority of the new locations. The Atlanta Thrashers recently relocated to Winnipeg and became the Jets. Why would the Thrashers move to a new market one-sixth the population of the current market? Winnipeg likely has many more hockey fans than Atlanta despite having a smaller population, demonstrated by the recent financial success of the

[1] Recently refers to after 1990.
[2] According to the Forbes data, Winnipeg and Ottawa ranked in the top 10 in terms of operating income for the 2011-2012 season (Forbes, 2012).

Jets. By relocating from an area with a low demand to an area with a high demand for hockey, one of the thirteen financially struggling teams in the NHL became one of the most lucrative.[3]

The NHL has many financially struggling franchises and has had two lockouts in the past ten years resulting from financial disputes between owners and players. The NHL must change something to solve the financial struggles and eliminate lockouts in the future.[4] Moving current struggling franchises in low-demand markets to new locations with a high demand for hockey could solve the financial problems by creating higher revenues for the struggling franchises. But what drives demand for the NHL? Is demand driven as a result of the team existing for many years and generating a large fan base due to its historic presence? Do large cities have a larger demand, due to larger populations? Does a team generate demand when it does well on the ice and wins championships? Or does a team simply succeed financially because the area has a large general demand for hockey, not just the NHL?

I predict that all of the factors mentioned above contribute to the financial success of a franchise. However, I believe the biggest contributor to the financial success of NHL franchises is location, with successful teams located in areas that have a large demand for hockey in general. I will use youth hockey participation rates as an observable, quantifiable measure of the general demand for hockey in a given area. Out of the top four revenue-generating teams, three are located in hockey-loving Canada. In addition, Montreal is a small city and their NHL team does much better financially than the teams in large American markets. These successes are no surprise, as there is a much higher general demand for hockey in Canada compared to the majority of the United States. Moving teams from low-demand to high-demand hockey markets in Canada and in the hockey hotbeds of the United States could potentially be lucrative relocations for struggling franchises.

[3] According to the Forbes data, revenues increased from 71 (Atlanta) to 105 million (Winnipeg) from 2010-2011 to 2011-2012 as a result of the move and net operating income increased from -5.2 to 13.3 million (Forbes, 2012).
[4] Lockouts are costly to the NHL's owners and players. In addition, fans are hurt when games are canceled.

The financial success of NHL franchises is determined largely by gross demand.[5] I will create a database for each of the past nine seasons, in each team's location, of observable, quantifiable factors that potentially increase NHL demand. Combining this database with previous financial data on each team, I will analyze the relationship between demand factors and financial status, using regression analysis. After obtaining results from the regression analysis, I will analyze what affects financial success and quantify their effect on success. Using this analysis, I will select struggling NHL teams to relocate and determine their optimal relocation areas. I will then use the relationship between observable demand factors and financial success to predict how revenues will change for struggling franchises after they move to a new location.

[5] Other factors, such as the efficiency of the Management, are also relevant. However, this information cannot be analyzed because the NHL financial information is not publically available, as all teams are privately owned.

II. Review of Mowat Centre for Policy Innovation Study

Policy analysts have hypothesized that Canadian teams produce larger revenues and operating incomes because Canada has a higher demand for hockey than most areas in the United States. The University of Toronto's Mowat Centre for Policy Innovation conducted a study, entitled "The New Economics of the NHL, Why Canada can Support 12 Teams," analyzing the financial success of Canadian franchises (Keller and McGuire, 2011). The authors, Keller and McGuire, create a simple regression to quantify the effect of wealth, population, and geographical location on revenues.[6] For geographical location, a binary variable ("dummy") equal to 1 was created if the team was located in Canada and 0 if otherwise. The authors name this dummy variable the "hoser" effect.[7] Based on this analysis they determined that franchises in Canada generate $24 million more gate revenue, revenue received from ticket sales, than teams in the United States. In addition, they determined wealth has an insignificant impact on gate revenue and each additional million in population generates $2 million in gate revenue. This makes sense intuitively because areas with higher populations in high hockey demand Canadian markets are expected to have a higher demand for the NHL. These conclusions provide a beneficial background for my analysis and predictions. However, the regression used in Keller and McGuire's analysis is much too simple to analyze what truly affects revenues.

I will not consider the "hoser" effect in my regression because youth hockey participation rates will capture the elevated demand for hockey in Canada. Demand for NHL teams is greater in Canada only as a result of the fact that they have a higher demand for hockey compared to the majority of U.S. markets. The Canadian binary and youth hockey are highly correlated. Therefore, including both variables results in multicollinearity. This will not affect the accuracy of the model, but it will affect the interpretation of the two variables, which could restrict the ultimate goal of the regression analysis in this paper. Including both variables may result in the Canadian binary masking the true effect of the youth

[6] The authors used the Forbes estimated gate revenues.

[7] In Canada "hoser" is a slang term used jokingly between Canadians and is similar to the term "loser." The term is a originates from hockey because, before Zambonis, the losing team had to "hose" down the ice.

hockey participation variable because of multicollinearity. I believe youth hockey participation rates are a more accurate indicator of hockey demand because they can quantify geographical differences in hockey demand between all NHL markets.

The "hoser" effect only compares general geographical differences in hockey demand between Canada and the United States. Therefore I am able to consider locations within both Canada and the United States by using the youth hockey variable instead of the Canada binary variable. For example, the Keller and McGuire model would assume Boston and Minnesota have a low demand for hockey because these cities are not in Canada. However, Boston and Minnesota have youth hockey participation rates higher than some areas of Canada.[8] In addition, Allen and McGuire do not adjust for winning percentage or making the playoffs.[9] Therefore, their model leaves out demand factors that likely increase revenue. If Canadian teams happen to be winning teams, their prediction of $24 million resulting from the "hoser" effect would be overstated because part of the increased revenue could be due to the fact that Canadian teams may have higher winning percentages.[10] I believe their analysis provides the foundation for my analysis. However, I will develop a more complex and accurate econometric model to analyze what affects revenues.

The Mowat Policy Paper also highlights the differences between the NHL and the MLB, NBA, and NFL. The NFL, NBA, and NFL have lucrative national TV contracts and the NHL does not. The authors explain how the recent moves of the 1990s and early 2000s were in hopes to gain a lucrative national TV contract. The NHL has not yet gained a very large national TV contract. The paper points out that the Levitt report, an analysis of the NHL's 2002-2003 financials, found 52% of league revenue was produced by gate revenues and another 21% was produced by premium seats, food sales, other concessions, and in-arena advertising (Levitt, 2004). This means the majority of the league's revenue is produced locally, not through lucrative national TV contracts. As a result, the local demand for an NHL

[8] See Table 4.3. Boston and Minnesota have a higher youth participation rates compared to Winnipeg.
[9] The authors admit they leave these factors out and that the factors could affect revenues.
[10] Winning teams increase demand, therefore increasing revenue.

team generates the majority of that team's revenue. Due to the evidence that local demand is the most important factor leading to financial success in the NHL, I will create a model heavily based on local factors.[11]

Keller and McGuire conclude with a qualitative analysis producing the grades of potential cities for new or relocated teams shown in Table 1.1.[12]

Table 1.1: Qualitative Analysis of Canadian Markets

City	Grade
Edmonton	B+
Toronto	A to A-
Hamilton	A-
Montreal	A-
Kitchener - Waterloo	B+
Vancouver	B to B+
London	B
Winnipeg[13]	B-
Quebec	B-
Saskatoon	C+
Halifax	C

Source: Keller and McGuire

Table 1.1 offers locations in Canada for consideration of relocation. Saskatoon and Halifax will not be considered because of their low grades. In addition, Montreal, Edmonton, and Vancouver are not large enough to support a second team and will also not be considered. In all professional sports, including the NHL, markets with two teams must have very large populations.[14] Hockey fans already follow the Canadiens, Oilers, and Canucks in these cities. Therefore, it is highly unlikely that adding a second team will generate a following in Montreal, Edmonton, or Vancouver that is large enough to support the team financially. The Mowat Policy paper divides the population by two in its qualitative

[11] The general increased popularity of the NHL and general increase in regional and national TV contracts, although they are not huge like the NFL contracts, will be captured by the time series I develop (explained in Section IV).
[12] These grades are based on the following weights for the following factors: 20% local population, 30% regional population, 10% population growth, 10% median after-tax household income, 15% number of high-income households, 10% corporate strength, 5% arena. The grades for the factors were determined through qualitative comparison.
[13] Already has a team but did not have a team at the time the Mowat Policy paper was completed.
[14] New York and Los Angeles metro areas have multiple teams and very large populations.

analysis for these cities. However, it is not a safe assumption to assume half the hockey fans in these areas will automatically support a new team instead of the incumbent. Therefore, the grades they gave these cities may be inflated.

Due to its large market size, the Toronto area may be able to support a second franchise. Toronto is the only Canadian area with a population similar in size to the two areas in the NHL that currently have multiple franchises. A team in Toronto, Hamilton, or Kitchener-Waterloo would be entering an area loyal to the Maple Leafs. However, the population may be large enough to support a second team, appealing to hockey fans who are not Leafs fans.[15] The following regression analysis will econometrically adjust for areas already loyal to a team ("loyalty effect").

London, another city in Ontario, is similar to Kitchener-Waterloo in size and geographical area. The only difference is that London is further away from Toronto. Therefore, the loyalty effect is likely to be smaller in London. From this assumption, Kitchener-Waterloo is not considered as a possible relocation area because London is believed to be a superior location for a team. In addition, Hamilton will be considered over Kitchener-Waterloo because its population is about 33% larger (Statistics Canada, 2013).

Keller and McGuire do an excellent job explaining why the NHL is failing financially and offer an analysis of viable Canadian cities for relocation. However, their econometrics fall short of predicting the impact of demand factors on revenue because their regression is oversimplified. This paper creates a regression that realistically models revenues. In addition, this study expands on their analysis, using regression results from an improved model to quantify predicted revenues for possible new locations in Canada and the United States.

[15] The Mowat paper estimates that there are about 9 million people in the Greater Toronto Area (including Hamilton and Kitchener-Waterloo). In comparison, there are about 5 million people in the Greater Montreal Area. A more realistic assumption of fans supporting a new team, compared to the 50% the Mowat paper assumes, would be 10%. 10% is an accurate prediction because it is likely that one out of every ten hockey fans in Canada is not already loyal to a Canadian team. At 10% Montreal and other areas listed above with multiple teams (Montreal is the biggest area outside of Toronto) shrink to below 500,000 possible hockey fans, making adding a new team in these markets unrealistic. In the Greater Toronto Area, this number adjusts to about 900,000, which may be enough to support a new team.

III. Hockey-Related Revenue

I use hockey-related revenue (HRR) as an indicator of the financial success of hockey franchises. Hockey-related revenue is defined in the 2005 Collective Bargaining Agreement between the NHL and NHL Players Association. Essentially, HRR is revenue net of "direct costs" for hockey-related activities (NHL CBA, 2005). Hockey-related revenue includes NHL regular season, pre-season, and playoff gate revenues and revenue from local cable broadcast, national broadcasts, local radio broadcast, luxury boxes, novelty sales, concessions, game parking, and other hockey-related activities. "Direct costs" include "any cost, including fixed and variable costs, attributable to a revenue-generating activity" such as "arena occupancy costs, and general and administration expenses" (NHL CBA, 2005). In general, HRR is the resulting revenue after the costs are deducted from the gross revenue created by hockey-related activities. HRR does not include revenue received from revenue sharing (which redistributes a fraction of revenues from the financially successful teams to the financially unsuccessful teams), relocation of other teams, or interest income (NHL CBA, 2005).

To estimate HRR, I use the Forbes database of revenues over the past 9 seasons for all NHL teams. The Forbes revenue is "net of revenue sharing and arena debt service" (Forbes, 2012). "Arena debt service" is the payments made on "arena occupancy costs." By deducting arena occupancy costs, the Forbes data is close to hockey-related revenue. However, Forbes includes revenue received from revenue sharing agreements. Because HRR does not include revenue sharing, I will adjust the data to pre-revenue sharing values by reversing the revenue sharing agreement, using the revenue sharing formulas to predict what HRR was for each team before these formulas were applied to redistribute revenue among teams. By comparing actual gross HRR to the Forbes revenues, I can determine if the Forbes data includes any additional sources of revenue or leaves out any additional costs that the NHL deducts from HRR. Table 2.1 summarizes gross Forbes revenue compared to gross actual HRR.

Table 2.1: Actual HRR v. Forbes Revenue

Season	Actual HRR ($ billions)	Forbes Revenue	Percentage
2002-2003	2	2.09	95.30%
2003-2004	2.08	2.27	91.90%
2005-2006	2.18	2.27	96.10%
2006-2007	2.32	2.44	95.20%
2007-2008	2.61	2.75	94.90%
2008-2009	2.62	2.82	93.00%
2009-2010	2.78	2.93	94.80%
2010-2011	2.93	3.09	94.80%
2011-2012	3.3	3.3	100.00%

Sources: 2002-2003 to 2005-2006 seasons (Vrooman, 2008), 2007-2008 (Tolensky, 2009), 2008-2008 (Shoalts, 2012), 2009-2010: estimated using average of post-lockout percentages, 2010-2011 (Oakes, 2011), 2011-2012 (Stubitz, 2012)

Because the Forbes data is slightly overestimated, I assume the data includes a few additional sources of revenue, or do not include a few of the costs, compared to actual HRR. Therefore, I adjusted the post-revenue sharing Forbes revenue estimates by taking the percentage shown in Table 2.1 from each team's Forbes revenue for each season. The Forbes data is now adjusted to post-revenue sharing HRR. In the next section, I will use the revenue sharing agreement to determine pre-revenue sharing HRR.

I use HRR to determine how well a team performs financially. The NHL's financial information is confidential. Therefore, it is not possible to determine what affects operating income because cost information is not available.[16] A low operating income could be the result of high costs or low demand. Because cost information is not available, revenue is the best indicator of the financial success of a hockey franchise. Outside of stadium payment costs, hockey franchises have similar costs because their organizations have similar costs. However, the Forbes data deducts stadium costs from their revenue numbers. Therefore, after adjusting the Forbes data to pre-revenue sharing amounts, the data will reflect the financial success of a team compared to other teams. In addition, there is available information on demand factors to analyze what affects revenue.

[16] Forbes also publishes operating income data.

III.A. Revenue Sharing

Calculating Redistribution Amount

In order to determine what affects HRR, I adjust the post-revenue sharing Forbes data to pre-revenue sharing values. Including funds received from revenue sharing and not including funds contributed to revenue sharing causes HRR to inaccurately reflect the true financial success of a team. For example, if Phoenix receives a substantial amount of funds from the revenue sharing agreement, using their post-revenue sharing HRR would not be representative of their financial status. I adjust the data to pre-revenue sharing values, using the NHL's revenue sharing agreement. This section explains the revenue sharing formula and methodology I used to adjust the Forbes data to pre-revenue sharing HRR. I use the revenue sharing formula from the 2005 Collective Bargaining Agreement between the NHL and NHL Players' Association.

First, the amount of funding needed to support the low-earning teams must be calculated. I will refer to the amount needed for low-earning teams as the "redistribution amount." The NHL shares revenue at the conclusion of the playoffs each season. The first step is to determine each team's available compensation. Available compensation is calculated by deducting the "midpoint" from each team's HRR. A league midpoint and minimum are calculated using Equation 1 and 2 below. Table 3.1 highlights previous season midpoints and minimums.

Equation 1: Midpoint = [((NHL gross HRR) x (player's share)] / # of teams (30).

Equation 2: Minimum = .0115 x (NHL gross HRR).

3.1: League Revenues, Players' Share[17], Midpoint, and Minimum

Season	HRR (mil)	Player's Share	Midpoint	Minimum
2002-2003	2000	54%	36.00	23.00
2003-2004	2080	54%	37.44	23.92
2005-2006	2180	54%	39.24	25.07
2006-2007	2320	55%	42.53	26.68
2007-2008	2610	56%	48.72	30.02
2008-2009	2620	56%	48.91	30.13
2009-2010	2780	57%	52.82	31.97
2010-2011	2930	57%	55.67	33.70
2011-2012	3374	57%	64.11	38.80

Source: Forbes HRR data ("HRR (mil)") and 2005 CBA ("Players' Share")

For teams that have available compensation less than the midpoint, their funding needed is calculated using Equation 3.[18]

Equation 3: funding needed = midpoint – max(available team compensation, Minimum).

Funding Eligibility

However, some teams do not receive the total funding needed. If a team ranks in the top 15 for HRR, they are automatically not eligible for funding. Teams with a designated market area of over 2.5 million households, defined by Nielson Media Research, are automatically removed from consideration for funding.

Funding for eligible teams is reduced if a team's growth rate in HRR is less than the league's growth rate or if their average attendance is less than 13,125.[19] If a club fails to meet either criterion, the funding they receive is reduced 25% for a first offense, 40% for subsequent two-year offenders, and 50% for subsequent three-year offenders. After the funding eligibility guidelines are applied, each team's funding needed is determined. The sum of all team's funding needed is the redistribution amount.

[17] The players' share is the amount of league HRR the players' receive in salary. The 2005 CBA states the player share is 54% when league revenue is below 2.2 billion, 55% when it is 2.2-2.4 billion, 56% when it is 2.4-2.7 billion, and 57% when it is above 2.7 billion.

[18] For example, if a team's available compensation was 40 million during the 2011-2012 season their funding needed is 61.11-40. For a team with an available team compensation of 30 million, their funding needed is 61.11-38.80.

[19] Teams didn't have an average season attendance less than 13,125 after 2002, based on ESPN hockey attendance numbers.

III.A.1. Funding the Redistribution Amount

There is a four-step process to generate the gross funding for the redistribution amount. The process includes the Central League Revenue Phase, Escrow Account Phase, Playoff Funding Phase, and Supplemental Phase.

Central League Revenue Funding Phase

The first funding phase is the Central League Revenue Funding Phase. The largest part of central league revenue is TV contracts. In this funding phase, up to 50% of the total central league revenue exceeding $300 million may be used to supply up to 25% of the redistribution amount. The NHL's national and regional TV contracts are worth $350 million a year (Hodgeson and Lefebvre, 2011).[20] This $350 million represents the bulk of the NHL's central league revenue. However, the central league revenue also includes "net revenue generated by NHL enterprises" (NHL CBA, 2005). NHL enterprises include revenue generated by NHL Game Center, an NHL product that streams games over the Internet. NHL enterprises also include NHL Network, a cable channel. Every piece of merchandise sold with the NHL logo generates central league revenue. Revenue for the NHL enterprises is not publically available. I believe these NHL enterprises will easily generate over $50 million in a year. Assuming the central league revenues generate around $400 million, this phase could contribute $50 million towards the redistribution amount.[21]

However, if this $50 million exceeds 25% of the redistribution amount, 25% of the redistribution amount will be funded by central league revenue. The NHL shared $150 million during the 2011-2012 season (Badenhausen, 2012). Therefore, the redistribution amount was $150 million during 2011-2012. Because $50 million exceeds 25% of $150 million, the league must have used $37.5 million of central league revenues to fund the redistribution amount. The NHL distributes central league revenues evenly among teams after a portion of the central league revenue is allocated to fund up to 25% of the

[20] Regional TV contracts are considered central league revenue. For example, a $100 million Canadian TV contract is split among the 30 NHL teams when central league revenues are evenly distributed.

[21] I believe $400 million is a conservative estimate. $50 million was calculated by taking (400-300) x 50%.

redistribution amount. Essentially, an even amount money is indirectly taken from each team during the Central League Revenue Funding Phase.[22] To adjust the post-revenue sharing HRR to pre-revenue sharing numbers for 2011-2012, $1.25 million was deducted from each team.[23] I used the same technique for each season.

Due to the privacy of the information, I was not able to find the amount of HRR shared for other seasons. Of the total league HRR, 4.44% was shared during the 2011-2012 season.[24] Therefore, I took 4.44% of league-wide HRR to calculate the estimated revenue shared, or redistribution amount, for the other seasons. In 2011-2012 the funding available for the Central League Revenue Funding Phase exceeded the limit by $12.5 million based on my conservative estimate of gross central revenue.[25] Therefore, I assume the central league funding phase supplies 25% of the redistribution amount every season. Therefore, I further adjust the Forbes data using Equation 4. Table 3.2 highlights the estimated revenue taken from each team during the Central League Revenue Funding Phase.

Equation 4:[26] Adjusted Forbes HRR = (Forbes HRR) + ([(Redistribution Amount) x (25%)] / 30).

Table 3.2: Redistribution from Central League Revenue Funding Phase

Season	Redistribution Amount ($ mil)	Revenue Taken from each Team ($mil)
2002-2003	88.80	0.7400
2003-2004	92.35	0.7696
2005-2006	96.79	0.8066
2006-2007	103.01	0.8584
2007-2008	115.88	0.9657
2008-2009	116.33	0.9694
2009-2010	123.43	1.0286
2010-2011	130.09	1.0841
2011-2012	150.00	1.2500

Source: Calculations derived from adjusted Forbes HRR

[22] The teams would receive this revenue if it were not for the revenue sharing agreement.
[23] 37.5 / 30 = 1.25
[24] I calculated this number from Badenhausen's article stating that $150 million was shared during the 2011-2012 season and assuming league HRR was 3374 million during this season.
[25] 50-37.5 = 12.5
[26] Add, not subtract, because the Forbes data is post-revenue sharing. Therefore, the Forbes data does not include the indirect Central League Funding contributions.

Escrow Account Funding Phase

The second phase is the Escrow Account Funding Phase. A fraction of each player's salary for the year is allocated to the Escrow Account. At the end of each season the NHL returns the remaining salary to all players. If league-wide player compensation, including the amount in the Escrow Account, is greater than players' share of HRR, a percentage of the Escrow Account is redistributed to the owners before the players receive the rest of their salaries on a prorated basis. Up to 1/3 of the remaining funding needed after the Central League Funding Phase for the redistribution amount may be funded by the Escrow Account Funding Phase. If league-wide player compensation is greater than the players' share of hockey-related revenue, this phase is used (NHL CBA, 2004). However, league-wide player compensation rarely exceeds the players' share by a significant amount and therefore, I will not consider this phase in my calculations.[27]

Playoff Funding Phase

The third phase in the revenue sharing agreement is the Playoff Funding Phase. This phase may account for up to 50% of the remaining funding needed to fund the lower earning franchises. Table 3.3 explains where the revenue comes from for this phase.

Table 3.3: Playoff Funding Phase Explained

Category	Contribution per Home Playoff Game
Top 10 Teams in HRR for regular season and preseason	50% of ticket value, net of taxes, for a sold-out regular season game*
Middle 10 Teams in HRR for regular season and preseason	40% of ticket value, net of taxes, for a sold-out regular season game
Bottom 10 Teams in HRR for regular season and preseason	30% of ticket value, net of taxes, for a sold-out regular season game

* For arenas with over 17,500 seats, they calculate the percentage of 17,500 to the seating capacity of the arena multiplied by the total ticket value for a sold-out regular season game.

Source: 2005 Collective Bargaining Agreement between the NHL and NHLPA.

Using the post-revenue sharing Forbes HRR data, I estimated the top ten, middle ten, and bottom ten teams in terms of hockey-related revenue for each season. I also created a database, using NHL.com

[27] If this phase were included, it would only fund a small portion of the redistribution amount. Therefore, leaving it out of my estimates has little effect on the accuracy of my pre-revenue HRR data.

calendars, to determine the amount of home playoff games each team had in a given season. I found the capacity of each arena shown in Table 3.4.

Table 3.4: NHL Arena Capacities

Team	Capacity
Toronto Maple Leafs	18,800
New York Rangers	18,200
Montreal Canadiens	21,273
Detroit Red Wings	20,066
Boston Bruins	17,565
Chicago Blackhawks	19,717
Vancouver Canucks	18,890
Philadelphia Flyers	19,537
Pittsburgh Penguins	18,387
Los Angeles Kings	18,118
Dallas Stars	18,532
Washington Capitals	18,398
Calgary Flames	19,289
Minnesota Wild	18,064
Edmonton Oilers	16,871
San Jose Sharks	17,562
Ottawa Senators	19,153
Colorado Avalanche	18,007
Anaheim Ducks	17,174
New Jersey Devils	17,625
Tampa Bay Lightning	19,758
Buffalo Sabres	18,690
Carolina Hurricanes	18,680
Winnipeg Jets	15,004
Nashville Predators	17,113
Florida Panthers	17,040
St Louis Blues	19,150
Columbus Blue Jackets	18,144
New York Islanders	16,234
Phoenix Coyotes	17,125
Pittsburgh Penguins	16,940
Atlanta Thrashers	18,545

*Pittsburgh Penguins capacity was 16,940 before moving to the CONSOL Energy Center for the 2011-2012 season, which has a capacity of over 18,000.

Source: StatsHockey NHL Arenas

I set the maximum arena capacity at 17,500 for my calculations. To determine the total amount of ticket revenue for each team per game, I multiplied arena capacity by average regular season ticket price using Team Marketing Report's average NHL ticket prices. I estimated each team's playoff funding contribution by Equation 5. The results of the Playoff Funding Phase for the 2011-2012 season are highlighted in Table 3.5.

Equation 5: Playoff Funding Phase Contribution = (# home playoff games) x (arena capacity) x (average ticket price) x (percentage responsible, based on Forbes post-revenue sharing HRR and Table 3.3).

Table 3.5: Calculation of Playoff Ticket Contribution Phase for 2011-2012 Season

Team	Home Playoff Games	Average Season Ticket Price	Estimated Total Contribution before % taken	Percent Shared	Amount Contributed to Revenue Sharing (millions)
Anaheim Ducks	0	$45.58	-	30%	-
Boston Bruins	4	$58.94	$4,125,800.00	50%	$2.06
Buffalo Sabres	0	$38.25	-	40%	-
Calgary Flames	0	$68.18	-	40%	-
Carolina Hurricanes	0	$41.58	-	30%	-
Chicago Blackhawks	3	$55.72	$2,925,300.00	50%	$1.46
Colorado Avalanche	0	$40.62	-	30%	-
Columbus Blue Jackets	0	$47.95	-	30%	-
Dallas Stars	0	$29.95	-	40%	-
Detroit Red Wings	2	$53.28	$1,864,800.00	50%	$0.93
Edmonton Oilers	0	$70.13	-	40%	-
Florida Panthers	4	$55.67	$3,794,467.25	30%	$1.14
Los Angeles Kings	9	$51.92	$8,177,400.00	50%	$4.09
Minnesota Wild	0	$62.63	-	40%	-
Montreal Canadiens	0	$88.67	-	50%	-
Nashville Predators	5	$51.04	$4,367,237.50	30%	$1.31
New Jersey Devils	12	$45.86	$9,630,600.00	50%	$4.82
New York Islanders	0	$49.06	-	30%	-
New York Rangers	11	$66.20	$12,743,500.00	50%	$6.37
Ottawa Senators	3	$55.51	$2,914,275.00	40%	$1.17
Philadelphia Flyers	6	$66.89	$7,023,450.00	50%	$3.51
Phoenix Coyotes	9	$36.15	$5,571,619.00	30%	$1.67
Pittsburgh Penguins	3	$63.06	$3,310,650.00	40%	$1.32
San Jose Sharks	2	$49.73	$1,740,550.00	40%	$0.70
St Louis Blues	5	$41.57	$3,637,375.00	30%	$1.09
Tampa Bay Lightning	0	$37.75	-	30%	-
Toronto Maple Leafs	0	$123.77	-	50%	-
Vancouver Canucks	3	$68.38	$3,589,950.00	50%	$1.79
Washington Capitals	6	$62.42	$6,554,100.00	40%	$2.62
Winnipeg Jets	0	$98.27	-	40%	-
				TOTAL	**$36.06**

Source: Team Market Report NHL Ticket Values (for ticket prices), NHL.com Calendar (for number of playoff games), Forbes revenue data and 2005 NHL CBA (for percentages)

During the 2011-2012 season the Playoff Funding Phase supplied about 32% of the remaining redistribution amount.[28] This is less than the maximum 50% for this phase.[29] Therefore, I add the amount

[28] 36 / (150-37.5) = 32%.

contributed in "Amount Contributed to Revenue Sharing (millions)" shown in Table 3.5 to the post-revenue sharing Forbes HRR data to move towards pre-revenue sharing numbers. I use this same method for all of the other seasons.[30]

Supplemental Funding Phase

The last funding phase is known as the Supplemental Funding Phase. The top ten HRR-earning teams are responsible for a percentage of the remaining funding needed for the redistribution amount. The percentage is calculated by comparing the top 10 teams to the 11th ranked HRR-earning team. Equations 6 and 7 calculate the percentage of funding each team is responsible for.

1. **Equation 6:** Team x's preseason & season revenues – Team 11's = Team x's incremental value.
2. **Equation 7:** Sum of incremental values for top ten teams / Team x's incremental value = Team x's supplemental %.

There is a cap of 20% for any team's supplemental percentage. If teams are set at the cap because their preliminary supplemental percentage exceeds 20%, the supplemental percentage is adjusted using Equation 8. If every team's supplemental percentage is below 20%, Equation 7 is sufficient and Equation 8 is not considered.

Equation 8: Supplemental % for non-capped x team = [1-(20% x (# of capped teams))] x [(sum of incremental values for non-capped teams) / (Team x's incremental value)] = Team x's supplemental %.

After calculating each team's supplemental percentage, the percentages are multiplied by the redistribution amount remaining, after the Central League and Playoff Funding Phases are deducted, to determine the amount each top-10 team will contribute to fund the lower earning teams as part of the revenue sharing agreement.

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[29] The Playoff Funding Phase never reached over 50% of the remaining redistribution amount for any season during the period I collected data for.

[30] I adjust for changes in arena capacity and ticket prices by using the correct year's data.

I used Equations 6, 7, and 8 to predict the amount each team contributed during the Supplemental Funding Phase. First, I adjusted post-revenue HRR Forbes data by adding back in the Playoff Funding contribution and Central League Funding contribution for each team by season to move as close as possible to pre-revenue sharing estimates. Next, I calculate available team compensation by subtracting the midpoint from the newly adjusted hockey-related revenue.[31] After ranking teams by adjusted HRR, the 11th ranked adjusted HRR is determined.[32] Using the 11th-ranked team's HRR after adding in the playoff and central phase contributions, I calculate the top 10 teams' incremental values.[33] After totaling the top 10 incremental values, I apply Equation 7 and Equation 8 (if needed) to the top 10 teams to calculate the top 10 teams' supplemental percentage.[34] To determine each team's contribution, I multiply the supplemental percentage by the remaining redistribution amount.[35]

After determining each of the top ten team's contribution, this number is added to each team's HRR to adjust their HRR to pre-revenue sharing levels.[36]

III.A.2. Calculating the Amount Low-Earning Teams Receive

The supplemental phase is the last stage of funding for the redistribution amount.[37] To complete the revenue sharing agreement, revenue sharing received by the low-earning teams is calculated. I eliminate the top 15 HRR-earning teams and teams with over 2.5 million households in their market area from being eligible to receive funds.[38] I don't consider growth rates in HRR.[39] The post-central funding HRR and post-playoff funding HRR data includes HRR received from the revenue sharing agreement for

[31] Midpoint was $64.11 million in 2011-2012.
[32] The Penguins were ranked 11th at $122.57 million during the 2011-2012 season.
[33] The Rangers available team compensation was $206.62 million during the 2011-2012 season. Therefore, their incremental value was $84 million (206.62-122.57).
[34] This is the percent of the remaining redistribution amount the team is responsible for.
[35] Remaining amount is 112.5. Therefore the Rangers' contribution is 20%*(76.44) = $15.29 million. The calculations for the entire adjustment to pre-revenue sharing HRR are shown in detail in Appendix B.
[36] Adjusted pre-revenue sharing hockey-related revenue (Rangers) = post-revenue sharing HRR + 1.25 + 0 + 15.29. The 0 is for the 0 playoff games the Rangers played.
[37] Recall, in 2011-2012 the revenue shared, or redistribution amount, was 4.4% of league-wide HRR.
[38] The Rangers, Islanders, Devils, Flyers, Blackhawks, Stars, Ducks, and Kings all are in designated market areas over 2.5 million households, according to Nielson's 2012 designated market areas.
[39] Growth rates can't be determined because the only source of data is post-revenue sharing. Therefore, it would not be possible to find growth rates in pre-revenue sharing hockey-related revenue between seasons.

those eligible.[40] I divide the redistribution amount by the number of teams eligible for revenue sharing.[41] I adjust the HRR for the eligible teams as close back to pre-revenue sharing as possible by subtracting the average distribution amount received from the HRR data for eligible teams. Next, the maximum between the calculated available team compensation and minimum shown in Table 3.1 is determined.[42] The maximum value determined is then subtracted from the midpoint shown in Table 3.1 to calculate the predicted amount of revenue needed.[43] After obtaining the revenue needed for each team, I determine the predicted percent of the redistribution amount that each team should receive.[44] Finally, the amount each team receives from revenue sharing can be predicted by multiplying the predicted percentage by the total redistribution amount.[45]

The calculations for the entire adjustment to pre-revenue sharing HRR, using the 2011-2012 season as an example, are shown in detail in Appendix B.

III.B. Summary

To determine the final pre-revenue sharing agreement HRR, I used Equation 9. The predicted pre-revenue sharing HRR during the 2011-2012 season is highlighted in Table 3.6.

Equation 9: Pre-Sharing HRR = Post-Sharing Forbes HRR + Central League Contribution + Playoff Contribution + Supplemental Contribution – Revenue Received.

Using the methods above to adjust the Forbes post-revenue sharing HRR, I adjust HRR to pre-revenue sharing estimates. To adjust for inflation, I used CoinNews's CPI data to adjust the pre-revenue

[40] At the HRR data's current adjusted state, the data includes adjustments made from these two stages. It also includes the Supplemental Funding Phase contribution for the top ten teams. However, it does not include the amount received by the lower-earning teams.
[41] For the 2011-2012 season it is $150 million / 12 teams = $12.5 million.
[42] For Phoenix, the minimum is used because 38.80 > 9 (9 is their available team compensation, calculated by (HRR – (redistribution amount/# of teams)) * (player's share)).
[43] The predicted amount here may not equal the amount remaining. For Phoenix it is $25.305 million for the 2011-2012 season.
[44] For Phoenix, this is 25.305/303.66 = 8.33% (303.66 is the sum of the predicted amount each team receives).
[45] For Phoenix, this is 150*8.33% = $12.5 million (150 is the 2011-2012 total redistribution amount). Phoenix received a predicted $12.5 million in 2011-2012. Other teams differ in the predicted amount of revenue they received based on the estimated percentage (8.33% for Phoenix).

sharing hockey-related revenue to the base 2003 dollars. By adjusting numbers from nominal to real, we standardize the values over time, adjusting for inflation.

From this point forward, I will refer to the adjusted post-revenue sharing Forbes data as "HRR." I will determine what affects HRR using the methodologies in Section IV.

Table 3.6: Revenue Sharing Agreement HRR for 2011-2012 Season (Nominal $ millions)

Team	Forbes HRR (post-revenue sharing)	HRR (estimated pre-revenue sharing)
New York Rangers	199	222
Toronto Maple Leafs	200	217
Montreal Canadiens	169	186
Vancouver Canucks	143	158
Boston Bruins	129	137
Detroit Red Wings	128	134
Philadelphia Flyers	124	132
New Jersey Devils	122	131
Chicago Blackhawks	125	130
Los Angeles Kings	120	126
Pittsburgh Penguins	120	123
Calgary Flames	117	118
Ottawa Senators	113	115
Washington Capitals	106	110
Edmonton Oilers	106	107
Winnipeg Jets	105	94
San Jose Sharks	101	90
Dallas Stars	100	101
Minnesota Wild	99	88
Buffalo Sabres	95	84
Anaheim Ducks	91	92
Colorado Avalanche	91	80
St Louis Blues	89	79
Nashville Predators	88	78
Florida Panthers	87	77
Tampa Bay Lightning	88	77
Columbus Blue Jackets	85	74
Carolina Hurricanes	85	84
Phoenix Coyotes	83	73
New York Islanders	66	67

Source: Forbes data (adjusted to post-revenue sharing HRR, not revenue)

IV. Methodology

This section summarizes data sources and modeling used to arrive at the results displayed in Section V. I created a "fixed-effects time-series regression" to determine variables that affect hockey-related revenue. This regression assumes HRR is determined by non-city-specific variables, such as on ice competitiveness, a binary ("dummy") variable for each team ("fixed effect"), and a binary variable for each season ("time-series"). The regression is notated in simple form in Regression 1.

Regression 1: Hockey-related revenue = $\beta_0 + \beta_n$ (non-city-specific variable n) + β_i (dummy for team i) + β_j (dummy for season j) + ε; where n is each non-city-specific variable, i is each team, and j is each season in the data set.

After running Regression 1, I obtain β_i for every team. This β_i is the fixed effect; therefore, the fixed effect for each team is obtained from regression results in Section V.[46] I also create a regression that assumes a team's effect on hockey-related revenue (fixed effect) is determined by city-specific variables. The regression, Regression 2, is a simple Ordinary Least Squares (OLS) regression.

Regression 2: β_i (fixed effect) = $\beta_0 + \beta_c$ (city-specific variable c) + ε; where c is every city-specific variable (such as population) and i is each team.

The explanation above offers a generalized map of the detailed methods explained below.

IV.A. Methodology for Fixed Effect Time-Series Robust Regression

Using the 31 different teams as panel data and the successive seasons as a time series, I create a fixed effects time-series robust regression. Thirty-one teams exist in the data because Atlanta moved to Winnipeg for the 2011-2012 season. I used a robust regression to eliminate the existence of heteroscedasticity. The fixed effects model creates a dummy variable for each team, not including the Montreal Canadiens, to adjust for the fact that each team's location and fan base is different.[47] There is no dummy created for the Canadiens because they are used as a standard of comparison for the other teams. The model assumes each team's impact on the dependent variable, HRR, is constant over time, or "fixed."

[46] The coefficients in the data results are the β's.

[47] Any team could be selected for comparison because it would not make a difference econometrically.

This model assumes season-to-season changes in HRR are due to hockey becoming more popular over time and other non-city specific variables changing within each team.

Variables correlated with a team's location, such as population, are not included in the fixed effects regression because population is assumed to be included in the fixed effects for each team. This explains why only "non-city-specific" variables are included in the fixed effects regression. For example, metropolitan area population remains relatively constant for each team over this period. A team with a large population may have higher HRR, but the fixed effect for each team captures this increase in hockey-related revenue. In essence, the fixed effects differ because the market for hockey differs for each team. I expect population and the fixed effects to be correlated; therefore, population is not included in the regression to eliminate accounting for population's effect twice. Theoretically, I could have included city-specific variables, such as population, in the fixed effects regression if there was temporal variation in these variables within each city. However, the practical problem is that these city-specific variables do not vary much within each city and therefore, do not explain team variation around the mean of HRR. As a result, relegating these city-specific variables to a secondary regression, with the dependent variable being the fixed effect, is appropriate. This secondary regression is explained is Section IV.B.

Factors that are not correlated with the fixed effects, denoted as "non-city-specific" variables, are included in this regression in addition to the fixed effects and time-series. These variables are explained in the next Section, IV.A.1.

The time series created in respect to seasons over time adjusts for the increase in popularity. To create a time series, a dummy variable for each season is created, not including 2002-2003. For the 2002-2003 season there is no dummy variable created because it is used as a comparison for the other seasons, as the Canadiens were used for the fixed effects. There are nine seasons from 2002-2003 to 2011-2012.[48]

[48] There are not ten seasons because there was a lockout during the 2004-2005 season.

IV.A.1. Non-City-Specific Variables

I collected data for the variables below throughout the nine seasons of data. For every season there are 30 teams. Therefore, there are 270 observations for each of the following variables.[49]

Relative Power Index (RPI):

Because the NHL includes overtime and shootout wins, a normal "winning percentage" does not completely explain a team's on-ice success. Many teams play tougher schedules, leading to a lower winning percentage. In addition, before the 2004-2005 lockout, a team's record included ties. Including ties skews the winning percentage. Therefore, we are using the ESPN-calculated Relative Power Index (RPI). RPI is calculated as: 25% multiplied by team winning percentage, 50% multiplied by opponents' average winning percentage, and 25% multiplied by opponents' opponents' average winning percentage (ESPN RPI data). To calculate winning percentage, ties count as half a win and half a loss. ESPN reports RPI data on a scale of 0 to 1. I adjusted this scale by multiplying the data by 100 to present a range from 0 to 100. The regression results in Section V, Data, will now be representative of a 1% change in RPI. In general, RPI offers a comparison of the competitive strength of each team.

A team that does well competitively is expected to generate a greater demand. Fans are more likely to watch a winning team. An increase in fans increases HRR by increasing attendance. In addition, ticket prices increase as demand increases. Fans are more likely to watch a winning team on TV. Increased viewership increases TV ratings. Increased TV ratings increase the amount businesses are willing to pay for commercials, increasing advertising revenue. An increase in advertising revenue increases the amount local broadcasting stations are willing to pay NHL franchises for local broadcast rights. An increase in local broadcasting contracts increases the revenue for the winning franchise. Therefore, a winning team increases gate revenues and TV revenues, increasing total HRR. As a result, RPI is expected to have a positive correlation with hockey-related revenue.

[49] Twenty-nine teams account for nine observations each (one every season). Atlanta accounts for eight observations and Winnipeg accounts for 1 observation.

Home Playoff Games:

This variable is the number of home playoff games an NHL franchise had in a given season. If the team did not make it to the playoffs, this number would be zero. The number of home playoff games was calculated by looking at previous NHL calendars during playoff games on NHL.com (NHL.com, 2012).

A home playoff game creates additional HRR because franchises host additional games that generate revenue. Fans pay increased prices for playoff tickets. Therefore, a playoff game creates much more revenue than a regular season game. An analysis of the 2010-2011 season regular season ticket prices compared to playoff season tickets determines an estimate of how much more playoff tickets cost. The average ticket cost for the 2010-2011 regular season for the top ten franchises was $70.102 (Team Marking Report, 2011). In comparison, the average ticket cost for the first round of the 2010-2011 playoffs for the top franchises was $228.24 (Seat Geek, 2011). An increased number of games at an increased rate creates additional HRR. In result, the number of home playoff games is expected to have a positive correlation with hockey-related revenue.

Stanley Cup Dummy (lagged):

The Stanley Cup dummy has a value of 0 if the team did not win a Stanley Cup in the following season and a value of 1 if the team did win a Stanley Cup in the previous season using NHL.com's Stanley Cup Champions information (NHL.com, 2012).

Winning a Stanley Cup in one season is expected to increase fan following in the previous season due to the increase in new fans. A championship winning team creates a contagion and this contagion is expected to continue into the following season. This contagion is often referred to as a "bandwagon." Many people hop on board this bandwagon and support the team and after they win the championship. In addition, an old fan is likely to become a bigger fan during and after a team wins a championship. The creation of new fans and increased demand of old fans increases demand for the team's services as a whole, increasing hockey-related revenue.

New Arena Dummy:

The new arena dummy variable has a value of 1 if the team built a new arena or significantly updated their arena in the past four seasons and has a value of 0 otherwise, using StatsHockey's NHL Arena opening dates.

Teams increase hockey-related revenue when they create a new arena because it temporarily increases demand for watching the team play. A paper by Ken Perry concludes that new arenas have a statistically significant impact on attendance in the NHL (Perry, 2009). The increase in attendance creates higher revenue in ticket sales; thus, creation of a new arena increases hockey-related revenue.

Summary of Non-City-Specific Variables

Table 4.1: Means, Standard Deviation, Minimum, and Maximum for variables above

Variable	Mean	Standard of Deviation	Minimum	Maximum
RPI	55.2263	2.431365	48.5	60.1
Home Playoff Games	2.851852	3.5351	0	14
Stanley Cup Dummy	0.0333333	0.1798388	0	1
New Arena Dummy	0.1037037	0.3054419	0	1

IV.A.2. Model Notation

The fixed-effects time-series robust regression is notated in Regression 3.

Regression 3: Hockey-related revenue = $\beta_0 + \beta_1$(RPI) + β_2(home playoff games) + β_3(Stanley Cup dummy) + β_4(new arena dummy) + β_i(team i dummy) + β_j(season j dummy) + ε; where i is every team except for the Montreal Canadiens and j is every year except for season 2002-2003.

IV.B. Methodology for OLS Robust Regression on Fixed Effects

After running the regression above, I obtain β_i for every team. This β_i is the fixed effect; therefore, the fixed effect for each team is obtained from the results of estimating Regression 3. To analyze what determines the fixed effect, the β_i*'s* from the fixed effects time-series regression are regressed on the observable factors that are specific to a team's location. These variables are denoted as "city-specific variables."

I created an ordinary least squares robust regression with the dependent variable being the team fixed effects. I again used a robust regression to eliminate the existence of heteroscedasticity. I used the variables explained below in the regression to analyze their effect on the team fixed effects and ultimately, HRR.[50] I took an average of the area youth hockey participation rates, metropolitan population, average metropolitan area income, and years with team over the time period (2003-2012) because the fixed effect is constant over time. Because the fixed effect is constant over time, there are 31 fixed effects. Therefore, there can only be one entry for each variable per fixed effect.

IV.B.1. City-Specific Variables

Average Area Youth Participation Rate:

Youth hockey rates are used as a proxy to determine demand for hockey in a given area. An area with a higher demand for hockey would have a higher youth participation rate. If a player wants to play ice hockey in the US or in Canada, they must register with either USA Hockey or Hockey Canada. Both governing bodies of youth hockey publish data on the number of players participating in hockey in each area. Hockey Canada publishes this information in their annual report and USA Hockey publishes this information in their "Season Final Registration Reports." Hockey Canada reports the number of players by year in each province and USA Hockey reports the number of players by year in each state. Every hockey player is required to sign up with these organizations every year to play hockey. Therefore, these numbers are an exact measure of the extent of youth hockey participation in a given area. Metropolitan area data is not available. To solve this problem I used regional participation numbers as explained below.

For Canada, I simply used the province in which the team was located to determine the relative number of youth playing in the area. In the US, I used the state in which the team was located unless the team was located near other states. For example, Philadelphia is very close to Delaware and New Jersey.

[50] The fixed effect has a one-to-one direct relationship with HRR. Therefore, the variables that determine the fixed effect have a direct one-to-one relationship with HRR.

Thus, Philadelphia's region is defined as a combination of these three states. Table 4.2 shows each U.S. team's defined regional area for youth participation rates.[51]

Table 4.2: US Participation Regions Defined by Team

Team	States
New York Rangers	NY, CT, NJ
Detroit Red Wings	MI
Boston Bruins	MA, CT, RI, NH, VT
Philadelphia Flyers	PA, DE, NJ
Chicago Blackhawks	IL
Pittsburgh Penguins	PA, OH
Dallas Stars	TX
New Jersey Devils	NY, NJ
Los Angeles Kings	CA
Minnesota Wild	MN
Colorado Avalanche	CO
Washington Capitals	DC, MD, VA
San Jose Sharks	CA
Anaheim Ducks	CA
Buffalo Sabres	NY
Florida Panthers	FL
St Louis Blues	MO, IL
Carolina Hurricanes	NC
Columbus Blue Jackets	OH
New York Islanders	NY, NJ
Nashville Predators	TN
Tampa Bay Lightning	FL
Atlanta Thrashers	GA
Phoenix Coyotes	AZ

To determine a true proxy for hockey demand in a given area it is important to use hockey participation rates instead of numbers. If numbers are used, it is hard to determine if the large number of players occurs because the area has a large population or because there is a large demand for hockey. To determine participation rates, youth population in the areas defined in Table 4.2 was calculated.

Youth population for each state was determined by using Census population by each state multiplied by the fraction of the population younger than 18 in the given state as reported by the US

[51] In an ideal world, data would be available with the number of players in a given metropolitan area.

Census.[52] For Canada, I used the same technique with information on province youth populations as reported by Statistics Canada.[53] I then calculated participation rates as a ratio of the number of youth hockey players compared to the calculated youth population in the given defined region. For example, for the Philadelphia Flyers I added up the total number of youth hockey players in PA, NJ, and DE and divided by the calculated youth population in PA, NJ, and DE. As stated above, I took the average youth participation over 2002-2012 for each team.

[52] In greater detail, I took an average of 2000 and 2010 under-18 percentages and multiplied the average by the state population calculated the same way I calculated Metropolitan Population, as explained below.

[53] Statistics Canada reports percentage under 19 instead of 18. To adjust for this I reduced the percentages by $1/19^{th}$.

Table 4.3: Youth Participation Rates by NHL Team

Team	Average Youth Participation Rate
Montreal Canadiens	5.700%
Toronto Maple Leafs	8.378%
Boston Bruins	2.424%
Chicago Blackhawks	0.716%
Detroit Red Wings	2.177%
New York Rangers	0.982%
Vancouver Canucks	4.990%
Philadelphia Flyers	0.844%
Pittsburgh Penguins	0.695%
Los Angeles Kings	0.210%
Dallas Stars	0.144%
Washington Capitals	0.438%
Calgary Flames	7.596%
Minnesota Wild	3.866%
Edmonton Oilers	7.596%
San Jose Sharks	0.210%
Ottawa Senators	8.378%
Colorado Avalanche	1.110%
Anaheim Ducks	0.210%
New Jersey Devils	0.924%
Tampa Bay Lightning	0.258%
Buffalo Sabres	0.989%
Carolina Hurricanes	0.244%
Winnipeg Jets	2.323%
Nashville Predators	0.161%
Florida Panthers	0.258%
St Louis Blues	0.638%
Columbus Blue Jackets	0.471%
New York Islanders	0.924%
Phoenix Coyotes	0.262%
Atlanta Thrashers	0.086%

Sources: USA Hockey, Hockey Canada, Statistics Canada, and US Census

It is no surprise that the most lucrative team in the NHL, the Maple Leafs, also have the highest youth participation rate. It is also no surprise that Atlanta, previous home of the struggling Thrashers, has the lowest youth participation rate. Hockey participation rates are used as an indicator of demand for hockey in the area where the team is located. All else constant, an area with higher youth participation

rates should have a larger fixed effect because the greater demand for hockey increases the TV contracts a team can obtain, as well as increases attendance and ticket prices. Therefore, I predict higher youth participation signals a higher demand for hockey and leads to a larger fixed effect and therefore, larger hockey-related revenue.

Participation rates were adjusted to a scale of 0 to 100 units. Therefore, in the results, the coefficient on youth participation rates coincides with a one-percentage point increase in youth participation rates.

Average Metropolitan Area Population:

For the United States teams I used the 2000 and 2010 Census Population for Metropolitan Statistical Areas for the location of each team reported by the U.S. Census Bureau. Metropolitan Statistical Area population data was used instead of city populations because the fan base for sports teams tends to proliferate outside the city limits to suburbs included in the Metropolitan Area. Fans come from the suburbs to the city for games and the market region for local TV broadcasts also extends outside the city limits. I assumed constant growth between these years and used the constant growth formula to estimate 2001-2009, 2011, and 2012 populations.[54] Canada also calculates population data for Metropolitan Statistical Areas but on a more frequent basis.[55] For 2008-2011 their government statistical database, Statistics Canada, reports metropolitan area population for every year. Statistics Canada also completed a census in 2001 and 2005. Therefore, I used the same constant growth to predict population for 2002-2005, 2007, and 2012. As with participation rates, I took an average of the metropolitan populations over 2003-2012.[56]

[54] Constant growth formula for 2001: $Y_{2001}=Y_{2000}(1+g)^{1/10}$ where g is $(Y_{2010}-Y_{2000})/Y_{2000,}$ 2002: $Y_{2002}=Y_{2000}(1+g)^{2/10}$

[55] Canada calculates this data every 5 years, instead of every 10 (US method).

[56] Because the 2002-2003 season takes place for more of 2003 than 2002, 2003-2012 was used instead of 2002-2011.

Table 4.4: Average Metropolitan Population defined by Team

Team	Average Population (millions)
Montreal Canadiens	3.74
Toronto Maple Leafs	5.41
Boston Bruins	4.52
Chicago Blackhawks	9.38
Detroit Red Wings	4.33
New York Rangers	18.77
Vancouver Canucks	2.25
Philadelphia Flyers	5.90
Pittsburgh Penguins	2.37
Los Angeles Kings	12.84
Dallas Stars	6.09
Washington Capitals	5.40
Calgary Flames	1.16
Minnesota Wild	3.21
Edmonton Oilers	1.11
San Jose Sharks	1.81
Ottawa Senators	1.19
Colorado Avalanche	2.46
Anaheim Ducks	12.84
New Jersey Devils	18.77
Tampa Bay Lightning	2.70
Buffalo Sabres	1.14
Carolina Hurricanes	1.05
Winnipeg Jets	0.77
Nashville Predators	1.59
Florida Panthers	5.44
St Louis Blues	2.79
Columbus Blue Jackets	1.79
New York Islanders	18.77
Phoenix Coyotes	3.98
Atlanta Thrashers	4.97

Source: US Census and Statistics Canada

An area with a larger metropolitan population is expected to have a larger fixed effect and thus higher hockey-related revenue, holding all else constant. A larger population potentially creates a larger fan base. The larger the fan base, the larger the demand for hockey, and the more HRR that team will

generate. However, population is only an indicator of potential fan base. Therefore, it would not be surprising if population did not have a significant impact on the fixed effects and thus hockey-related revenue. A prime case for this is the Atlanta Thrashers. Being in the Atlanta Metropolitan Area, the Thrashers have one of the largest metropolitan populations. However, they also have a low youth participation rate. Therefore, they likely have a much smaller fan base compared to the Montreal Canadiens.[57] However, all else constant, a larger city is expected to have larger HRR.

Population was adjusted to millions of people, leading the coefficient from the results to coincide with a change of one million in population.

Average Metropolitan Area Income:

For the United States teams I collected Metropolitan Statistical Area income per capita as reported by the United States Census for the years 2003-2009. For years 2010-2012, due to the absence of data I estimated the income per capita using personal income growth change by Metropolitan area as reported by the BEA. For Canada, I also used income per capita. Using the Board of Trade of Montreal's Personal Income per Capita and the reports by the Economic Development Department for Quebec and Montreal, I collected 2003-2011 incomes per capita for all large Canadian Metropolitan Areas, except for Hamilton and London. For 2012, I used the growth rate from 2010 to 2011 for each area to estimate 2012 incomes. I was able to obtain income per capita by metropolitan area income, separated by couple income and non-couple income, for all cities from Statistics Canada, including Hamilton and London.[58] Comparing the separated income data to the income per capita data for metropolitan areas with data available, I created a formula that predicted income per capita that came close to actual total income per capita for the metro areas with data available.[59] Using this formula and the separated income per capita, I estimated income per capita for Hamilton and London. In addition, Canada's income information was in

[57] Multiplying participation rates by population we can determine Montreal amounts to .21 and Anaheim amounts to .027. This suggests Montreal has a demand for hockey almost 8 times that of Anaheim.

[58] Exact data was available at a cost, but with limited funding as an undergraduate student, I decided it was not worth the cost.

[59] This equation basically assumes 35% of households are couples and 65% are non-couples: 0.35(couple household median income) + 0.65(non-couple median income) = income per capita.

Canadian dollars. Therefore, I used yearly exchange rates from the Bank of Canada to convert the Canadian information to USD.

Because I adjusted HRR to real instead of nominal dollars (2003 USD as base), I used the same method to adjust income to 2003 USD.

Table 4.5: Average Metropolitan Area Income by Team (multiple sources – explained above)

Team	Avg. Metro. Income (thousands 2003 USD)
Montreal Canadiens	26.84
Toronto Maple Leafs	30.11
Boston Bruins	46.28
Chicago Blackhawks	38.38
Detroit Red Wings	33.61
New York Rangers	45.04
Vancouver Canucks	28.46
Philadelphia Flyers	39.29
Pittsburgh Penguins	35.88
Los Angeles Kings	37.07
Dallas Stars	36.10
Washington Capitals	48.70
Calgary Flames	40.41
Minnesota Wild	40.30
Edmonton Oilers	36.22
San Jose Sharks	49.95
Ottawa Senators	32.08
Colorado Avalanche	40.70
Anaheim Ducks	37.07
New Jersey Devils	45.04
Tampa Bay Lightning	32.46
Buffalo Sabres	31.63
Carolina Hurricanes	34.14
Winnipeg Jets	32.29
Nashville Predators	34.27
Florida Panthers	36.76
St Louis Blues	35.05
Columbus Blue Jackets	33.33
New York Islanders	45.04
Phoenix Coyotes	30.53
Atlanta Thrashers	33.14

An area with a larger average metropolitan area income is expected to have a larger fixed effect, leading to higher HRR, ceteris paribus. The more money an area has to spend on consumption, the more likely they are to spend more on hockey. In addition, price levels vary from city to city; therefore, areas with higher cost of living may have higher ticket prices as well, generating more HRR. However, it would not be surprising if income had little effect or no effect on the fixed effect, because each area's consumers' willingness to pay is not observable. For example, Washington D.C. may have a higher average income than Toronto, but fans in Toronto may have a much higher willingness to pay which would undermine the effect of income on the fixed effects. This willingness to pay may also be captured by the youth participation rate, as an area with a higher demand for hockey based on youth participation rate will also have a higher willingness to pay.

Income was adjusted to thousands of dollars (2003 USD), leading the coefficient from the results to coincide with a change of one thousand dollars.

Years Since Team was Formed:

This variable is simply [season year]-[year team was formed] where "year team was formed" is the exact year the team entered the NHL. The data was created using information from the DetroitHockey.net's NHL Expansion / Relocation Timeline (DetroitHockey.net, 20.

Table 4.6: Years with a Team (2012) by Team

Team	Years with Team
Montreal Canadiens	95
Toronto Maple Leafs	95
Boston Bruins	88
Chicago Blackhawks	86
Detroit Red Wings	86
New York Rangers	86
Vancouver Canucks	42
Philadelphia Flyers	45
Pittsburgh Penguins	45
Los Angeles Kings	45
Dallas Stars	19
Washington Capitals	38
Calgary Flames	32
Minnesota Wild	12
Edmonton Oilers	32
San Jose Sharks	21
Ottawa Senators	20
Colorado Avalanche	17
Anaheim Ducks	19
New Jersey Devils	30
Tampa Bay Lightning	20
Buffalo Sabres	42
Carolina Hurricanes	15
Winnipeg Jets	18
Nashville Predators	14
Florida Panthers	19
St Louis Blues	45
Columbus Blue Jackets	12
New York Islanders	40
Phoenix Coyotes	16
Atlanta Thrashers[60]	12

Source: DetroitHockey.net

Reviewing the information above, the six teams that have existed the longest, known as the "Original Six," are also consistently among the top ten in terms of HRR. The longer a team exists, the

[60] Because the Thrashers did not have a team in 2012, I included all of the earlier years, but not 2012 to get 12.

more time it has to broaden its fan base. Therefore, a team that exists longer compared to another team is expected to have more fans, increasing the fixed effects and HRR, holding all else constant. As I did with the other variables, I also took an average of years with team over the 9 seasons I collected data.

Pre-Loyalty Dummy

There are metropolitan areas with multiple teams. In the Los Angeles Metropolitan Area, the Anaheim Ducks and Los Angeles Kings exist. In the New York City Metropolitan Area the New York Islanders, New York Rangers, and New Jersey Devils exist. I create a dummy variable equal to 1 for the newer teams in the Los Angeles and New York area. The Rangers and Kings existed before the Ducks entered the L.A. area and the Devils and Islanders entered the New York area. When new teams enter, they are expected to have a more difficult time to gain new fans. The difficulty to develop new fans results from fan loyalties. Fans are not likely to become loyal to a new team when they are already loyal to another team. Therefore, if a team currently exists in a market, the new team may not gain as much support as the previous team in that area. Therefore, the Ducks, Devils, and Islanders have a dummy equal to 1, as they were new teams entering markets where teams existed. The dummy predicts the amount that team loyalties matter.

I assign new locations with a pre-loyalty dummy equal to 1 if they are within 70 miles of another team. Seventy miles is just over one hour driving and therefore, the previous team will have a strong loyalty presence in that area. I expect the average fan will still make a trip to see a game if they are about 70 miles away from a arena. In addition, I expect the team to have a large TV presence within 70 miles of the team's location. I will keep this 70 miles in mind when considering new locations for current struggling teams.

Summary of City-Specific Variables

Table 4.7: Means, Standard Deviation, Minimum, and Maximum of City-Specific Variables

Variable	Mean	Standard of Deviation	Minimum	Maximum
Average Area Youth Participation Rate (%)	2.071045	2.701909	0.0860188	8.377746
Average Metropolitan Area Population (millions)	5.436895	5.385011	0.7740639	18.76888
Average Metropolitan Area Income (thousands USD)	36.97377	5.921031	26.84162	49.95303
Years Since Team was formed	37.96774	27.46936	11	94

IV.B.2. Model Notation

The OLS robust regression is notated in Regression 4.

Regression 4: Team Fixed Effect = $\beta_0 + \beta_1$(youth participation) + β_2(metro population) + β_3(metro average income) + β_4(years with team) + β_5(Pre-Loyalty Dummy) + ε

IV.C. Conclusion

By combining the OLS Regression (fixed effects as the dependent variable) and the Fixed Effects Time-Series Regression (HHR dependent variable), a two-stage econometric model is created. The first stage is the OLS model to predict the fixed effects. The second stage takes the predicted fixed effects and inserts it into the Fixed Effects Time-Series model. By combining both models, HHR for new locations can be predicted. Without the first stage prediction of the fixed effects, the fixed effect for a new location cannot be predicted because the fixed effect is unobservable.

By using both models above, two models are combined to create a model that makes sense both through economic intuition and econometrically. Therefore, the results in Section V, Data, will determine what affects HRR and create a predictive model of HRR for new locations. Most importantly, the results will predict if moving teams from low-to high-demand hockey areas, based on youth participation rates, is a viable solution to solve the financial struggles of some of the teams in the NHL.

V. Data

Using the methodology from Section IV, I ran Regressions 3 and 4 using the database I created in Stata to produce the results below. In addition, I analyze the results to create a predictive model of HRR.

V.A. Fixed Effects Time-Series Regression (second stage)

Regression 3: Hockey-related revenue = $\beta_0 + \beta_1$(RPI) + β_2(home playoff games) + β_3(Stanley Cup dummy) + β_4(new arena dummy) + β_i(team *i* dummy) + β_j(season *j* dummy) + ε; where *i* is every team except for the Montreal Canadiens and *j* is every year except for season 2002-2003.

As explained in Section IV, Methodology, when reading the fixed effects by team below, the coefficient refers to the amount each particular team makes compared to the Montreal Canadiens, ceteris paribus. In addition, when reading the results of the time series by season, the coefficient refers to the additional amount of hockey-related revenue compared to the 2002-2003 season, holding all else constant. If hockey became more popular over time, the coefficient on each season will increase over time. The coefficients on the non-city-specific variables (RPI, home playoff games, Stanley Cup dummy, and new arena dummy) suggest the amount hockey-revenue changes due to a one-unit increase in these variables.

The constant in the regression below coincides with the Montreal Canadiens 2002-2003 season with RPI=0, 0 playoff games, not winning a Stanley Cup in the previous season, and not having a new stadium.

V.A.1. Data Results

Table 5.1: Fixed Effects Time-Series Regression: Dependent Variable is real HRR (in millions USD, adjusted to 2003, pre-revenue sharing)

Variable	Coeff.	Robust Std. Err.	t-statistic	P>|t|	95% Confidence Interval	
RPI	0.227638	0.45357	0.50	0.616	-.0666108	.1121384
Home Playoff Games	1.66661	0.2543874	6.55*	0.000	1.165348	2.167873
Stanley Cup Dummy (lagged)	5.074734	3.74876	1.35	0.177	-2.312082	12.46155
New Arena Dummy	10.10505	3.402844	2.97*	0.003	3.399847	16.81025
Fixed Effects by Team						
Toronto Maple Leafs	27.97393	9.861831	2.84*	0.005	8.54149	47.40636
Boston Bruins	-25.20868	7.18393	-3.51*	0.001	-39.3644	-11.05297
Chicago Blackhawks	-36.64713	7.983531	-4.59*	0.000	-52.37843	-20.91582
Detroit Red Wings	-19.49713	7.007249	-2.62*	0.006	-33.3047	-5.689558
New York Rangers	13.80866	7.662698	1.80**	0.073	-1.290449	28.90777
Vancouver Canucks	-23.76861	8.117706	-2.93*	0.004	-39.76431	-7.772922
Philadelphia Flyers	-22.85209	7.73332	-2.96*	0.003	-38.09036	-7.613817
Pittsburgh Penguins	-50.78171	7.640344	-6.65*	0.000	-65.83677	-35.72664
Los Angeles Kings	-33.31679	7.101488	-4.69*	0.000	-47.31006	-19.32353
Dallas Stars	-27.74093	8.033465	-3.45*	0.001	-43.57063	-11.91123
Washington Capitals	-54.78987	7.182833	-7.63*	0.000	-68.94342	-40.63631
Calgary Flames	-41.26592	7.796309	-5.29*	0.000	-56.62831	-25.90353
Minnesota Wild	-42.25517	7.304524	-5.78*	0.000	-56.64851	-27.86183
Edmonton Oilers	-49.43421	7.34427	-6.73*	0.000	-63.90587	-34.96255
San Jose Sharks	-52.82458	7.085287	-7.46*	0.000	-66.78592	-38.86324
Ottawa Senators	-40.40874	7.465181	-5.41*	0.000	-55.11865	-25.69883
Colorado Avalanche	-41.74296	8.692336	-4.80*	0.000	-58.87094	-24.61497
Anaheim Ducks	-47.21335	7.080563	-6.67*	0.000	-61.16538	-33.26131
New Jersey Devils	-53.89393	8.676969	-6.21*	0.000	-70.99163	-36.79623
Tampa Bay Lightning	-47.87623	8.200875	-5.84*	0.000	-64.0358	-31.71665
Buffalo Sabres	-57.77573	6.935236	-8.33*	0.000	-71.4414	-44.11006
Carolina Hurricanes	-58.89761	7.04418	-8.36*	0.000	-72.77795	-45.01727
Winnipeg Jets	-49.34205	7.505012	-6.57*	0.000	-64.13044	-34.55365
Nashville Predators	-65.05988	6.992364	-9.30*	0.000	-78.83812	-51.28164
Florida Panthers	-53.27338	7.985688	-6.67*	0.000	-69.00893	-37.53782
St Louis Blues	-54.5983	7.528659	-7.25*	0.000	-69.4333	-39.76331
Columbus Blue Jackets	-56.43413	7.15125	-7.89*	0.000	-70.52545	-42.34281
New York Islanders	-55.78685	7.590205	-7.35*	0.000	-70.74311	-40.83058
Phoenix Coyotes	-67.9189	7.359918	-9.23*	0.000	-82.4214	-53.41641
Atlanta Thrashers	-58.62747	7.129998	-8.22*	0.000	-72.67691	-44.57803
Time-Series By Season						
2003-2004	5.198974	3.546136	1.47	0.144	-1.788579	12.18653
2005-2006	1.847398	3.511945	0.53	0.599	-5.072784	8.767579
2006-2007	7.312197	3.378714	2.16*	0.031	.6545442	13.96985
2007-2008	13.23635	3.299808	4.01*	0.000	6.734175	19.73852

2008-2009	13.79161	3.257036	4.21*	0.000	7.373724	20.2095
2009-2010	17.10595	3.824073	4.47*	0.000	9.570729	24.64117
2010-2011	17.67748	3.636171	4.86*	0.000	10.51252	24.84244
2011-2012	29.03692	4.148698	7.00*	0.000	20.86204	37.2118
Constant	83.18083	25.42132	3.27*	0.001	33.08889	133.2728

*Statistically Significant at 95% Confidence Interval
**Statistically Significant at 80% Confidence Interval
Observations: 270 (30 teams from season 2002-2003 to season 2011-2012 (lockout during 2004-2005 season))
R-Squared: 0.8709

V.A.2. Data Analysis

Using the regression results from Table 5.1, the fixed effects can be analyzed. Every team, excluding the Rangers, is highly correlated with hockey-related revenue due to t-statistics greater than 1.96 that are significant at the 95% confidence interval. The Rangers are correlated with hockey-related revenue at the 80% confidence interval.

To further understand the coefficients on the fixed effects, take for example the fixed effect of the Toronto Maple Leafs. The coefficient of 27.97 means the Toronto Maple Leafs make 27.97 million (2003 USD) more in HRR than the Montreal Canadiens in a given season if the other variables are held constant. This means in a given season, if both teams have the same RPI, the same number of home playoff games, no Stanley Cup win in the previous season, and the same arena status, the Maple Leafs make 27.97 million in 2003 USD more than the Canadiens before the revenue sharing formula is applied. This makes sense intuitively because the Toronto Maple Leafs are the most lucrative team in the NHL. In addition, the fixed effect of the Phoenix Coyotes can be analyzed. The coefficient of -67.92 means that the Phoenix Coyotes make 67.92 million (2003 USD) less in HRR compared to the Montreal Canadiens in a given season if the all other variables are held constant. This also makes sense intuitively because the Phoenix Coyotes are one of the teams that are struggling financially. By using the Montreal Canadiens as a standard of comparison we can also analyze differences between any two teams. For example, the

results in Table 5.1 suggest the Maple Leafs make 95.89 million (2003 USD) more than the Coyotes before revenue sharing, ceteris paribus.[61]

The time-series trend can also be analyzed by using the regression results in Table 5.1. The coefficients for the 2006-2007 through 2011-2012 seasons are statistically significant at the 95% confidence interval. These results suggest the majority of the seasons are correlated with HRR. The coefficient on the 2010-2011 season suggests that in the 2010-2011 each team made 17.68 million (2003 USD) more than in the comparison season, 2002-2003. This suggests the Maple Leafs would have made 17.68 million (2003 USD) more in 2010-2011 than in 2002-2003 if they had the same RPI, arena status, amount of home playoff games, and Stanley Cup status in both seasons, before the revenue sharing formula is applied. As hypothesized, the coefficients on each season increase over time, suggesting that hockey gained popularity over time because HRR for each team increased over time, all else constant. For example, from the 2010-2011 to 2011-2012 season the results suggest HRR increased $11.36 million holding all else constant.[62] As the NHL gains popularity, demand increases and therefore ticket and gate revenues increase. In addition, an increase in general NHL demand increases TV contracts. The increased revenue from gate revenue and TV contracts increases hockey-related revenue. Note that by missing a season, the league's growth is stalled as popularity ceases to increase and may even potentially decrease. However, the lack of significance on the coefficients for the 2003-2004 and 2005-2006 seasons do not allow us to conclude that the lost season decreased popularity. It is important to reiterate that these are adjusted in 2003 U.S. dollars and the increase in coefficients over time is not due to inflation, but other factors such as popularity.[63]

In addition to the time-series and team fixed effects, an analysis of the variables included in the regression above can determine the effect of these variables on HRR. As predicted, the number of home playoff games a team plays has a statistically significant positive correlation, at the 95% confidence

[61] Calculated as the difference between the Maple Leafs' and Coyotes' fixed effects.
[62] I used the difference between the coefficients on these two seasons.
[63] The results are in 2003 USD due to the fact that hockey-related revenue is adjusted to 2003 USD and we are determining the variables effect on real USD, not nominal.

interval, with hockey-related revenue. The coefficient on home playoff games suggests each home playoff game a team plays creates an additional 1.67 million (2003 USD) in hockey-related revenue. This coefficient suggests that a team with home ice advantage for the entire playoffs that wins the Stanley Cup could make up to 26.67 million (2003 USD) in additional playoff revenue.[64] As explained earlier, this makes sense intuitively because home playoff games create additional HRR. Although teams contribute a percentage of their playoff ticket sales to revenue sharing, they are still likely to have large gains from home playoff games, as confirmed by the results in Table 5.1.[65] Therefore, it is important to consider the potential gains from a successful post-season.

Using the regression results from Table 5.1, the effect of a new arena on hockey-related revenue can also be analyzed. With a t-statistic of 2.97, a new arena is positively correlated with hockey-related revenue and statistically significant at a 95% confidence interval. The coefficient on this variable suggests that for the first four years with a new arena the team makes an additional 10.11 million (2003 USD). Using this coefficient and the season coefficient, we can predict that the New York Rangers made 21.46 million (2003 USD) more hockey-related revenue compared to the previous season when they updated MSG for the 2011-2012 season.[66] As predicted, this makes sense intuitively because a new arena increases attendance and thus increases HRR.

The value of the constant for the 2002-2003 season in Table 5.1 above suggests that the Montreal Canadiens made 83.18 million (2003 USD) in that season, assuming RPI=0, 0 playoff games, no Stanley Cup in the previous season, and no new arena in the past four years, before they contributed funds to the revenue sharing agreement. In addition, the regression suggests that the fixed-effects time-series regression with the variables used explains 87.09% of the variation in hockey-related revenue.

[64] A team can have a maximum of 16 home playoff games in a given season. However, the data for home playoff games has an observed maximum of 14 because it is extremely unlikely that a team will be the home team for every round and every series will go 7 games.

[65] Teams only contribute a percentage less than or equal to 50% of their revenue for a sold-out regular season game. Teams charge elevated ticket prices for playoff games.

[66] Also holding constant the RPI, home playoff games, and Stanley Cup dummy. Calculation: 11.359 + 10.10505 = 21.46405

V.A.3. Preliminary Predictive Model for Hockey-Related Revenue

Using the coefficients from the regression results above a predictive model can be created to predict HRR. The numerical coefficient values replace the β's from the Regression 3.

Predictive Model 1[67]**:** Hockey-related revenue = 83.18083 + (team fixed effects) + (season coefficient) + .227638(RPI) + 1.66661(home playoff games) + 5.074734(Stanley Cup dummy) + 10.10505(new arena dummy)

Considering the example of the Philadelphia Flyers in the 2011-2012 season, the team fixed effects would be -22.85209 and the season coefficient would be 29.03692. Given the facts that the Flyers did not win a Stanley Cup in 2010-2011, did not build a new arena recently, played 6 home playoff games, and had an RPI of 58.1, the effect of these variables can be calculated as: 1.66661(6) + .227638(58.1) = 23.22 million. Therefore, the predicted hockey-related revenue for the Flyers in 2011-2012 is 83.18083 - 22.85209 + 29.03692 + 23.22 = 112.6 million in 2003 USD. Converting this number to 2012 dollars, using 2003 and 2012 Consumer Price Index (CPI) values, the model predicts that the Flyers made about $140.1 million (2012 USD) during the 2011-2012 season (112.6*(229/184)).[68] According to the adjusted Forbes pre-revenue sharing data, the Flyers actually made $132 million during the 2011-2012 season.

For an analysis of optimal relocations, this model alone falls short to predict HRR for a new location because the fixed effect for the new location is not available. An OLS regression to predict the team fixed effect solves this problem and allows us to combine both models to create a two-stage model that predicts the hockey-related revenue of a new team.

V.B. OLS Robust Regression on Fixed Effects (first stage)

When predicting a new team's hockey-related revenue, the predicted location's fixed effect will be inserted into "team fixed effects" in Predictive Model 1 above. As explained in Section IV,

[67] In this equation, HRR represents pre-revenue sharing in 2003 dollars.
[68] The fixed effect coefficient is -22.85 from Table 5.1 and (229/184) is the 2012 to 2003 CPI ratio, adjusting to nominal dollars.

Methodology, I ran an OLS robust regression of the fixed effects coefficients on the city-specific variables from Table 5.1.

V.B.1. Data Results

Table 5.2: OLS Robust Regression: Dependent Variable is Fixed Effects Coefficients (in millions 2003 USD)

Variable	Coefficient	Robust Std. Err.	t-statistic	P>|t|	95% Confidence Interval	
Average Youth Participation (%)	2.979706	1.087345	2.74*	0.011	0.7402776	5.219135
Average Metropolitan Area Population (millions)	2.226185	0.6724107	3.31*	0.003	0.8413291	3.611041
Average Metropolitan Area Income (thousands 2003 USD)	-0.4450235	0.376598	-1.18	0.248	-1.220642	0.3305947
Years Since team was formed	0.3920605	0.0969383	4.04*	0.000	0.1924124	0.5917087
Pre-Loyalty Dummy	-29.90464	13.03003	-2.30*	0.001	-56.74048	-3.068796
Constant	-52.93255	13.50969	-3.92*	0.001	-80.75628	-25.10882

*Statistically Significant at 95% Confidence Interval
Observations: 31 (31 Teams and Fixed Effects)
R-Squared: .7371

V.B.2. Data Analysis

Using the regression results from Table 5.2, the independent variables' effects on the team fixed effect can be analyzed. As hypothesized, youth participation rates have a positive statistically significant correlation with the team fixed effect. The coefficient on youth participation rates suggests that a one-percentage point increase in average youth participation rate increases the fixed effect by 2.98 million in 2003 USD. The Maple Leafs have a youth participation rate of about 8%, compared to the Stars, who have a participation rate of about 0.01%. Assuming Dallas and Toronto were identical in all aspects other than youth hockey participation, the coefficient suggests that the Maple Leaf's fixed effect would be 23.8 million, in 2003 USD, higher than the Stars.[69] This suggests that the Maple Leafs also make an additional $23.8 million HRR in each year over the course of the 2002-2003 to 2011-2012 seasons because there is a

[69] The increase in 2012 (nominal) dollars is $35.49 million. I calculated this as 23.8*(229/184).

higher demand for hockey in Toronto compared to Dallas.[70] Therefore, the prediction that teams in a region with a higher demand for hockey, based on youth participation rates, have higher HRR was correct.

The regression results in Table 5.2 indicate that metropolitan population size has a statistically significant positive correlation with the fixed effect. The coefficient on metropolitan population suggests that a metropolitan area with identical income, years with team, youth participation rate, and identical pre-loyalty status as another metropolitan area will have a team that makes 2.23 million (2003 USD) more than a team in another metropolitan area with 1 million fewer inhabitants before revenue sharing.[71] This makes sense because cities with bigger populations are more likely to have a larger fan base. The more hockey fans in a city, the greater the demand for hockey. A greater demand leads to a higher fixed effect and higher HRR.

In addition, the number of years since the team was formed has a statistically significant positive correlation with the fixed effects. The coefficient suggests that a team gains an additional 392,060 in 2003 USD with each additional year of existence.[72] An old team like the Detroit Red Wings, which has existed for about 80 years, is expected to have a higher fixed effect than a new team like the Coyotes, which has existed for about 16 years. The coefficient suggest the Red Wings will have about a 25 million 2003 USD higher fixed effect than the Coyotes, ceteris paribus, over the course of the 2002-2003 to 2011-2012 seasons because they have had time to obtain a larger fan base than the Coyotes.[73]

Pre-loyalty, or incumbency, also has a statistical impact on the fixed effect. The coefficient on the pre-loyalty dummy suggests that teams entering areas with fans loyal to previous teams have a fixed effect that is 29.9 million (2003 USD) less than the incumbent team.[74] To provide an example of this

[70] The fixed effect has a directly related one-to-one effect on hockey-related revenue in the second stage of the two-stage regression.
[71] Adjusted to nominal this number becomes 2.77 million in 2012 USD.
[72] Adjusted to nominal this number becomes 487,944 in 2012 USD.
[73] Adjusted to nominal this number becomes 31.11 million in 2012 USD.
[74] The only city-specific variable that will differ is the years a team exists. In addition, the 29.9 million becomes 37.21 million in 2012 USD.

effect, I compare the Kings to the Ducks by combining the pre-loyalty and years with a team in existence effect. The Kings and Ducks have the same metropolitan information and thus, their fixed effect differs only in years with team and pre-loyalty. The Kings existed for 26 years before the Ducks entered the Los Angeles area. Therefore, the model predicts the Kings' fixed effect is 40.04 million higher than that of the Ducks, in 2003 USD.[75] This means that if the two teams have the same RPI, past Stanley Cup status, number of home playoff games, and arena status in any given season, the Kings will generate an additional 40.04 million (2003 USD) HRR over the Ducks. This makes sense because the Kings fans remained loyal to the Kings when the Ducks entered the market, resulting in the Ducks having a tougher time generating a fan base.

The R-squared suggests that the variables in this OLS regression explain 73.71% of the variance in the fixed effects. The remaining 26.29% of variation is due to unobservable factors in each city. In addition, this OLS model would be more accurate if more precise data were available, for example, exact metropolitan area youth participation rates. However, unobservable city-specific factors are included in the fixed effect for cities that currently have a team. Therefore using only the second-stage regression to analyze hockey-related revenues for current teams explains 87.09% of the variance in hockey-related revenue. However, for the cities without teams, their fixed effect must be predicted using the OLS model.

V.C. Complete Predictive Model for Hockey-Related Revenue

The OLS regression in Table 5.2 provides a predictive model for the team fixed effect as shown in Predictive Model 2 below.

Predictive Model 2: Team Fixed Effect = -52.93255 + 2.979706(youth participation) + 2.226185(metro population) – 0.4450235(metro average income) + 0.3920605(years with team) – 29.90464(pre-loyalty dummy)

As stated earlier, the team fixed effect is plugged into the fixed-effect time series, Regression 4. The complete combined predictive model for hockey-related revenue is presented below.

[75] Calculation: (26*0.39)+29.9 = 40.04

Combined Predictive Model: Pre-revenue sharing hockey-related revenue = 83.18083 + [-52.93255 + 2.979706(youth participation) + 2.226185(metro population) - 0.4450235(metro average income) + 0.3920605(years with team) – 29.90464(pre-loyalty dummy)] + (season coefficient) + 0.227638(RPI) + 1.66661(home playoff games) + 5.074734(Stanley Cup dummy) + 10.10505(new arena dummy)

Based on the Flyers information for average participation, average population, average income, and years with a team, their predicted fixed effect is: -52.93255 + 2.979706(.8444646) + 2.226185(5.903039) - 0.4450235(39.29073) + 0.3920605(45) – 29.90464(0) = -37.11. Therefore the predicted HRR equation for the Flyers becomes: 83.18083 – 37.11 + 29.03692 + 23.22 = 98.326 (2003 USD).[76] Adjusting back to nominal 2012 dollars, this number becomes $122.37 million, compared to the pre-revenue adjusted Forbes $132 million value. In addition to the 2011-2012 Philadelphia Flyers, I used the predictive models above (Combined Predictive Model and Predictive Model 1) to compare predicted to actual HRR for each team over the past nine seasons. These charts can be found in Appendix A. Because the predicted HRRs track the actual HRR well, the ability of the model to predict HRR is further verified.

Using the combined predictive model, I can estimate HRR for new locations with the same method used above for the Philadelphia Flyers. After applying the revenue-sharing agreement explained in Section III.A, I can also predict post-revenue sharing hockey-related revenues.

V.D. Conclusion

The fixed effect provides differences in HRR based on city-specific variables. The second-stage model includes the fixed effects and adds the effect of the particular season, RPI, Stanley Cup dummy, Home Playoff Games, and New Arena dummy. Essentially, the fixed effect is the most important aspect of determining the long-term financial success of a given team, or proposing new locations for current teams, because all other variables in the second stage model are short term as they vary from season to season. A team may play well and have a new arena one year, leading them to short-term financial

[76] The season effect is 29.03 and 23.22 was calculated in Section V.A.3.

success. However, the team could suffer financially in the absence of on-ice success and a new arena. Therefore, the fixed effects and predicted fixed effects are the most important indicators in determining the long-term financial viability of new locations and analyzing the long-term financial struggles of current teams. Therefore, I will use the fixed effect as the most important indicator of future financial success when determining new locations for currently struggling teams.

VI. Predictions

This section will select currently struggling NHL teams to relocate and will use the Combined Predictive Model to predict HRR for the new locations. As explained in the conclusions from Section V, Data, the fixed effect is the best comparison for determining the long-term financial success and for analyzing the struggles of current teams. Table 6.1 identifies the eleven teams experiencing the greatest financial difficulties. I calculated an average of real HRR and operating income during the previous three seasons.

VI.A. Selecting Teams to Move

Table 6.1: Struggling NHL Teams Considered for Relocation

Team	Average HRR (real millions)	Fixed Effect (millions 2003 USD)	Average of Operating Income (real millions)
Phoenix Coyotes	50.94	-67.92	-21.70
Nashville Predators	57.47	-65.06	-5.47
Carolina Hurricanes	55.68	-58.90	-7.03
Buffalo Sabres**	61.88	-57.78	-7.97
Columbus Blue Jackets	55.69	-56.43	-13.23
New York Islanders*	51.72	-55.79	-9.53
St Louis Blues	57.34	-54.60	-6.30
Florida Panthers	56.79	-53.27	-9.53
Tampa Bay Lightning	58.88	-47.88	-9.83
Anaheim Ducks	69.89	-47.21	-8.13
Colorado Avalanche	59.91	-41.74	4.30

*Not considered due to new arena in Brooklyn for 2013-2014 season and future new ownership
**Not considered due to recent new ownership (bought by Terry Pegula)
Source: Forbes NHL Revenue (adjusted) and Operating Income Data

The Phoenix Coyotes, Nashville Predators, and Carolina Hurricanes are teams in need of relocation based on their low fixed effect, which represent low predicted long-term financial success. The Columbus Blue Jackets are an additional team to consider for relocation due to their low fixed effect and largely negative operating income. Therefore, I select the Coyotes, Predators, Hurricanes, and Blue Jackets as the currently struggling teams for relocation analysis.

VI.B. Selecting New Locations for Teams

By moving the four teams indicated above to high-demand areas, their HRRs should increase. The OLS regression results shown in Table 5.2 suggest that years of team existence, metropolitan population, loyalty, and the youth participation in the area are positively and significantly correlated with HRR. Therefore, when considering new locations to relocate teams, these four factors were considered. By bringing a team back to an area that previously had a team, the relocated team is expected to regenerate a following from residents who were fans of the team that previously existed. Therefore, I included the years a team previously existed when predicting the fixed effect for the new city. For example, if I moved a team back to Hartford, I assume they would become the Whalers and the Whalers previously existed in Hartford for 26 years. Table 6.2 contains information on the metropolitan areas that I believe could be successful based on the statistically significant variables in Table 5.2.

Table 6.2: Data for Possible New Locations

Team	Average Youth Participation Rate (%)	Average Metropolitan Area Income (thousands 2003 USD)	Average Metropolitan Population (millions)	Years with Team Previously in Existence	New Arena Dummy
London, Ontario[#]	8.37	31.285	0.467023	0	1
Quebec City, Quebec[^]	5.65	29.950	0.724998	24	0*
Hamilton, Ontario[#,77]	8.37	32.476	0.70692	0	1
Milwaukee, WI	1.32	36.502	1.536455	0	0
Hartford, CT[^]	1.44	43.042	1.189814	26	0
Seattle, WA	0.448	42.905	3.3175635	0	0
San Francisco, CA	0.209	52.037	4.2605458	0	0
Toronto, Ontario[78]	8.37	30.111	5.411229	0	0

*Could update arena causing it to be considered as a "new arena," but not necessary

[#]Hamilton's arena is in need of updates to be NHL-ready and London does not have a big enough arena for NHL games.

[^]Hartford used to have the Whalers and Quebec used to have the Nordiques.

Sources: USA Hockey and Hockey Canada, US Census and Statistics Canada, Multiple as listed in City-Specific Variables Section (for Metro Income), and DetroitHockey.net

[77] This team would be entering within 70 miles of the Toronto Maple Leafs and thus, the Pre-Loyalty dummy on Hamilton would be equal to one.

[78] This is assuming adding a second team, as suggested by the Mowat Policy paper. The second team in Toronto would have a pre-loyalty dummy equal to one.

High participation rates are apparent in Table 6.2 for most areas and areas with a team in existence for an extended period of time are apparent for Quebec and Hartford. Table 6.2 includes all of the information needed to predict the fixed effect for each team used in the fixed effect time series regression.

Using Predictive Model 2 the fixed effect for each possible new city can be predicted using the information from Table 6.2. I calculate the fixed effect for the new locations using the same method I used in my example of the Philadelphia Flyers. After calculating the fixed effect for the new cities, as shown in Table 6.3, I predict the season effect. I will predict hockey-related revenues for the 2012-2013 season.[79] Therefore, the 2012-2013 season coefficient must be predicted, as it is part of the Combined Predictive Model used to predict HRR.

To predict the effect of the 2012-2013 season I first calculated the average percentage increase in hockey-related revenue between the last three seasons.[80] I predicted the 2012-2013 season coefficient, assuming the season effect would grow at this rate for the 2012-2013 season.[81] Using this method, I estimated the 2012-2013 season coefficient to be 30.94 million in 2003 USD.

In addition to the season effect, the new arena effect is calculated using information from Table 6.2. Because the Kings won the Cup last season, all of the new locations have a dummy equal to 0 for the Stanley Cup Dummy. In addition, because the 2012-2013 season has not yet been completed, RPI and home playoff games can't be determined. I use the observed means from the past nine seasons for RPI and home playoff games.[82] Using the observed means assumes the team moving to the new location is average competitively. To predict the new team HRR shown in Table 6.3, I use Equation 10.

Equation 10: Predicted HRR = (229/184) x [83.18083 + (predicted fixed effects) + (30.93741) + 0.227638(55.2263) + 1.66661(2.862) + 10.10505(new arena dummy)]

[79] This assumes the 2012-2013 season is a full, 82 game season. I realize that the current 2012-2013 season is a shortened, 48 game season.
[80] Calculation: Average of (2711-2394)/2394, (2394-2358)/2358, and (2358-2248)/2248 is 6.55%, these numbers are real HRR (2003 USD).
[81] Calculation: (1.0655)*(29.03692) = 30.94
[82] The observed mean RPI was 55.2263 and the observed mean for home playoff games was 2.862.

Table 6.3: Predicted Fixed Effect and HRR for Possible Relocations

New Team	Fixed Effect (millions 2003 USD)	Predicted Revenue (millions 2012 USD)
Quebec City, Quebec	-38.41	115.82
London, Ontario	-40.88	125.74
Hartford, CT	-54.96	95.23
Toronto, Ontario	-59.26	89.87
Milwaukee, WI	-61.82	86.68
Seattle, WA	-63.31	84.83
San Francisco, CA	-65.98	81.50
Hamilton, Ontario	-70.78	88.04

Using the results from Table 6.3, the top four areas for the four teams relocating are Quebec, London, Hartford, and Toronto, based on fixed effect. However, if a team moves within 50 miles of another franchise, the incumbent franchise must approve the move due to league relocation guidelines. Therefore, the Maple Leafs would have to approve a second team entering Toronto and a first team entering Hamilton, Ontario.[83] In order to gain the Leafs' approval, the new team would likely have to pay the Leafs a potentially large sum of money. A team in London would not be entering the Maple Leafs' 50 mile radius territory and therefore, would not have to pay the Leafs any sum of money.

The econometric model predicts moving a team to Toronto or Hamilton would only make about $1 to $5 million more than moving a team to Milwaukee or Seattle. Therefore, it is better to relocate a team to Milwaukee or Seattle over Hamilton or Toronto. In these locations the new team will not have to gain the Maple Leafs' approval and pay them a potentially large sum of money. The Mowat Policy paper and many hockey fans believe moving a second team to Toronto or to Hamilton are optimal moves for currently struggling teams. However, these proponents may be underestimating the loyalty of fans in this area to the Maple Leafs. Despite relocating to an area with a huge demand for hockey and large population, it is unlikely a new team in Hamilton or Toronto would generate revenues large enough to benefit from relocating after they pay for the Leafs' approval. This is further substantiated by the fact that

[83] Hamilton is within 50 miles of Toronto. However, London lies outside of the 50 mile territorial zone and would not have a conflict with the Toronto Maple Leafs.

the econometric model predicts that a new team in Hamilton or Toronto will do only marginally better than a new team in Milwaukee or Seattle.

The econometric model uses the loyalty dummy to adjust for loyalty of fans. However, it only has the loyalty of fans to the Rangers and Kings as observations, due to the fact that these are the only incumbent teams in metropolitan areas with multiple teams. As a result, the loyalty effect is based on loyalty of Rangers and Kings fans. Maple Leafs and Canadiens fans are often viewed as the most diehard fans in the NHL. Therefore, I believe the loyalty effect would have a likely larger negative effect on a new team in Toronto or Hamilton than the econometric model predicts. As a result, I believe my estimates for Toronto and Hamilton could be inflated.

In addition, the fixed effect of Hamilton is lower than that of any team currently in the NHL, suggesting that moving a team to Hamilton is not beneficial for any team in the NHL. If the new arena effect for Hamilton is not included, their predicted HRR becomes only $75.53 million. This HRR is less than the predicted 2012-2013 revenue for all teams I consider relocating, except Carolina, as shown in Table 6.8.[84] Because the econometrics and economic intuition suggests Toronto and Hamilton are not optimal cities for relocation, I will model the move of the four teams to Quebec, London, Hartford, and Milwaukee.[85]

VI.C. Hockey-Related Revenue Prediction Calculations

Table 6.4 lists new potential areas and current teams from highest to lowest fixed effect. I match the current team with the highest fixed effect with the new location with the highest fixed effect.

Table 6.4 Fixed Effect (millions USD 2003) for New Locations

New City	Fixed Effect	Current Team	Fixed Effect
Quebec City, Quebec	-38.41	Columbus Blue Jackets	-56.43
London, Ontario	-40.48	Carolina Hurricanes	-58.90
Hartford, CT	-54.96	Nashville Predators	-65.06
Milwaukee, WI	-61.82	Phoenix Coyotes	-67.92

[84] Carolina is just slightly lower at 75.18 million.
[85] Many people have suggested moving a team to Seattle. I also believe moving a team to Seattle is a viable and profitable move. However, I believe Milwaukee, Quebec, Hartford, and London are more beneficial locations.

I plan to move the Blue Jackets to Quebec, Hurricanes to London, Predators to Hartford, and Coyotes to Milwaukee. The Blue Jackets have the highest fixed effect of the current teams I consider relocating and Quebec has the highest fixed effect of the new locations. Therefore, I will analyze moving the Blue Jackets to Quebec. If I were to move the Blue Jackets to Milwaukee, Table 6.4 suggests that the move would not be profitable if the team performed the same (same amount of home playoff games and RPI) in each city.[86] Matching the highest to lowest fixed effect for current to new locations maximizes the total profitability of the moves.[87] Table 6.4 shows each move will lead to a higher fixed effect. The increase in fixed effects suggests that each move will be profitable, holding constant RPI, new arenas, Stanley Cups, and home playoff games. Therefore, a prediction of the fixed effect for each move verifies the profitability of moving these teams to the new four areas. An analysis of the fixed effects also predicts the moves will increase HRR by 65.71 million in 2012 USD.[88] Accounting for London's new arena, the model predicts an increase of 81.96 million 2012 USD.[89] Table 6.5 displays the HRR for the four teams I consider relocating in 2011-2012.

Table 6.5: 2011-2012 HRR for Relocating Teams

Team	HRR (millions 2012 USD)
Columbus Blue Jackets	73.8
Carolina Hurricanes	73.8
Nashville Predators	78.1
Phoenix Coyotes	73.4
Total	**299**

Source: Adjusted Forbes HRR data

Therefore, based on the fixed effects analysis, I believe moving these four teams will increase hockey-related revenues by 27.41%.[90] This assumption holds constant RPI, home playoff games, and Stanley Cup dummy from 2012-2013 as in 2011-2012. This 27.41% increase supports moving teams

[86] Milwaukee already has a arena for the Bucks and they will have the same Stanley Cup dummy status.
[87] If I were only to move the Coyotes, the best location for them would be Quebec. In addition, if I were not going to move the Blue Jackets, I would move Phoenix to Hartford, Nashville to London, and Carolina to Quebec to maximize total profitability.
[88] Calculation: ((total of new fixed effects)-(total of current fixed effects))*(229/184).
[89] Calculation: (10.04*(229/184)) + 65.71 = $81.96 million.
[90] Calculation: 81.96/299 = 27.41%.

from low to high-demand markets. In order to have a concrete example of what revenues may look like, I insert the fixed effects for the new areas into the second-stage regression; then I add the season (30.94), RPI, Stanley Cup Dummy, and New Arena Dummy effects. I assume each team will have the same RPI and number of home playoff games as they did in the previous season. For example, the new Quebec Nordiques will have an RPI of 52.5 and play 0 playoff games, as shown in the Table 6.6. Every team has a Stanley Cup dummy (lagged) of 0, since the Kings won the cup last year. Table 6.6 summarizes this information.

Table 6.6: 2011-2012 Season Information for Teams Relocating

Team	RPI	Home Playoff Games
Nashville	58.2	5
Phoenix	56.9	9
Carolina	54.4	0
Columbus	52.5	0

Source: ESPN RPI data and NHL.com Calendars

Equation 11: Predicted HRR = (229/184) x [83.18083 + 30.9374 + (fixed effect calculated in Table 6.4) + .227638(Previous RPI) + 1.66661(Previous Playoff Home Games) + 5.074734(Previous Stanley Cup Dummy) + 10.10505(new arena dummy)]

Using the information from Table 6.4, Table 6.6, and Equation 11, I calculate the predicted 2012-2013 HRR, shown in Tables 6.7 and 6.8. I also calculate every current NHL team's 2012-2013 HRR. To calculate the 2012-2013 HRR, I take the average of the growth rates in HRR between the last three seasons for each team. I assume each team will grow at their respective average growth rate and calculate the predicted 2012-2013 HRR based on this assumption.[91] Although I believe my model is an accurate predictor, I believe using growth rates and previous numbers are a more accurate predictor of future HRR. Therefore, I did not use my model to predict future revenues of teams that currently exist.

[91] Calculation: (1+growth rate)*(2011-2012 pre-revenue sharing HRR).

Table 6.7: Predicted Hockey Related Revenue v. Current Team Predicted Hockey Related Revenue, 2012-2013 (millions 2012 USD)[92]

Old Team	Estimated 2012-2013 HRR	New Team	Estimated 2012-2013 HRR	Percent Change
Columbus Blue Jackets	77.12	Quebec City, Quebec	109.10	41.48%
Carolina Hurricanes	83.51	London, Ontario	119.56	43.17%
Nashville Predators	85.87	Hartford, CT	100.49	17.03%
Phoenix Coyotes	81.80	Milwaukee, WI	99.87	22.09%
Total	**328.29**	**Total**	**429.02**	**30.68%**

Winnipeg Case Study Comparison

To support the accuracy of my results, I applied the same method used to predict the estimated 2012-2012 HRR for new locations in Table 6.7 to predict the 2011-2012 HRR for the Winnipeg Jets. I will compare the 2011-2012 predicted HRR to the actual 2011-2012 Winnipeg HRR to verify my results. I used Winnipeg's metro population, participation rate, years with team, loyalty dummy, and metro income to predict the fixed effect. I predicted Winnipeg's fixed effect as -51.61, compared to the actual fixed effect of -49.34. In addition, I calculated the season coefficient for the 2011-2012 season using the same method I used to predict the 2012-2013 season coefficient.[93] The predicted coefficient for the 2011-2012 season is 18.113, compared to the actual 2011-2012 season coefficient of 29.037. Winnipeg did not have a new arena and the Atlanta Thrashers had a 2010-2011 RPI of 53.7, did not win a Cup in the 2010-2011 season, and played zero playoff games. I assume Atlanta will perform the same in Winnipeg, as I did with my predictions in Table 6.7. Based on all this information I use Equation 10 to predict the Winnipeg Jets will have a HRR of $77.22 million (2012 USD). Because Atlanta only made $57.53 million (2011 USD) during the 2010-2011 season and had a growth rate of essentially zero over the past

[92] The results above predict an overall 30.68% increase. This number differs slightly from the 27.41% increase calculated from Tables 6.4 and 6.5. Both predictions assume the team remains the same competitively and include the arena effect. However, the HRR in Table 6.7 for the 2012-2013 season differ from the 2011-2012 numbers and the season coefficient for the new areas' predicted was included. This is where the slight discrepancy arises.

[93] Calculation: Average of (2394-2358)/2358, (2358-2248)/2248, and (2248-2227)/2227 is 2.46%, these numbers in this formula are real HRR (2003 USD).

few years, my predictions predict this move will be lucrative and increase revenue for the team by about 35%.[94]

Winnipeg's actual HRR during the 2011-2012 season was $93.75 million (2012 USD). If I had not underestimated the 2011-2012 season coefficient, my predictions for Winnipeg would be about $91 million.[95] Adjusting for actual RPI and home playoff games, this number remains $91 million because the Jets did not do much better last season than the Thrashers did in 2010-2011.[96]

I believe the biggest fault with my predictions lies within the predicted season coefficient, as demonstrated by the example above. From the 2010-2011 season to the 2011-2012 season the season coefficient skyrocketed upwards, suggesting a large increase in hockey revenues across the league most likely resulting from an increase in the popularity of the league. The coefficient on the statistically significant seasons has always increased. By assuming only a 6.55% increase in the season coefficient and estimating it to increase from 29.037 to 30.94, I believe my estimates for the new teams are conservative. Because my conservative results prove the moves to be lucrative, I am confident that these moves will be beneficial for the teams involved.

VI.D. Predicted League Effect and Revenue Sharing Effect from Moves

The analysis in Section VI.C was based off of predicted pre-revenue sharing values for HRR. When relocating a team, it is important to analyze the predicted post-revenue sharing HRR because this is the relocating team's final HRR. In addition, it is important to analyze the effect of moving teams on other teams in the NHL. I use Equations 1 and 2 to predict the minimum and midpoint for the 2012-2013 league.[97] I then calculate the amount needed for the lower earning teams from revenue sharing

[94] Assuming zero growth, the predicted 2011-2012 HRR for Atlanta is the same as the 2010-2011 HRR.
[95] Calculation: 77.22 + 13.595 = 91 million (13.595 = (229/184) * (29.037-18.113))
[96] They had 0 playoff games and an RPI of 54.7.
[97] I use the player's share as 50% because the newest 2012-2013 CBA changes the player's share to 50%. This new CBA is not yet available to the public and I make the assumption that the league will maintain the same revenue sharing agreement.

(redistribution amount).[98] I assume the Central League Funding Stage will supply 25% of the redistribution amount.[99] Because the placement of teams in the 2012-2013 playoffs is unpredictable, the Playoff Funding stage is not considered in this analysis. Therefore, the calculation for the Supplemental Funding Phase, explained in Section III.A.1. is applied to cover the remaining 75% of needed revenue. I use Equation 12 to calculate post-revenue sharing HRR.

Equation 12: Post-revenue sharing HRR = Pre-revenue sharing HRR – Central League Funding Contribution – Supplemental Funding Contribution + Amount received from Revenue Sharing.

The calculations can be found in greater detail in the Appendix C. I applied this same method to the pre-relocation league and post-relocation league. The results are shown in Table 6.8 and 6.9 below.

[98] First, I calculate the available compensation for each team (HRR-Midpoint). Then, I find the needed compensation for each team (Midpoint – max(HRR, minimum)). I eliminate any team in the top half of the league in HRR or with a designated market area of over 2.5 million households. Then, I use previous calculated pre-revenue sharing HRR to calculate growth rates over time. I reduce the needed compensation for teams growing less than the league growth rate based on the reduction numbers found in the 2004-2005 CBA (25% reduction for first time offenders, 40% for consecutive second time offenders, 50% for third consecutive or greater, offenders). I then calculated the sum for adjusted needed compensation. This is the total amount needed for revenue sharing.

[99] Therefore, I take (25% x total needed revenue)/30 from every team.

Table 6.8: League HRR before Relocations, Highlighting Revenue Sharing Results (millions 2012 USD)

Team	Before Revenue Sharing HRR	After Revenue Sharing HRR	Change
New York Rangers	258.15	233.24	-24.91
Toronto Maple Leafs	236.09	211.18	-24.91
Montreal Canadiens	210.02	185.11	-24.91
Vancouver Canucks	179.85	158.12	-21.73
Boston Bruins	148.84	140.81	-8.03
New Jersey Devils	147.95	140.31	-7.64
Philadelphia Flyers	147.81	140.23	-7.58
Los Angeles Kings	142.73	137.40	-5.33
Chicago Blackhawks	139.01	135.32	-3.69
Pittsburgh Penguins	136.01	133.65	-2.37
Detroit Red Wings	133.62	132.31	-1.31
Ottawa Senators	132.90	131.59	-1.31
Calgary Flames	129.44	128.13	-1.31
Washington Capitals	127.49	126.17	-1.31
Edmonton Oilers	124.32	123.01	-1.31
Dallas Stars	105.23	103.92	-1.31
Winnipeg Jets	101.85	114.84	12.99
San Jose Sharks	98.38	108.51	10.13
Anaheim Ducks	93.34	92.03	-1.31
Buffalo Sabres	90.68	100.81	10.13
Minnesota Wild	86.33	96.46	10.13
Nashville Predators	85.87	103.62	17.76
St Louis Blues	83.59	96.58	12.99
Colorado Avalanche	83.23	96.22	12.99
Florida Panthers	82.92	93.05	10.13
Phoenix Coyotes	81.80	99.56	17.76
Tampa Bay Lightning	80.59	90.72	10.13
Columbus Blue Jackets	77.12	85.34	8.22
Carolina Hurricanes	75.18	83.40	8.22
New York Islanders	70.46	69.15	-1.31

Based on Table 6.8, the predicted revenue shared is 4.3% of HRR. This is consistent with the 4.4% calculated earlier (page 16).

Table 6.9: League HRR after Relocations, Highlighting Revenue Sharing Results (millions 2012 USD)

Team	Before Revenue Sharing HRR	After Revenue Sharing HRR	Change
New York Rangers	258.15	230.15	-27.99
Toronto Maple Leafs	236.09	208.10	-27.99
Montreal Canadiens	210.02	182.03	-27.99
Vancouver Canucks	179.85	155.42	-24.42
Boston Bruins	148.84	139.81	-9.03
New Jersey Devils	147.95	139.36	-8.58
Philadelphia Flyers	147.81	139.29	-8.52
Los Angeles Kings	142.73	136.73	-5.99
Chicago Blackhawks	139.01	134.86	-4.15
Pittsburgh Penguins	136.01	133.35	-2.66
Detroit Red Wings	133.62	132.15	-1.47
Ottawa Senators	132.90	131.42	-1.47
Calgary Flames	129.44	127.97	-1.47
Washington Capitals	127.49	126.01	-1.47
Edmonton Oilers	124.32	122.84	-1.47
London, Ontario	119.56	125.19	5.63
Quebec City, Quebec	109.10	125.19	16.09
Dallas Stars	105.23	103.75	-1.47
Winnipeg Jets	101.85	118.65	16.81
Hartford, CT	100.49	118.03	17.54
Milwaukee, WI	99.87	115.10	15.23
San Jose Sharks	98.38	108.68	10.31
Anaheim Ducks	93.34	91.87	-1.47
Buffalo Sabres	90.68	110.79	20.12
Minnesota Wild	86.33	96.63	10.31
St Louis Blues	83.59	96.84	13.25
Colorado Avalanche	83.23	96.48	13.25
Florida Panthers	82.92	93.23	10.31
Tampa Bay Lightning	80.59	90.90	10.31
New York Islanders	70.46	68.99	-1.47

VI.E. Conclusions

VI.E.1. Benefit for Teams not Relocating

The teams moving are not the only teams affected by the relocation. The revenue sharing agreement depends on the revenues of other teams in the league. By reviewing the net change in HRR from the revenue sharing before and after moving the four teams, the effect of the moves on the rest of the league can be analyzed. Table 6.10 summarizes the net benefit for all other teams not relocating.

Table 6.10: Net Change in HRR from Moves for Non-Relocating Teams (millions 2012 USD)

Team	Pre-Move Revenue Sharing	Post-Move Revenue Sharing	Change from Moves
New York Rangers	-24.91	-27.99	-3.08
Toronto Maple Leafs	-24.91	-27.99	-3.08
Montreal Canadiens	-24.91	-27.99	-3.08
Vancouver Canucks	-21.73	-24.42	-2.69
Boston Bruins	-8.03	-9.03	-1.00
New Jersey Devils	-7.64	-8.58	-0.94
Philadelphia Flyers	-7.58	-8.52	-0.94
Los Angeles Kings	-5.33	-5.99	-0.66
Chicago Blackhawks	-3.69	-4.15	-0.46
Pittsburgh Penguins	-2.37	-2.66	-0.29
Detroit Red Wings	-1.31	-1.47	-0.16
Ottawa Senators	-1.31	-1.47	-0.16
Calgary Flames	-1.31	-1.47	-0.16
Washington Capitals	-1.31	-1.47	-0.16
Edmonton Oilers	-1.31	-1.47	-0.16
Dallas Stars	-1.31	-1.47	-0.16
Winnipeg Jets	12.99	16.81	3.82
San Jose Sharks	10.13	10.31	0.18
Anaheim Ducks	-1.31	-1.47	-0.16
Buffalo Sabres	10.13	20.12	9.99
Minnesota Wild	10.13	10.31	0.18
St Louis Blues	12.99	13.25	0.26
Colorado Avalanche	12.99	13.25	0.26
Florida Panthers	10.13	10.31	0.18
Tampa Bay Lightning	10.13	10.31	0.18
New York Islanders	-1.31	-1.47	-0.16
		Total	**-2.45**

Table 6.10 suggests the majority of the league's post-revenue HRR will only change slightly as a result of the relocating teams. However, the results suggest the top teams are negatively affected by

loosing a few million dollars. It may be surprising that the top teams contributing substantial amounts to revenue sharing may lose money rather than benefit from this move. The percent of the total supplemental funding phase the top 10 teams contribute to revenue sharing does not change. The amount needed for the supplemental funding phase is dependent on how much the lower-earning teams need. As the four teams relocate, the total league HRR increases. As the total league HRR increases, the midpoint increases. As the midpoint increases, the redistribution amount needed also increases.[100] Therefore, the new teams relocating increases the midpoint, therefore causing the top teams to have to contribute a few million more HRR.

Although these teams may be worse off, they may be better off in the long term. Moving teams to high-demand locations may increase the amount of money the NHL can receive in national and regional TV contracts. TV contracts may increase because overall league popularity will likely increase as aggregate demand for the NHL increases as a result of current teams moving to high demand locations. Although the potential increase in TV contracts may be hard to predict, the increase would reduce the net loss, or possibly create a net gain, for the top teams that may lose money.

VI.E.2. Benefit for Teams Relocating

Table 6.11: Predicted Post-Revenue Sharing Benefit for Relocating Teams (millions 2012 USD)

Old Team	Estimated 2012-2013 HRR	New Team	Estimated 2012-2013 HRR	Percent Change
Columbus Blue Jackets	85.45	Quebec City, Quebec	125.19	46.51%
Carolina Hurricanes	75.18	London, Ontario	125.19	66.52%
Nashville Predators	103.24	Hartford, CT	118.03	14.32%
Phoenix Coyotes	99.67	Milwaukee, WI	118.65	19.05%
Total	**363.54**	**Total**	**487.06**	**33.98%**

Upon preliminary review, the average predicted percent increase of 36.6% using Table 6.11 justifies moving all of the teams above to the new locations. However, relocation costs must be considered before justifying the moves.[101]

[100] The midpoint = (total HRR * Players' share) / 30.
[101] Average increase differs from gross increase, as shown in Table 6.11.

VI.F. Relocation Costs and Considerations

London, Ontario

The NHL requires a $60 million fee for teams relocating. London would need to build a new arena to host an NHL team. The home of the Winnipeg Jets, the MTS Centre, was built in 2004 for a cost of $133 million (Fitzsimmons, 2009). Adjusted for inflation, this number becomes $162 million. Because London is a small city, London needs an arena similar to Winnipeg's to host a team. Therefore, London's arena will likely cost around $162 million. As a result, the total cost of relocating Carolina to London is $222 million. A $222 million 30-year loan at 6.5% would cost the London team about $16.8 million per year. Adjusting for the cost, my results predict the new London team would still make about $33 million more (44% increase) during the 2012-2013 season in London compared to Carolina.[102]

It is likely that current owners will sell a team relocating to new investors, as demonstrated by True North Sports and Entertainment Limited bought the Thrashers from Atlanta Spirit LLC (Forbes, 2012). Forbes estimates the Carolina Hurricanes are worth $162 million (Forbes, 2012).[103] A 30-year, $162 million loan at 6.5% interest would cost the investors about $12 million per year to buy the Hurricanes. Including the relocation fee, payment for the Hurricanes, and cost to build a new arena, the move to London is still beneficial, with a predicted $21 million gain for the 2012-2013 season.[104] This $21 million gain accounts to a 28% increase in HRR. These gains will likely continue into the future, proving the move to be a long-term financially lucrative relocation.

Quebec, Quebec

Quebec has already broke ground on building a brand new $400 million arena that will hold over 18,000 spectators, expected to be completed in 2015. This stadium is funded entirely by the province and the city of Quebec (Canadian Press, 2012). In addition, Quebecor CEO, Pierre Karl Paldeau has already

[102] 125-17-75 = 33.
[103] The Forbes valuation is "value of team based on current arena deal (unless new arena is pending) without deduction for debt (other than arena debt)." Therefore, this valuation includes the $3 million arena yearly contract as stated by "Comparison of Operating Costs for Similar Arenas" (TLHocking & Associates LLC).
[104] 33 – 12 = 21.

expressed great interest in investing in a team that would move to Quebec. The combination of Quebec's potentially lucrative location, new stadium, and guaranteed investor make the city a frontrunner for an NHL team. The stadium is being built in hopes to bring back an NHL team and eventually host the Winter Olympics (AP, 2009). The NHL team would likely pay $5 million per year in rent to play games at the arena (Canadian Press, 2012).

However, there are concerns about Columbus' current contract with Nationwide. Nationwide invested $52 million in the Blue Jackets. As a result, Nationwide has a 30% ownership interest in the franchise. The Blue Jackets extended their contract to stay in the Columbus Arena until 2039. In addition, Nationwide paid $28.5 million to keep their name on the Blue Jackets' Arena, even though Nationwide sold their ownership of the arena (TLHocking & Associates LLC, 2012). This creates a legal dilemma if the Blue Jackets were to break their contract and move to Quebec. Nationwide Insurance is headquartered in Columbus, Ohio. Therefore, Nationwide would likely not approve of Columbus moving to Quebec even if the move was lucrative for them, given their 30% stake in the team. As a result, the Blue Jackets may have to pay Nationwide a large sum of money to break their contract.

It is difficult to predict the cost for Columbus to break their contract. However, in a worst-case scenario I predict a settlement with current owners, Nationwide, and potential investors would cause the potential investors to return the $28.5 and $52 million to Nationwide in addition to the 30% stake they would receive from a sale of the team.[105] Therefore, the potential investors in Quebec would pay the $145 million Forbes valuation of the Blue Jackets, pay the $60 million relocation fee, and return the $80.5 million to Nationwide. A 30-year, $285.5 million loan at 6.5% interest would cost the investors $21.6 million per year. In addition, the investors would pay an additional $5 million in arena rent, as mentioned above. As a result, I predict the move will generate $25.4 million in additional HRR, after all costs are accounted for, in 2012-2013.[106] This 30% predicted increase proves the move of Columbus to Quebec is

[105] Would likely be larger, but the new investors of the Blue Jackets have the fact that the Blue Jackets lose money every year to help them in the litigation that would ensue. Therefore, the sale and relocation of the Blue Jackets is justified.

[106] 125 + 12 (2012 USD new arena effect) – 21.6 - 5 - 85 = 25.4.

lucrative. This percentage increase will likely continue into the subsequent seasons, resulting in large long-term gains.

Hartford

Hartford's XL Center holds just under 15,000 for hockey, making the arena a viable NHL arena (AEG Facilities, 2013). The Nashville Predators owners have to pay a settlement fee of $10 million to leave Nashville, assuming losses prevail (TLHocking & Associates LLC, 2012). However, this $10 million is already included in the Forbes estimate of their valuation. Forbes estimates the Predators are worth $167 million. Therefore, the cost to potential investors is $227 million, including the relocation fee. A 30-year, $227 million loan at 6.5% interest would cost investors about $17 million per year. Therefore, after accounting for costs, I believe moving Nashville to Hartford would result in a loss of 2 million in HRR for the 2012-2013 season. Therefore, the move of Nashville to Hartford will likely not be lucrative, as these losses may continue into the future.

Consequently, I will instead analyze moving the St Louis Blues to Hartford. I select St. Louis because they have the lowest fixed effect of all teams I consider after Columbus, Carolina, Nashville, and Phoenix. Their predicted 2012-2013 post-revenue sharing HRR is $98 million. Forbes values the Blues as the lowest-valued NHL franchise at $130 million. Therefore, it will cost potential investors $190 million after the relocation fee is added to the cost to acquire the Blues. A 30-year, $190 million loan at 6.5% interest will cost potential investors $14 million per year. Therefore, the financial gain from moving St Louis to Hartford is about $6 million.[107] Because these gains will continue into the future, I predict the relocation of St Louis to Hartford to be financially lucrative.

Milwaukee

Milwaukee's BMO Harris Bradley Center holds almost 18,000 fans for hockey, making it a viable NHL arena (BMO Harris, 2013). The NHL currently owns the Coyotes; therefore, the NHL is currently losing millions on their ownership of the Coyotes. According to Forbes, the Coyotes are worth $134 million (Forbes, 2012). The total cost to potential investors becomes $194 million when accounting

[107] 118 – 14 – 98 = 6.

for the NHL relocation fee. A 30-year, $194 million loan would cost about $14.8 million per year at 6.5% interest. As a result, the potential gain for relocating Phoenix to Milwaukee, less costs, becomes $4.2 million per year. Although this seems like a small gain, the gain will continue into the future, resulting in large long-term gains. Therefore, I predict this move will be financially beneficial for the Coyotes.

Investors

According to the Mowat Policy study, Gary Bettman, the NHL's Commissioner, has hinted that a new location must have adequate fan support, serious investors, an NHL-sized arena (18,000 seats, however Bettman stated the 15,000 MTS Centre was adequate for Winnipeg), and no territorial conflicts with current teams (50 mile zone) (Keller and McGuire, 2011). My econometric model proves all of the potential areas above have adequate fan support and research proves that if London builds an arena, all areas will have an NHL sized arena. In addition, the areas I selected do not have territorial conflicts with any other teams. However, I do not know if London, Hartford, and Milwaukee have serious investors. Serious investors are the last aspect needed for these potential moves to become realistic. Because Quebec City has a serious investor, the city is a realistic potential relocation for an NHL team.

Summary of Moves after Costs

Table 6.12: Predicted Post-Revenue Sharing Benefit after Moves, Net Costs (millions USD)

Old Team	Estimated 2012-2013 HRR	New Team	Estimated 2012-2013 HRR	Percent Change
Columbus Blue Jackets	85.45	Quebec City, Quebec	110.59	29.42%
Carolina Hurricanes	75.18	London, Ontario	96.15	27.89%
St Louis Blues	97.9	Hartford, CT	103.63	5.85%
Phoenix Coyotes	99.67	Milwaukee, WI	103.85	4.19%

Average Increase: 16.84%

Although the percentage increase is small for St Louis and Phoenix, this increase is expected to continue into future seasons. Therefore, Table 6.12 shows all the moves I mentioned are potentially beneficial, with an average increase of about 17%.

VI.G. Limitations and Uncertainties

The NHL franchises are private and actual team HRR is not available to the public. The data in this analysis was obtained by adjusting Forbes revenue to pre-revenue sharing HRR. Therefore, if Forbes revenues are far from actual NHL revenues, net of revenue sharing and arena debt, my analysis is based on flawed data. In addition, the NHL's revenue sharing agreement is very complex. I believe the methods I used to estimate the effect of the revenue sharing agreement are close to correct. Without actual revenue sharing numbers and HRR from the NHL, my predictions can't be completely accurate.

There are two small possible inaccuracies with the assumptions of my econometric model. The first is the years with team variable. My predictive model assumes bringing back the teams to areas that previously had teams, specifically Hartford and Quebec, will generate the same interest these teams once had.[108] I name this effect the "previous fan" effect. It is likely that the support for the Whalers and Nordiques has dissipated over time. Therefore, bringing back these teams may not generate the predicted amounts. Of the predicted HRR for Hartford, $12.7 million is attributed to the "years with team" effect.[109] For Quebec, $11.7 million of the predicted hockey-related revenue is attributed to the "years with team" effect.[110] It is likely that bringing back the Nordiques and Whalers will regenerate some interest. However, assuming they will regenerate the same interest they had in the past may be unlikely. Therefore, the additional $12.7 and $11.7 million in hockey-related revenue may be overstated. If the $12.7 million is not included in my prediction for Hartford, the gains from moving St Louis become negative. However, even if the $11.7 million was not included in the estimate for Quebec, the move still generates a predicted $13.44 million during the 2012-2013 season.[111] Therefore, even if the Quebec Nordiques regenerate no interest from the "previous fan" effect, the move will still be very lucrative.

In addition, my model does not adjust econometrically for the fan loyalties present in a given area without a team. The loyalty effect only accounts for fan loyalties in areas with a team present. Hartford is

[108] My predictive model counts years with teams previously in existence when bringing back a team.
[109] (229/184) * (.39206) * (26 years) = 12.68.
[110] (229/184) * (.39206) * (24 years) = 11.71.
[111] 110.59 – 11.7 – 85.45 = 13.44.

located between Boston and New York City. Therefore, many Boston Bruins and New York Rangers fans are likely to live in the area. These fan loyalties are not observed; therefore, the loyalties were not included in my econometric model. However, the fans in the new suggested locations may be willing to adopt the new team as their team because of the convenience in traveling to games and presence in the local TV market. Therefore, I don't believe fan loyalties will have a large effect on HRR for the suggested areas because they are not very close to other teams. As a consequence of the fan loyalty effect, my results may be slightly overstated.

Although a critique of the econometric model used suggests the estimates of gains from moving teams may be slightly overestimated, the Winnipeg Jets case study in Section VI.C suggests the opposite. I use the same method I used to predict estimates for 2012-2013 HRR for the suggested locations to predict the 2011-2012 HRR for the Winnipeg Jets. The prediction for the Winnipeg Jets was $16.5 million less than the actual 2011-2012 pre-revenue sharing HRR.[112] This case study suggests my results are conservative, not over-estimated. There is a possibility that a new team generates additional interest. Because the move from Atlanta to Winnipeg is the only information I have available for a new team during the time period of my data, I decided not to adjust econometrically for a "new team effect."

Because my results are conservative, there is a possibility moving St Louis to Hartford could be lucrative even if the "previous fan" effect is not included. Because the "previous fan" effect will likely have some beneficial effect on the Hartford Whalers and because my results are conservative, I predict the move of St Louis to Hartford will be financially beneficial.

[112] 93.75 – 77.22 =16.53.

VII. Final Suggestion and Conclusion

Summary

After collecting and analyzing data, a two-stage econometric model was created to predict HRR for new locations and analyze factors that effect HRR. I discovered long-term demand for an NHL franchise (determined by HRR) is dependent on the area's youth participation rate, metro population, years with a team in existence, and fan loyalties in the area. After determining demand factors, I selected optimal locations for struggling NHL franchises using the predictive model. Accounting for relocation costs, I determined the predicted net benefit from relocating four current teams to the four optimal areas I selected. The average net benefit for relocating teams was determined to be 17%, proving that moving teams from low to high demand markets is financially beneficial.

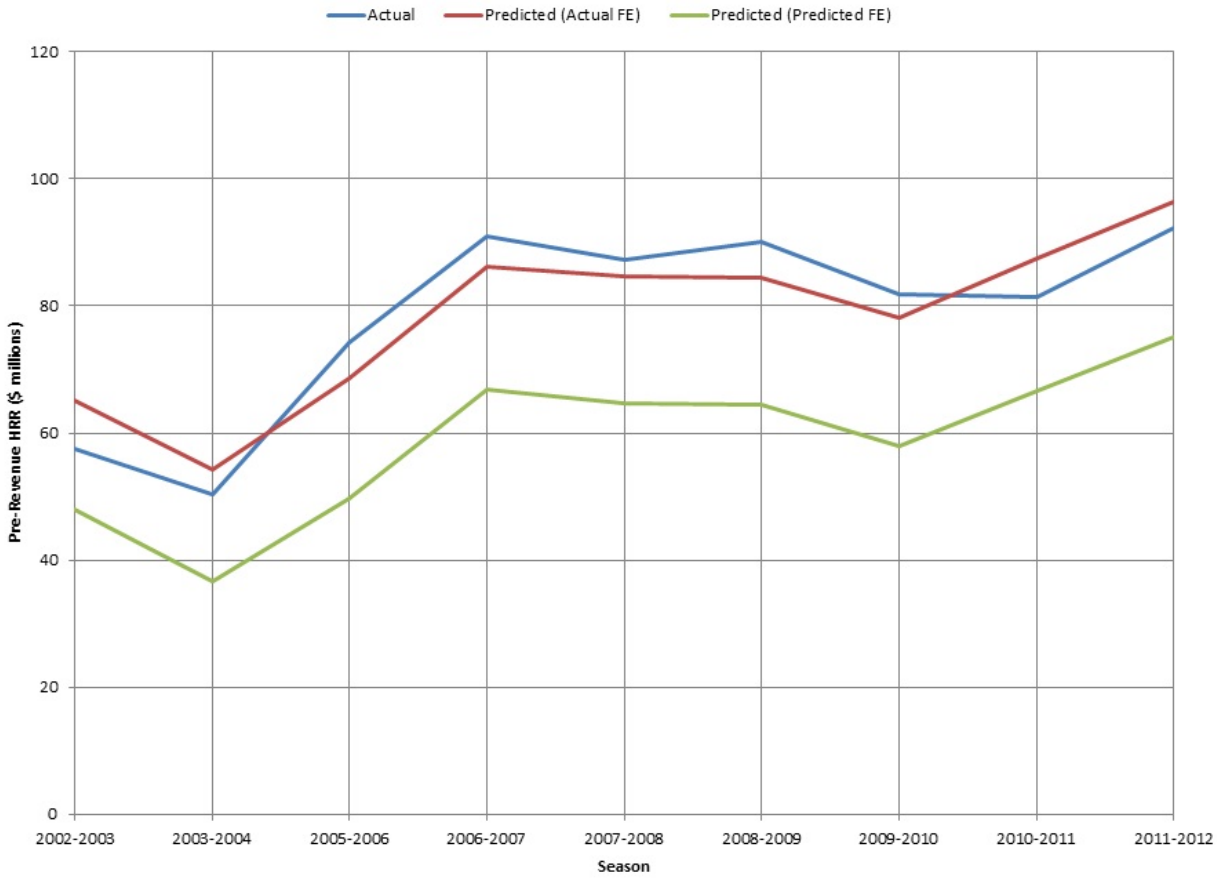
Final Suggestion to the NHL

Assuming the Forbes data accurately reflects post-revenue sharing revenue, I believe my results are accurate. Because the Winnipeg Jets case study suggests my results are conservative, I believe relocating Columbus, Carolina, St Louis, and Phoenix will be financially beneficial. As a result, I recommend that the NHL move Columbus, Carolina, St Louis, and Phoenix to Quebec, London, Hartford, and Milwaukee respectively. The only missing link that is needed to complete these financially beneficial moves is serious NHL investors in London, Hartford, and Milwaukee (Quebec already seems to have a serious investor). If the NHL was to move just one team, I suggest moving them to Quebec will be both optimal and realistic based on my analysis. In general, I believe relocating struggling teams to high-demand markets will solve the financial troubles for the NHL's struggling teams.

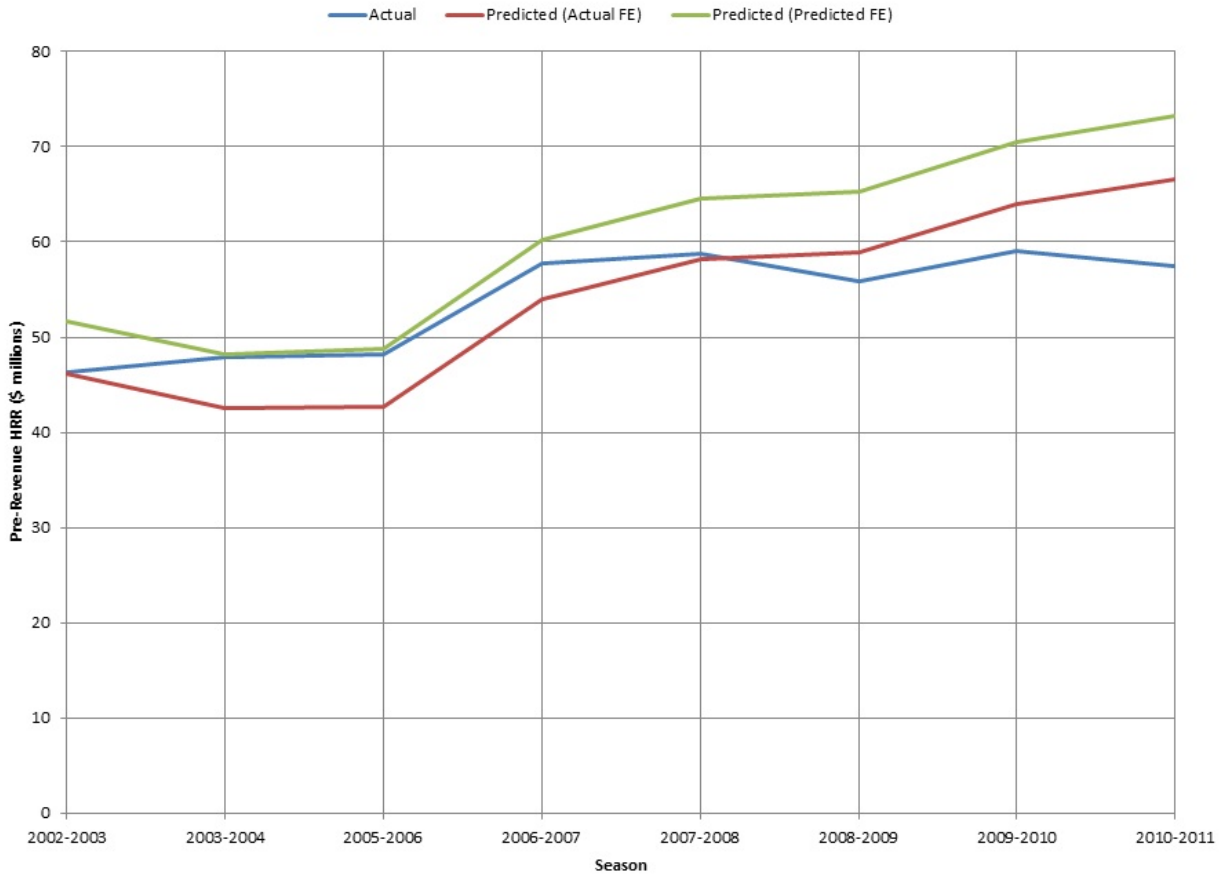
Appendix A

Using Predictive Model 1, I predicted HRR ("Predicted (Actual FE)") using the fixed effects, season coefficients from Table 5.1, and non-city specific data for each team in every season. In addition, I used the Combined Predictive Model to predict HRR ("Predicted (Predicted FE)") using city-specific data, non-city specific data, and season coefficients for each team in every season. These two trend lines and actual pre-revenue HRR are plotted over time for each team below to demonstrate the accuracy of the modeling. For the new locations, I used the Combined Predictive Model ("Predicted (Predicted FE)" trends below are outcome of this model).

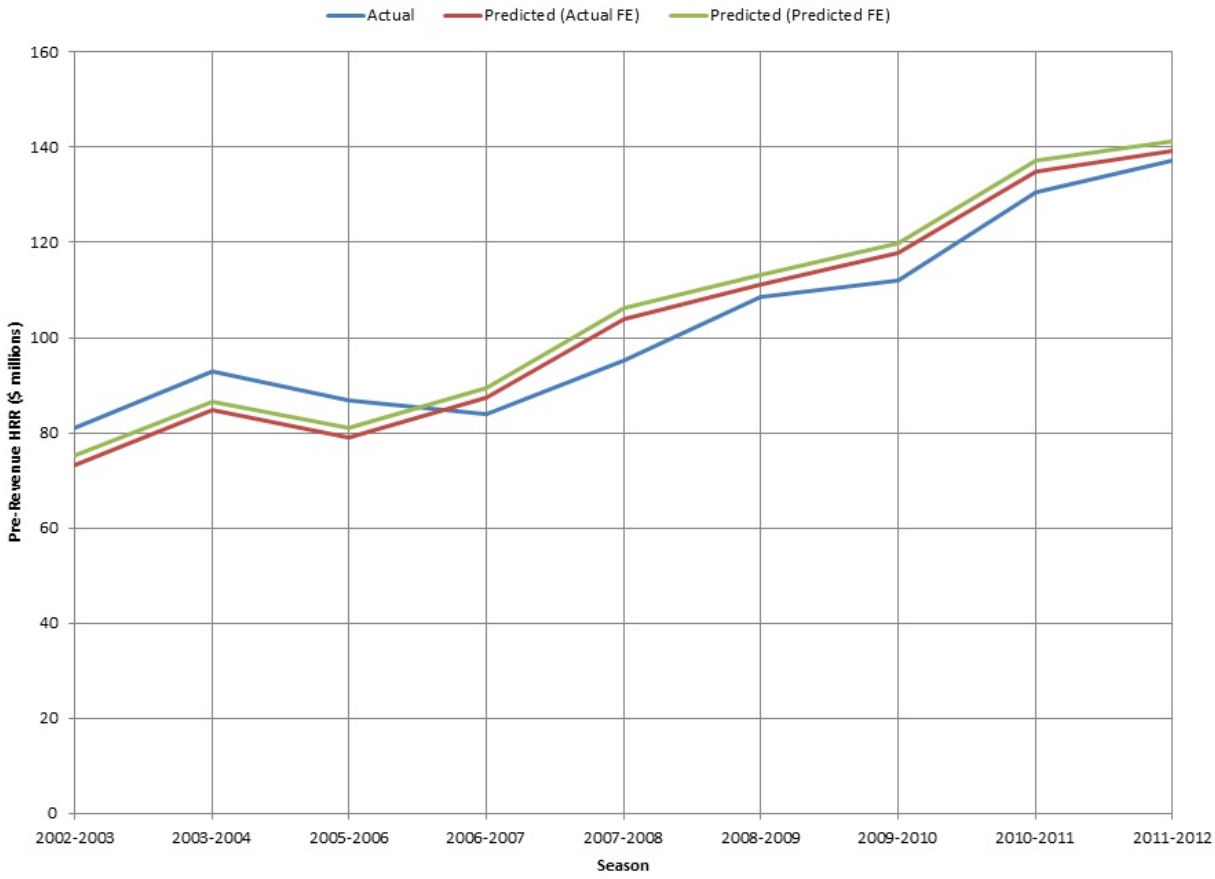
A1. Anaheim Ducks



A2. Atlanta Thrashers

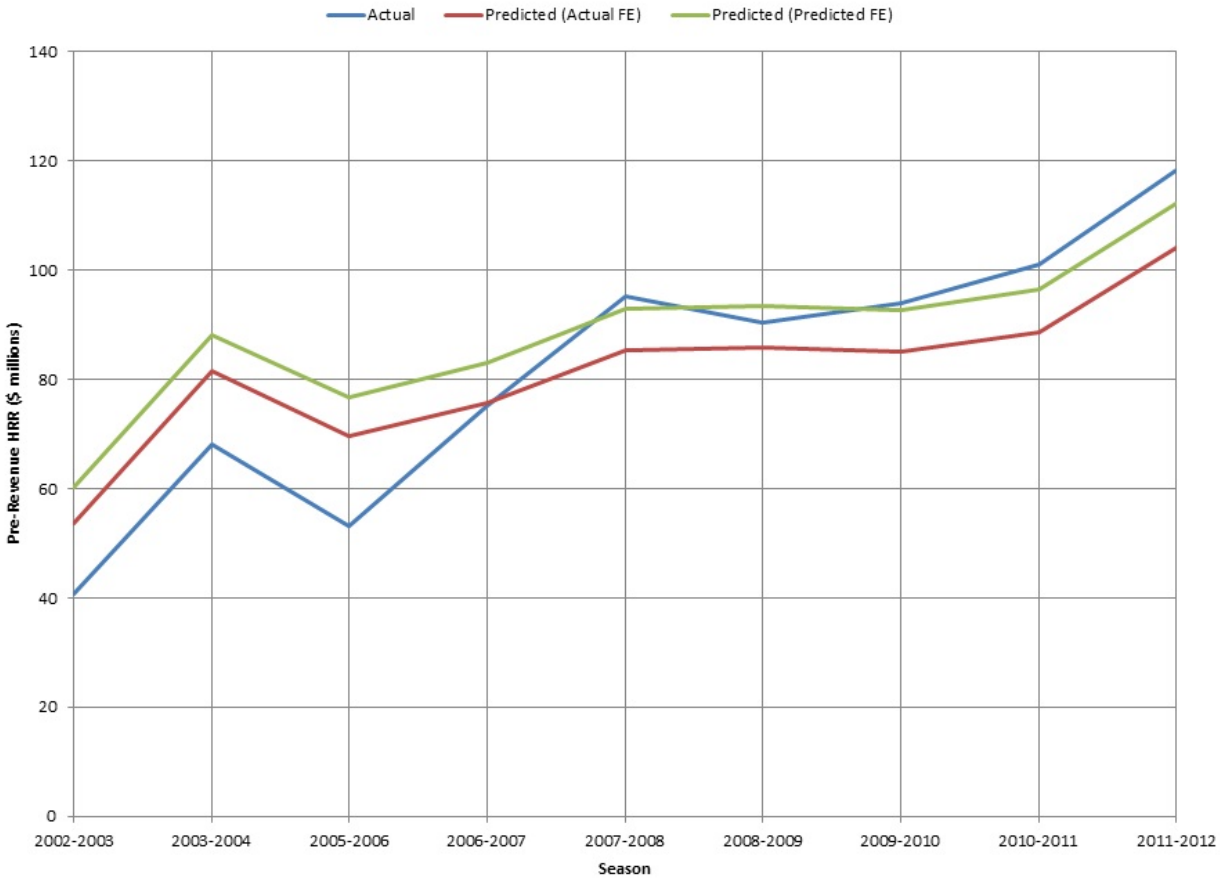


A3. Boston Bruins

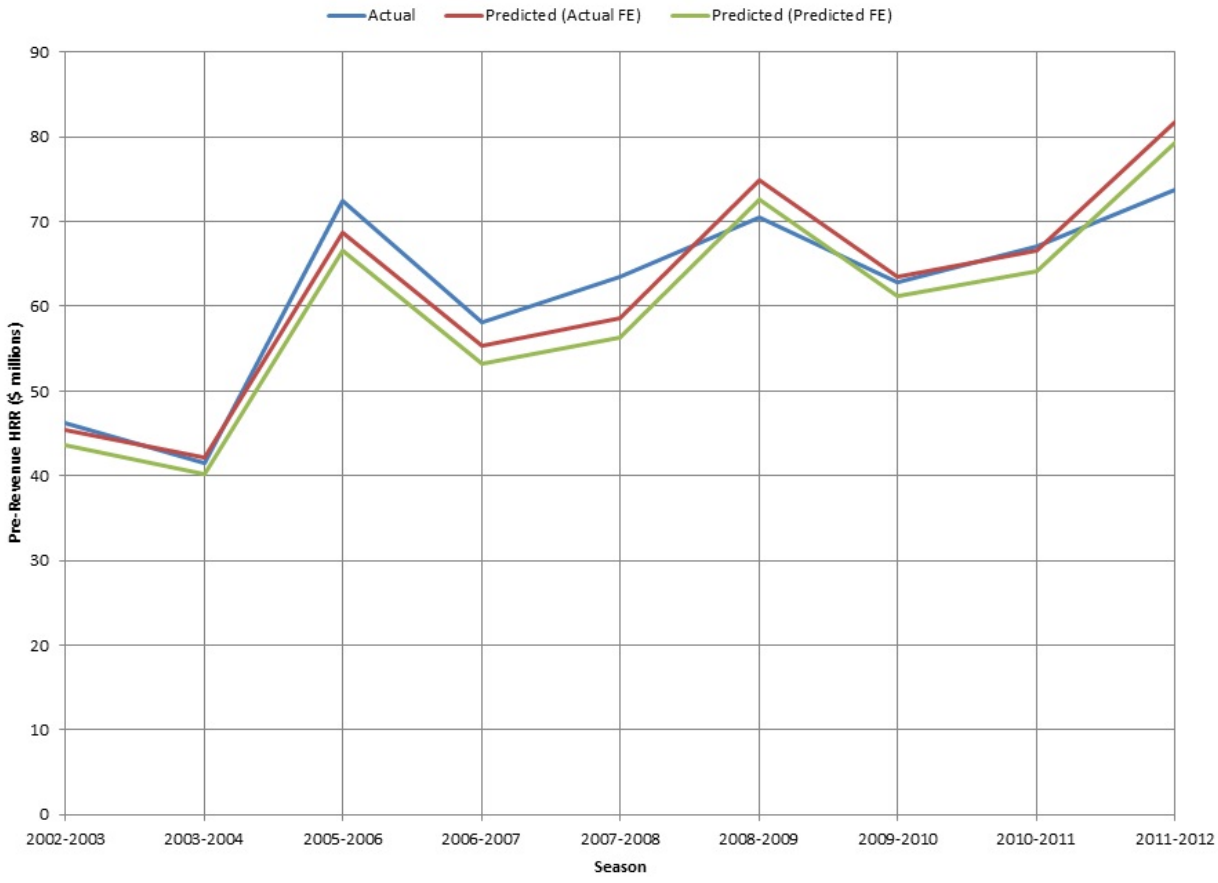


A4. Buffalo Sabres

A5. Calgary Flames

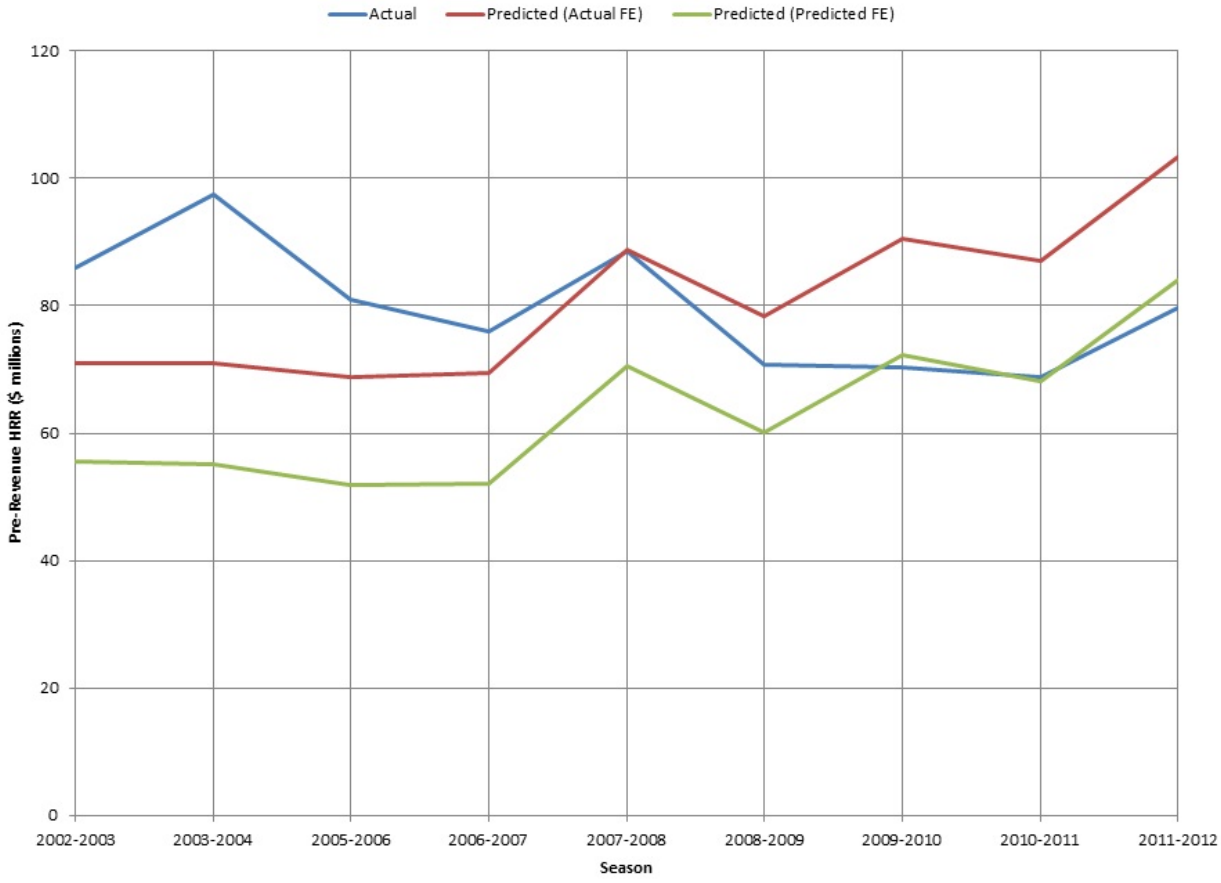


A6. Carolina Hurricanes



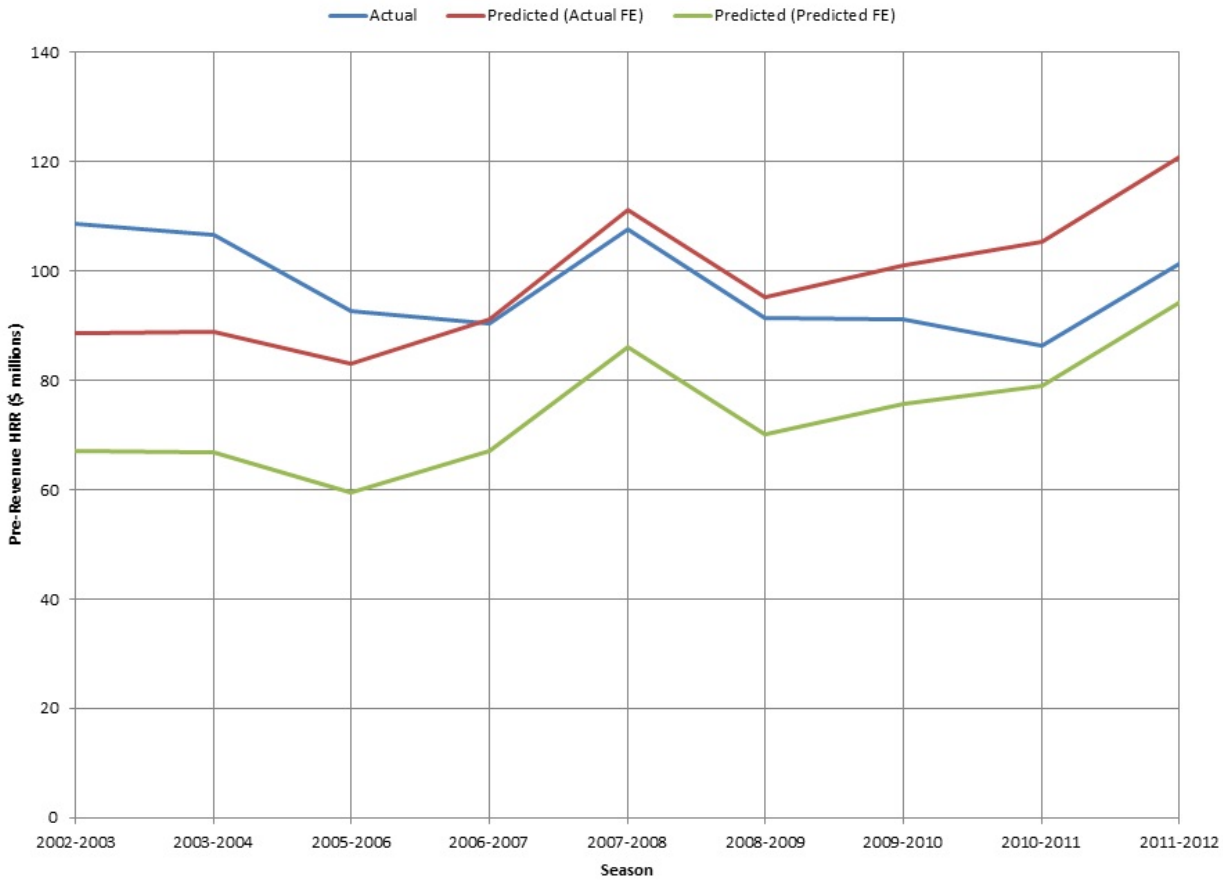
A7. Chicago Blackhawks

A8. Colorado Avalanche

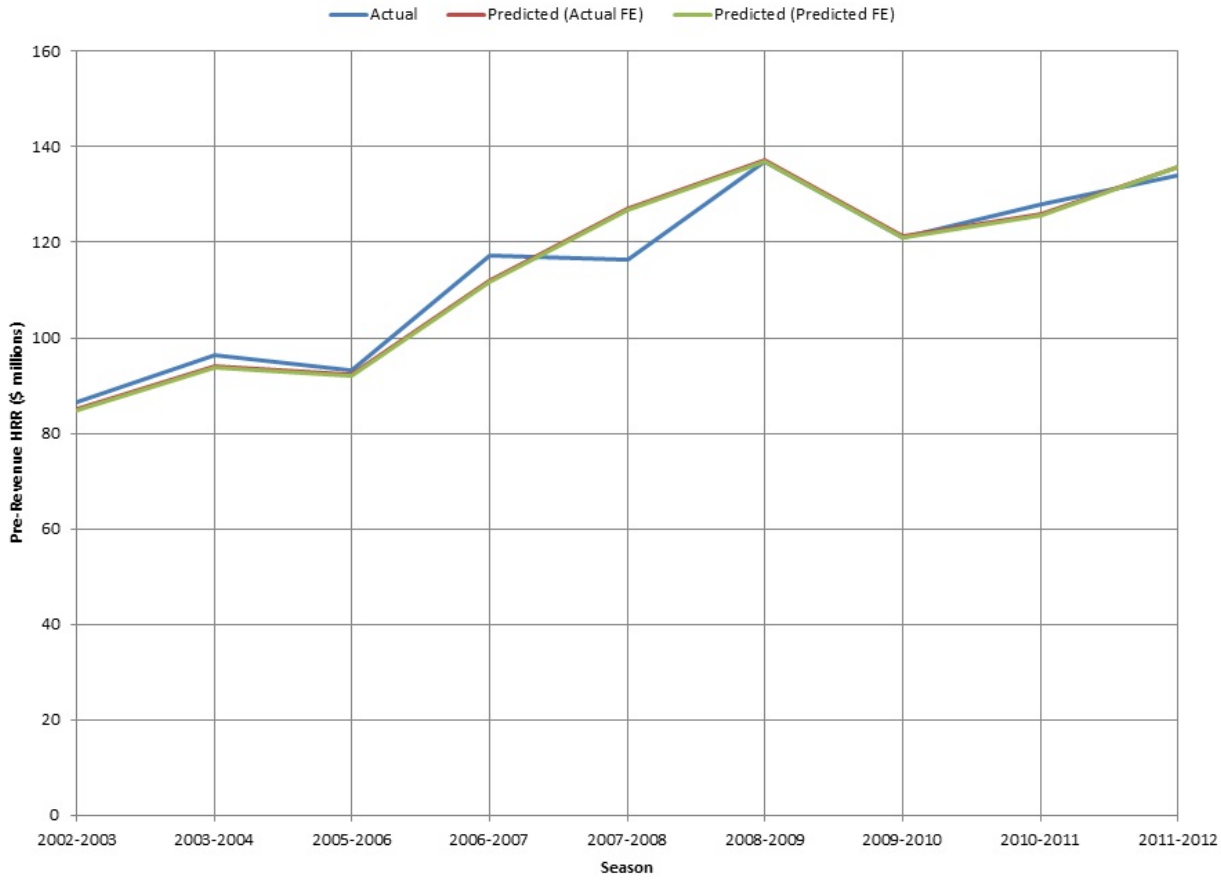


A9. Columbus Blue Jackets

A10. Dallas Stars



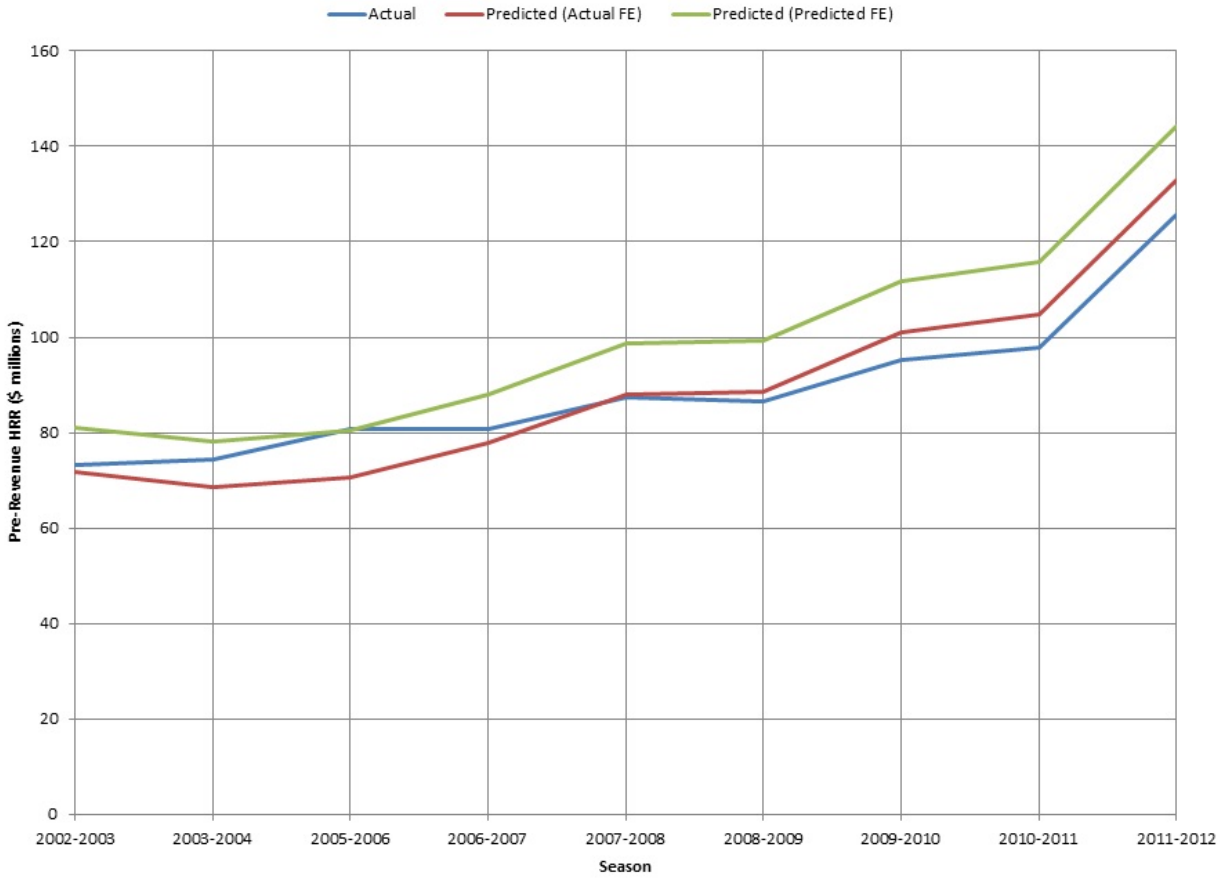
A11. Detroit Red Wings



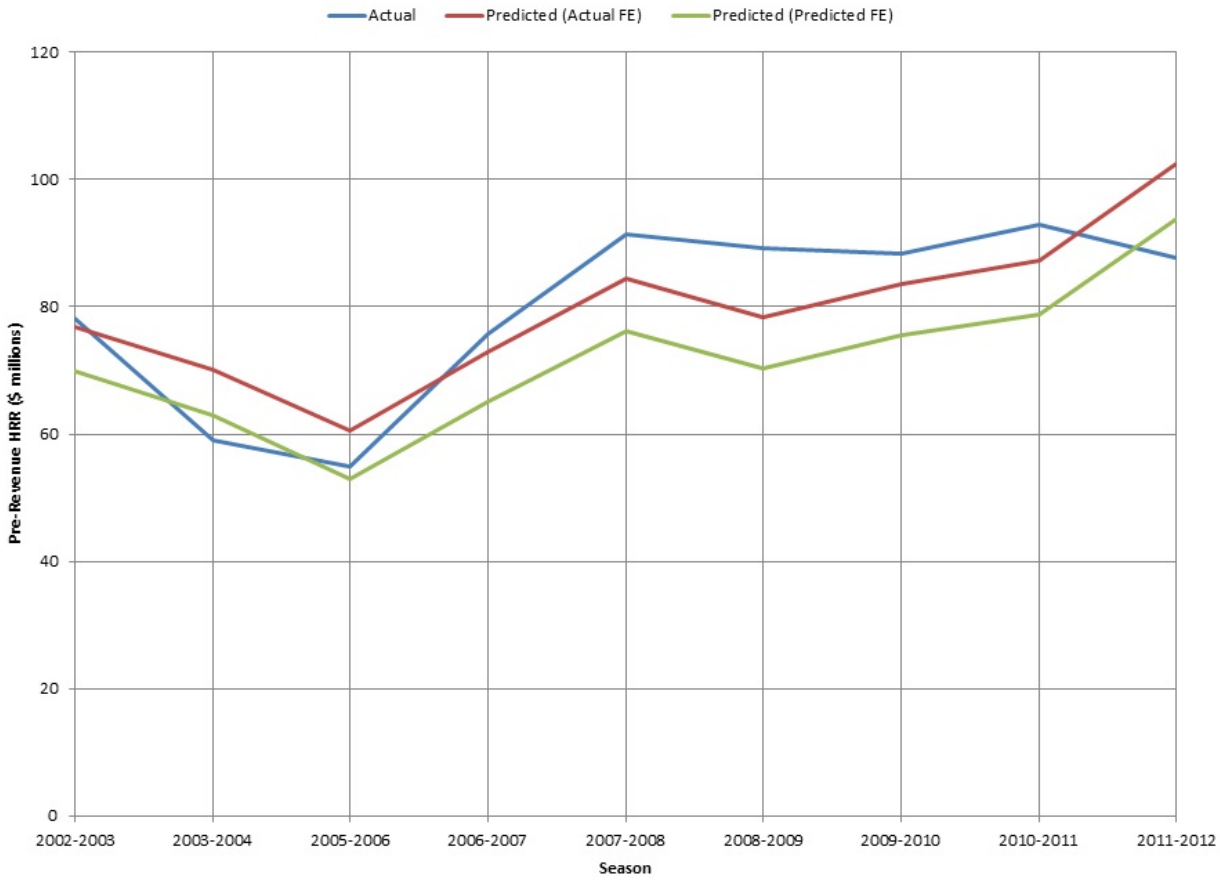
A12. Edmonton Oilers

A13. Florida Panthers

A14. Los Angeles Kings



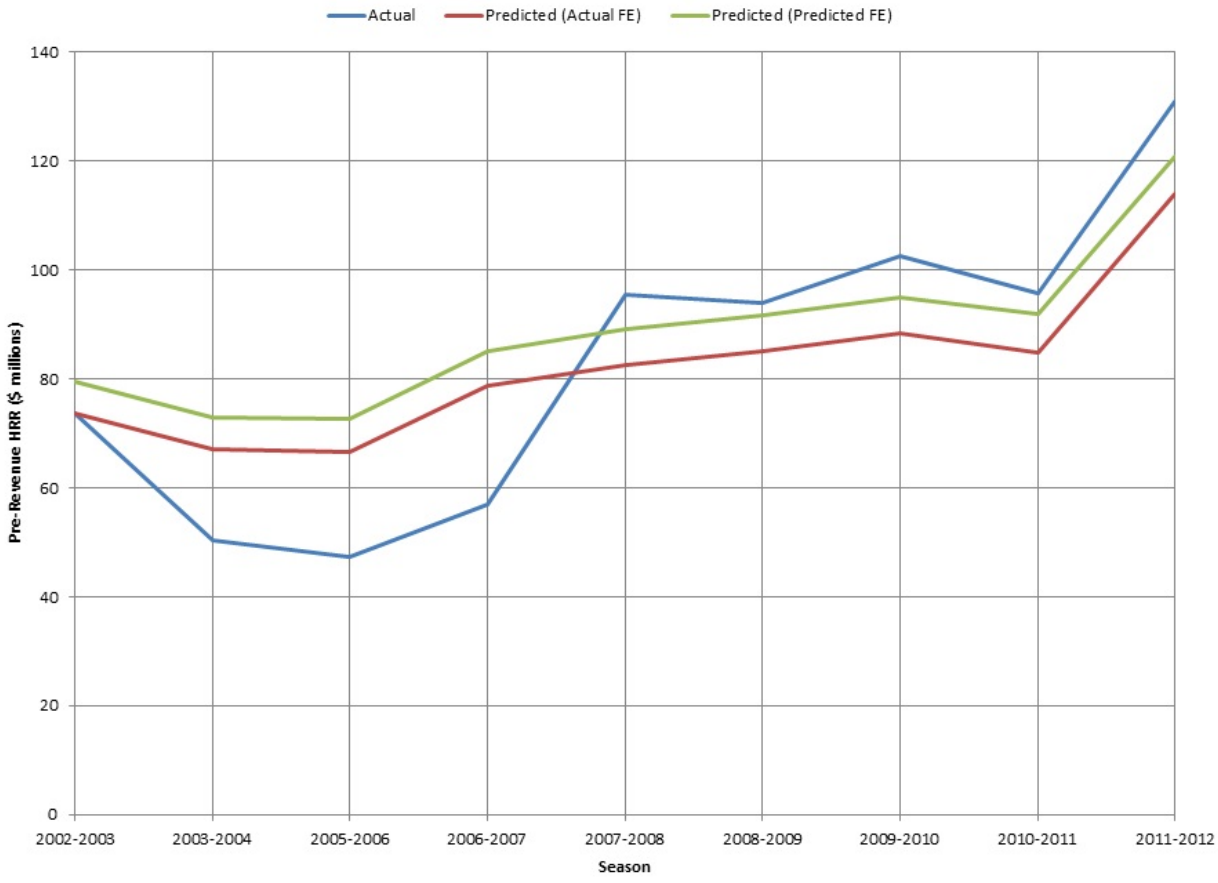
A15. Minnesota Wild



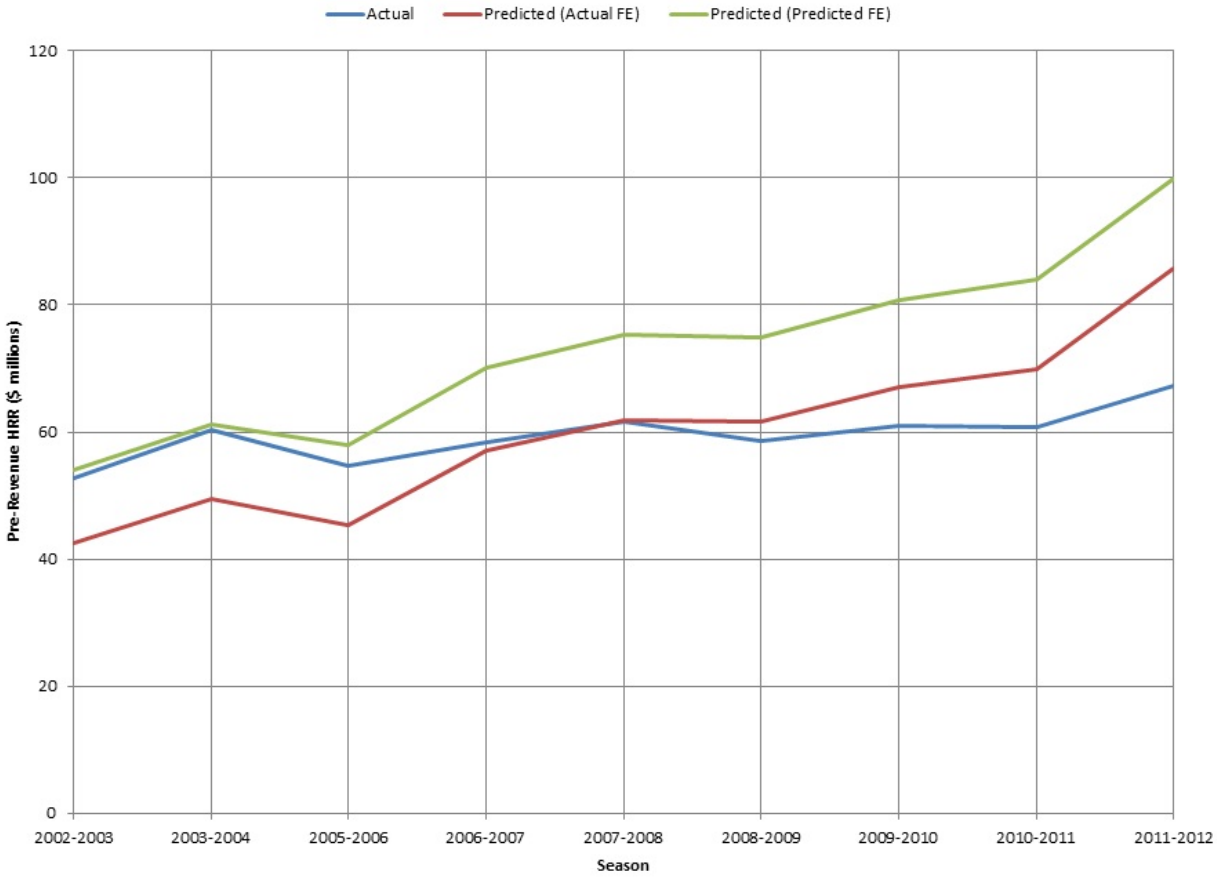
A16. Montreal Canadiens

A17. Nashville Predators

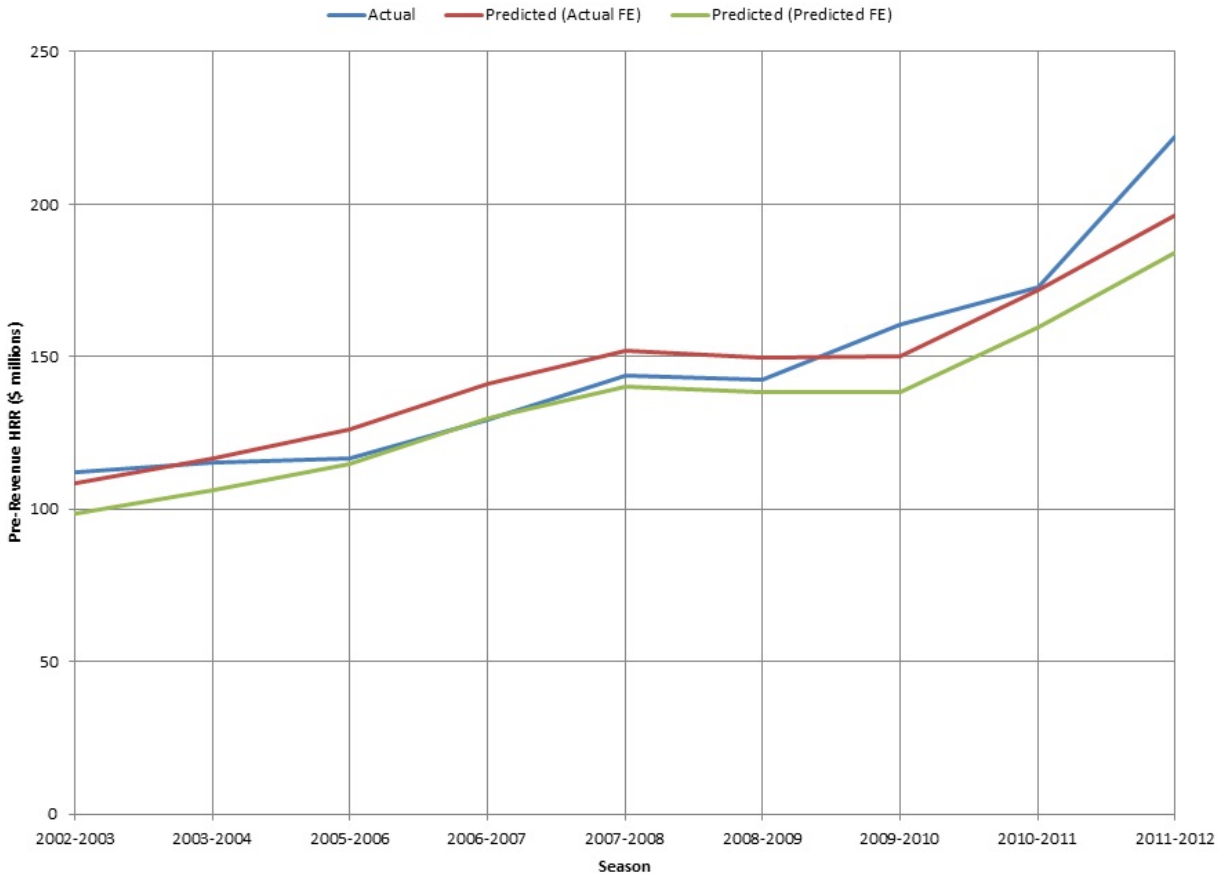
A18. New Jersey Devils



A19. New York Islanders

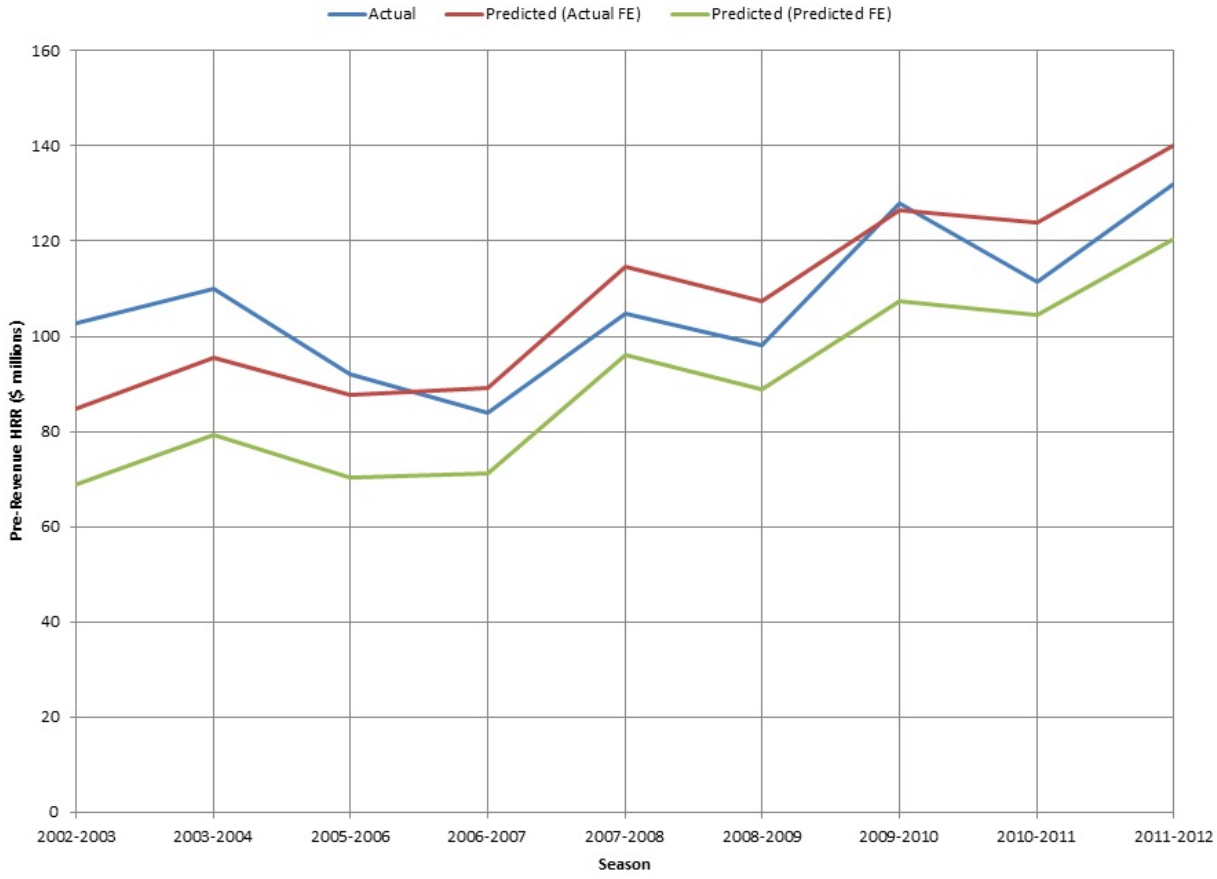


A20. New York Rangers

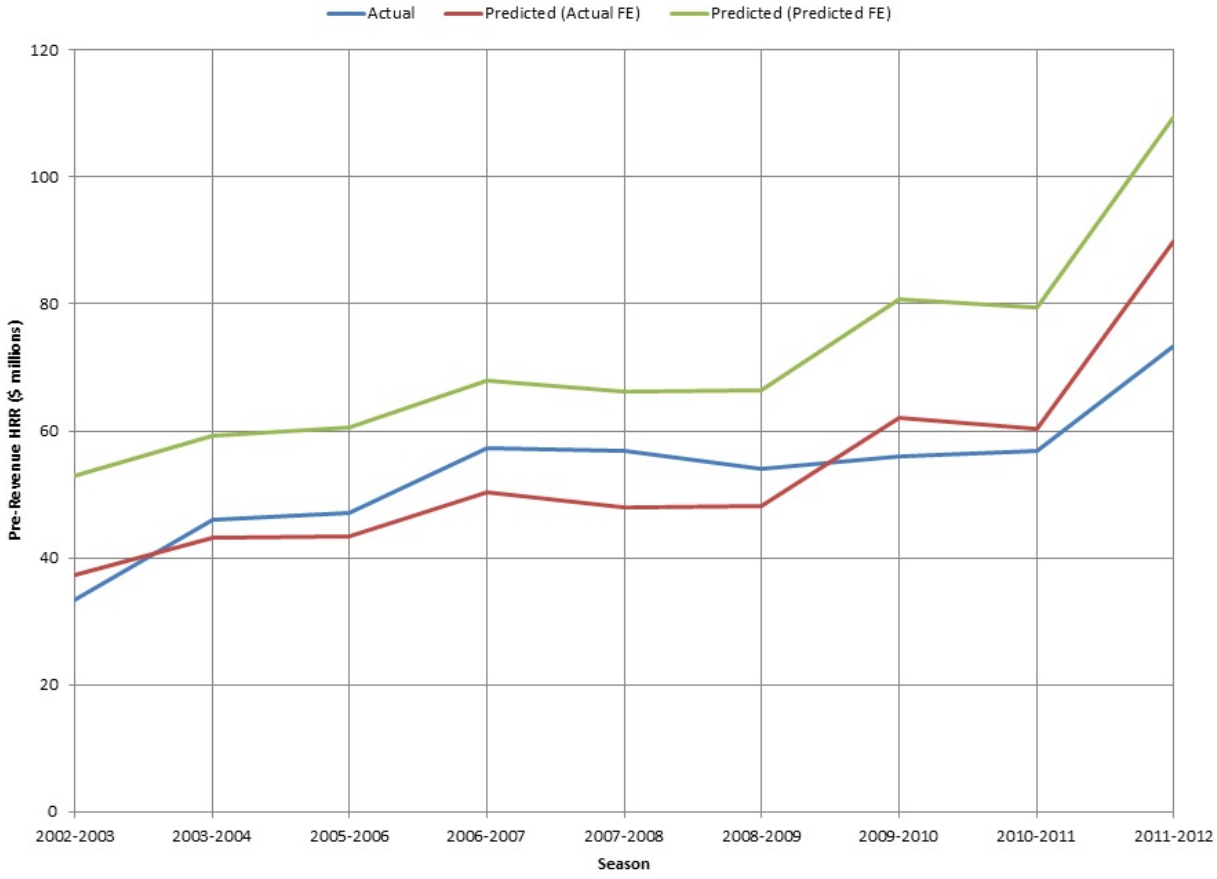


A21. Ottawa Senators

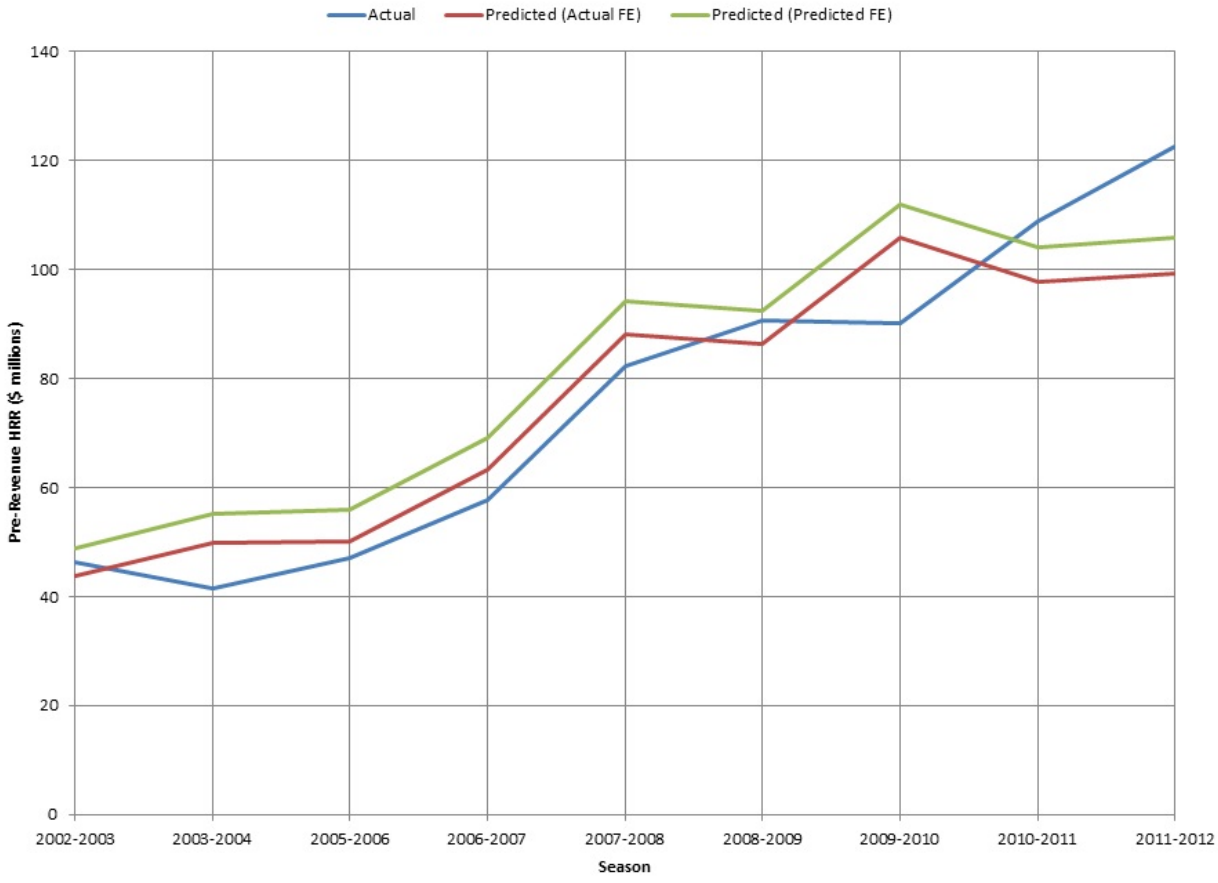
A22. Philadelphia Flyers



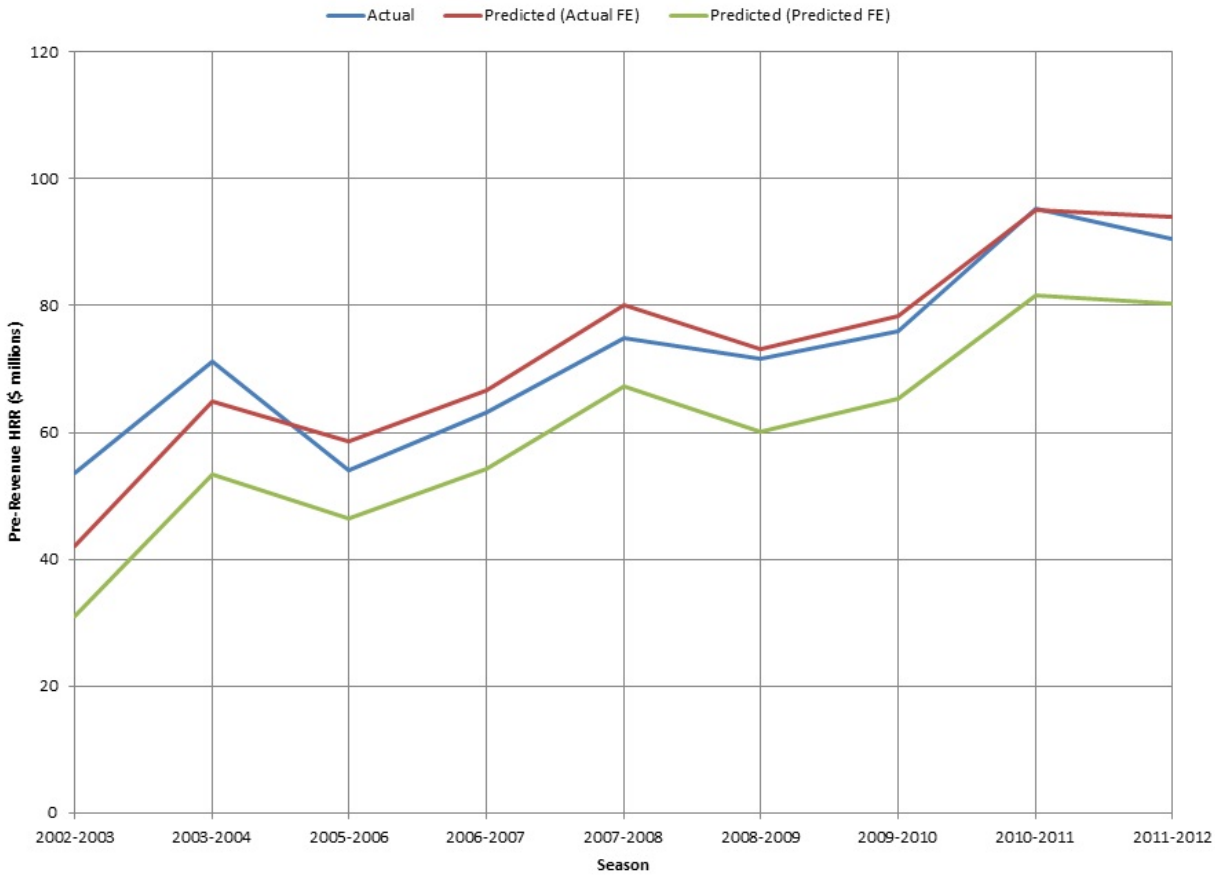
A23. Phoenix Coyotes



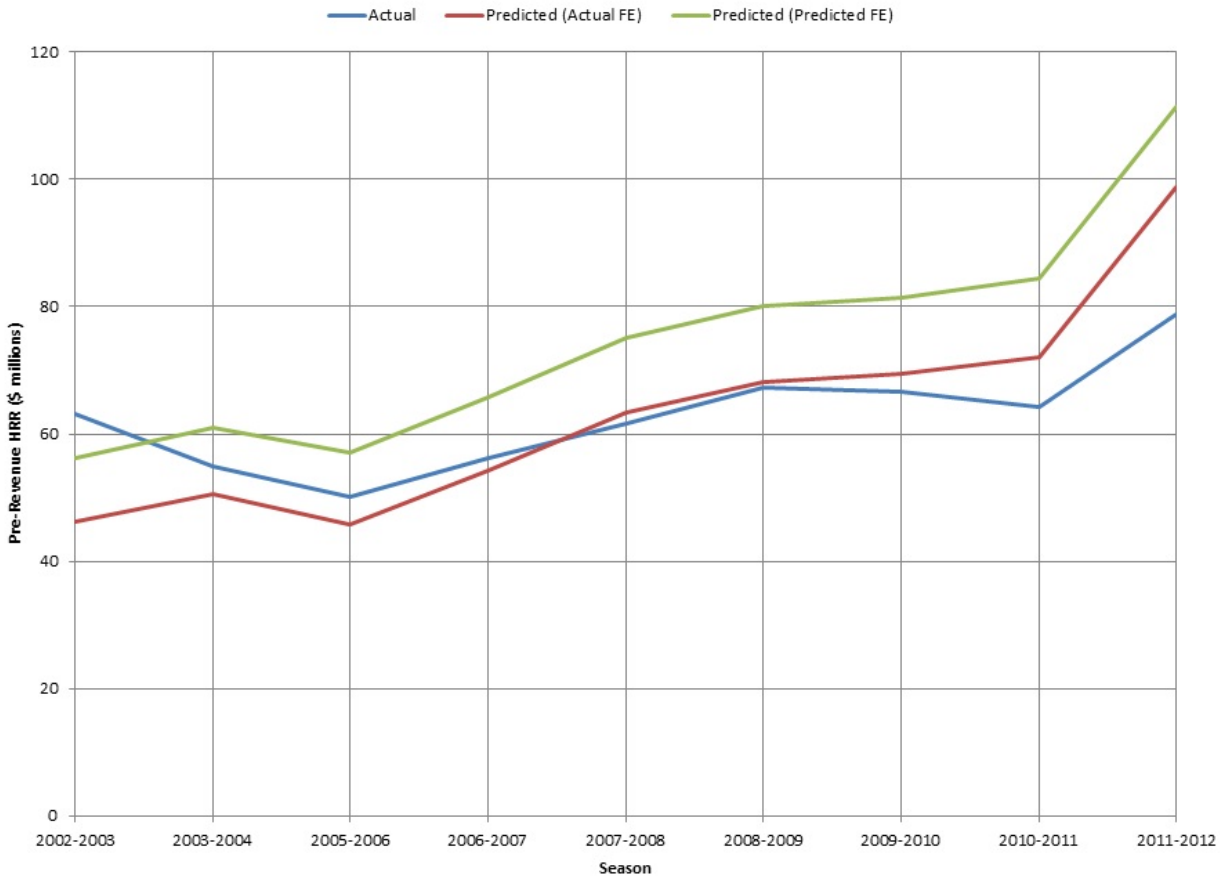
A24. Pittsburgh Penguins



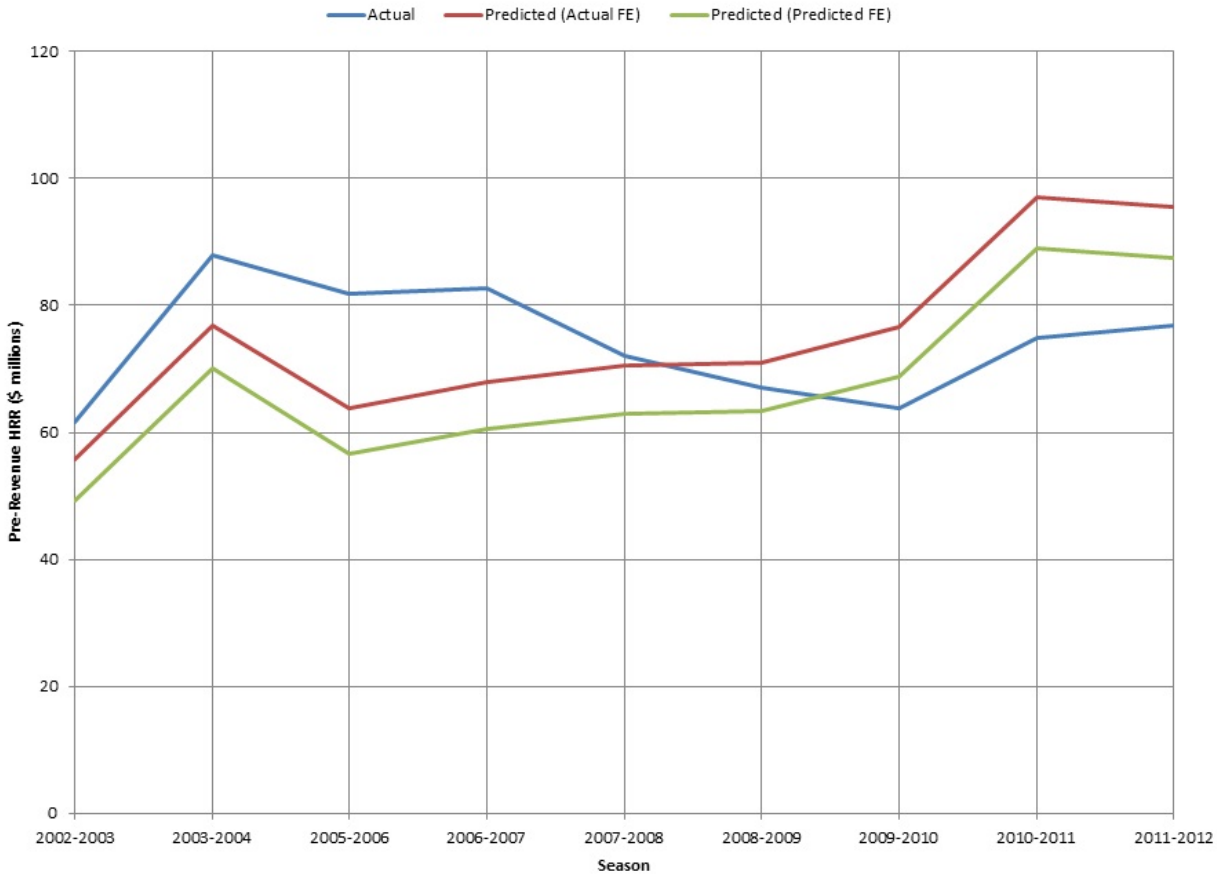
A25. San Jose Sharks



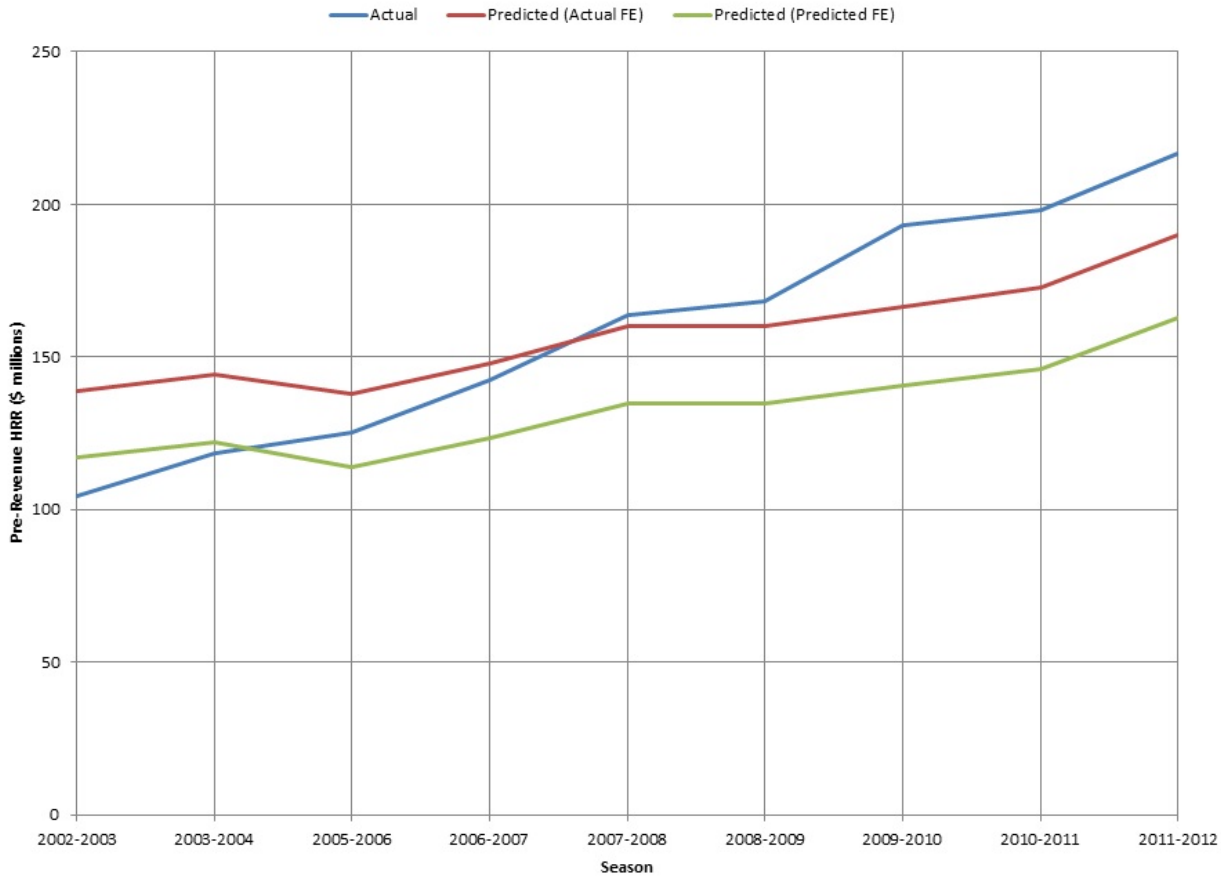
A26. St. Louis Blues



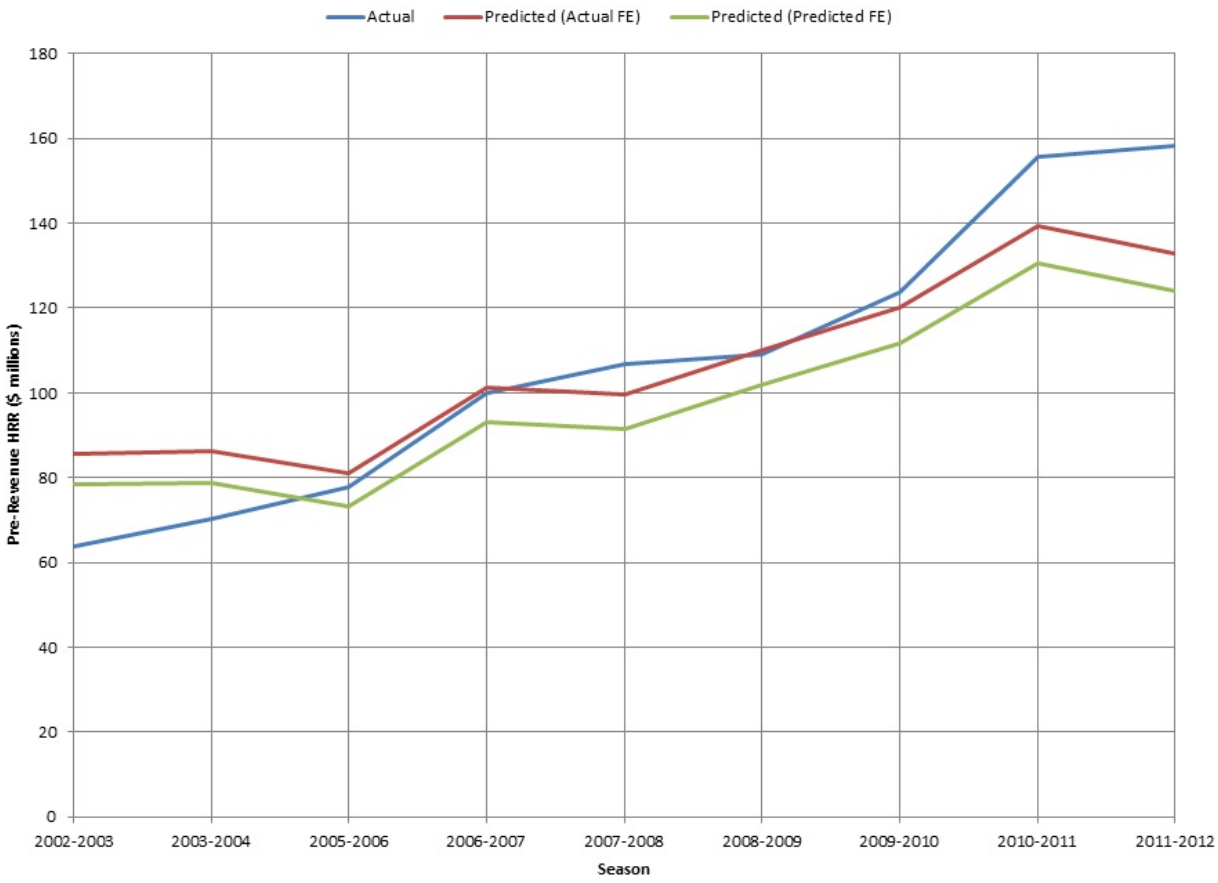
A27. Tampa Bay Lightning



A29. Toronto Maple Leafs



A30. Vancouver Canucks



A31. Winnipeg Jets (only one year of data)

Appendix B

B1. Numbers for 2011-2012 Revenue Calculation (nominal)

Team	Post-Revenue HRR	Central League Phase Contribution	Playoff Phase Contribution*	HRR + Phase 1 to 3	Available Compensation	Incremental Value	Supplemental %	Supplemental Contribution	Adjusted HRR	Adjusted Available Compensation	Compensation Needed	Estimated Percent Needed	Revenue Sharing Received	Pre-Revenue HRR
New York Rangers	199	1.25	6.37	206.62	142.52	84.05	20.000%	15.45	-	-	-	-	0.00	**222**
Toronto Maple Leafs	200	1.25	0.00	201.25	137.14	78.68	20.000%	15.45	-	-	-	-	0.00	**217**
Montreal Canadiens	169	1.25	0.00	170.25	106.14	47.68	20.000%	15.45	-	-	-	-	0.00	**186**
Vancouver Canucks	143	1.25	1.79	146.04	81.94	23.47	15.757%	12.17	-	-	-	-	0.00	**158**
Boston Bruins	129	1.25	2.06	132.31	68.21	9.74	6.538%	5.05	-	-	-	-	0.00	**137**
Detroit Red Wings	128	1.25	0.93	130.18	66.08	7.61	5.108%	3.95	-	-	-	-	0.00	**134**
Philadelphia Flyers	124	1.25	3.51	128.76	64.66	6.19	4.154%	3.21	-	-	-	-	0.00	**132**
New Jersey Devils	122	1.25	4.82	128.07	63.96	5.49	3.686%	2.85	-	-	-	-	0.00	**131**
Chicago Blackhawks	125	1.25	1.46	127.71	63.61	5.14	3.450%	2.67	-	-	-	-	0.00	**130**
Los Angeles Kings	120	1.25	3.27	124.52	60.41	1.95	1.307%	1.01	-	-	-	-	0.00	**126**
Pittsburgh Penguins	120	1.25	1.32	122.57	58.47	0	0.000%	0.00	-	-	-	-	0.00	**123**
Calgary Flames	117	1.25	0.00	118.25	54.14	0	0.000%	0.00	-	-	-	-	0.00	**118**
Ottawa Senators	113	1.25	1.17	115.42	51.31	0	0.000%	0.00	-	-	-	-	0.00	**115**
Washington Capitals	106	1.25	2.62	109.87	45.77	0	0.000%	0.00	-	-	-	-	0.00	**110**
Edmonton Oilers	106	1.25	0.00	107.25	43.14	0	0.000%	0.00	-	-	-	-	0.00	**107**
Winnipeg Jets	105	1.25	0.00	106.25	42.14	0	0.000%	0.00	93.75	29.64	25.31	0.08	12.50	**94**
San Jose Sharks	101	1.25	0.70	102.95	38.84	0	0.000%	0.00	90.45	26.34	25.31	0.08	12.50	**90**
Dallas Stars	100	1.25	0.00	101.25	37.14	0	0.000%	0.00	-	-	-	-	0.00	**101**
Minnesota Wild	99	1.25	0.00	100.25	36.14	0	0.000%	0.00	87.75	23.64	25.31	0.08	12.50	**88**
Buffalo Sabres	95	1.25	0.00	96.25	32.14	0	0.000%	0.00	83.75	19.64	25.31	0.08	12.50	**84**
Anaheim Ducks	91	1.25	0.00	92.25	28.14	0	0.000%	0.00	-	-	-	-	0.00	**92**
Colorado Avalanche	91	1.25	0.00	92.25	28.14	0	0.000%	0.00	79.75	15.64	25.31	0.08	12.50	**80**
St Louis Blues	89	1.25	1.09	91.34	27.24	0	0.000%	0.00	78.84	14.74	25.31	0.08	12.50	**79**
Nashville Predators	88	1.25	1.31	90.56	26.45	0	0.000%	0.00	78.06	13.95	25.31	0.08	12.50	**78**
Florida Panthers	87	1.25	1.14	89.39	25.28	0	0.000%	0.00	76.89	12.78	25.31	0.08	12.50	**77**
Tampa Bay Lightning	88	1.25	0.00	89.25	25.14	0	0.000%	0.00	76.75	12.64	25.31	0.08	12.50	**77**
Columbus Blue Jackets	85	1.25	0.00	86.25	22.14	0	0.000%	0.00	73.75	9.64	25.31	0.08	12.50	**74**
Carolina Hurricanes	85	1.25	0.00	86.25	22.14	0	0.000%	0.00	73.75	9.64	25.31	0.08	12.50	**74**
Phoenix Coyotes	83	1.25	1.67	85.92	21.82	0	0.000%	0.00	73.42	9.32	25.31	0.08	12.50	**73**
New York Islanders	66	1.25	0.00	67.25	3.14	0	0.000%	0.00	-	-	-	-	0.00	**67**
Total	**3374**	**37.5**	**35.24**	**3446.74**							**303.66**			**3374**

Total Revenue Shared	**150**
Supplemental Share Needed	**77.26**
Midpoint from table [#]	**64.106**
Minimum from table [#]	**38.801**
Sum of Incremental Values	**269.98**

Eligible to receive funding

*Taken from Table 3.5

B2. Formulas For Values Determined in B1

Central League Phase Contribution = (Total Revenue Shared x 25%) / 30

Playoff Phase Contribution = taken from Table 3.3

HRR + Phase 1 to 3 = Post-Revenue HRR + Central League Phase Contribution + Playoff Phase Contribution

Available Compensation = Post-Revenue HRR – Midpoint

Incremental Value (for top 10 teams) = HRR + Phase 1 to 3 - HRR + Phase 1 to 3 (FOR PENGUINS)

Supplemental % = 20% for Toronto, New York Rangers, and Montreal

Supplemental % = Incremental Value / Total Incremental Value for Canucks through Kings (20% for top 3)

Supplemental Contribution = Supplemental % x Total Revenue Shared

Adjusted HRR = HRR + Phase 1 to 3 – Total Revenue Shared / 12 teams (12 teams eligible for revenue sharing)

Adjusted Available Compensation = Adjusted HRR – Midpoint

Compensation Needed = Midpoint – MAX (Adjusted Available Compensation, Minimum)

Estimated Percent Needed = Compensation Needed / Total Compensation Needed

Revenue Sharing Received = Percent Needed x Total Revenue Shared

Pre-Revenue HRR = Post-Revenue HRR + Central Phase Contribution + Playoff Phase Contribution +Supplemental Phase Contribution – Revenue sharing Received

Appendix C

C1. Numbers for 2012-2013 Pre-Move Revenue Sharing Calculations

Team	Before Revenue Sharing HRR	Years Under HRR Growth	Available Team Compensation	Needed	Received	Incremental Value	Supplemental %	Suppplmental Contribution	Central Phase Contribution	After Revenue
New York Rangers	258.15	0	196.63	0	0	124.52	20.00%	23.60	1.31	233.24
Toronto Maple Leafs	236.09	3	174.58	0	0	102.47	20.00%	23.60	1.31	211.18
Montreal Canadiens	210.02	0	148.51	0	0	76.40	20.00%	23.60	1.31	185.11
Vancouver Canucks	179.85	0	118.33	0	0	46.22	17.31%	20.42	1.31	158.12
Boston Bruins	148.84	2	87.32	0	0	15.21	5.70%	6.72	1.31	140.81
New Jersey Devils	147.95	0	86.43	0	0	14.32	5.36%	6.33	1.31	140.31
Philadelphia Flyers	147.81	0	86.30	0	0	14.19	5.31%	6.27	1.31	140.23
Los Angeles Kings	142.73	0	81.22	0	0	9.11	3.41%	4.02	1.31	137.40
Chicago Blackhawks	139.01	3	77.50	0	0	5.39	2.02%	2.38	1.31	135.32
Pittsburgh Penguins	136.01	0	74.50	0	0	2.39	0.89%	1.06	1.31	133.65
Detroit Red Wings	133.62	2	72.11	0	0	0.00	0	0	1.31	132.31
Ottawa Senators	132.90	0	71.38	0	0	0.00	0	0	1.31	131.59
Calgary Flames	129.44	0	67.93	0	0	0.00	0	0	1.31	128.13
Washington Capitals	127.49	0	65.97	0	0	0.00	0	0	1.31	126.17
Edmonton Oilers	124.32	0	62.80	0	0	0.00	0	0	1.31	123.01
Dallas Stars	105.23	1	43.71	0	0	0.00	0	0	1.31	103.92
Winnipeg Jets	101.85	1	40.33	19.07	14.30	0.00	0	0	1.31	114.84
San Jose Sharks	98.38	2	36.87	19.07	11.44	0.00	0	0	1.31	108.51
Anaheim Ducks	93.34	4	31.83	0	0.00	0.00	0	0	1.31	92.03
Buffalo Sabres	90.68	2	29.16	19.07	11.44	0.00	0	0	1.31	100.81
Minnesota Wild	86.33	2	24.81	19.07	11.44	0.00	0	0	1.31	96.46
Nashville Predators	85.87	0	24.35	19.07	19.07	0.00	0	0	1.31	103.62
St Louis Blues	83.59	1	22.08	19.07	14.30	0.00	0	0	1.31	96.58
Colorado Avalanche	83.23	1	21.71	19.07	14.30	0.00	0	0	1.31	96.22
Florida Panthers	82.92	2	21.41	19.07	11.44	0.00	0	0	1.31	93.05
Phoenix Coyotes	81.80	0	20.29	19.07	19.07	0.00	0	0	1.31	99.56
Tampa Bay Lightning	80.59	2	19.08	19.07	11.44	0.00	0	0	1.31	90.72
Columbus Blue Jackets	77.12	4	15.60	19.07	9.53	0.00	0	0	1.31	85.34
Carolina Hurricanes	75.18	2	13.66	19.07	9.53	0.00	0	0	1.31	83.40
New York Islanders	70.46	4	8.95	0	0.00	0.00	0	0	1.31	69.15
Total	**3690.77**				**157.32**	**410.22**				**3690.77**
		1, receive 75%	**Supplemental Phase**		**117.99**					
MIDPOINT	**61.51**	**2, receive 60%**								
MINIMUM	**42.44**	**3+, receive 50%**								

C2. Formulas for Values Determined in C1

*I used the same formulas for the Post-Move Revenue Sharing Calculations.
The teams in blue are the teams eligible for revenue sharing based on households in market area.

Available Team Compensation = Before Revenue Sharing HRR – MIDPOINT

Needed = MIDPOINT – MAX(Available Team Compensation, MINIMUM)

Received = Needed x Percent Eligible (shown next to Midpoint and Minimum based on Years Under HRR Growth)

Incremental Value = Before Revenue Sharing HRR – Before Revenue Sharing HRR for Detroit

Supplemental % = Incremental Value / Total Incremental Value for Canucks through Penguins (20% for top 3)

Supplemental Contribution = Supplemental % * Supplemental Phase (117.99)

Central Phase Phase Contribution = (Total for Received x 25%) / 30

After Revenue = Before Revenue Sharing HRR + Received – Supplemental Contribution – Central Phase Contribution

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