Major Themes in Economics

Volume 6 Article 4

Spring 2004

The Relationship between Team Payroll and Team Performance in the National Hockey League

Brandi Glasnapp
University of Northern Iowa

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ABSTRACT. The National Hockey League (NHL) is in serious financial trouble. More than half of the 30 teams lost money during the 2002-03 season. Player salaries have increased dramatically over the last decade and payroll costs account for the majority of total operating costs. This paper analyzes how team payroll affects team performance. Linear Regression analysis is used to determine the effect of payroll on performance. A Granger Causality test is performed using payroll and performance data from the 1998-99 to 2003-04 seasons. No conclusive evidence is found that supports the common belief that payroll can be used to predict a team's success.

I. Introduction

There are cracks in the National Hockey League's ice. Player salaries are higher than ever before and many teams' operating revenues have failed to meet costs. The overall health of the league is at risk due to the financial losses of individual teams. What can teams do to consistently win and also make a profit? In professional sports, emphasis is placed on paying extraordinary sums of money to the best players–athletes who will surely help the team win a championship. Recent National Hockey League (NHL) owners have tested this theory. Some have been successful with a high payroll while others have succeeded with much lower payrolls. It can be shown that a high payroll may help sustain success but it is not a significant determinant of a team's point total. NHL teams need to start making a positive operating profit. Reevaluating player salaries should be the first priority. Team success is determined by how teammates perform on the ice together, not by the sum of its players' salaries.

II. Current Economic Trouble

Although sports are flourishing in America, the NHL is on the brink of disaster. Former Securities and Exchange Commission Chairman Arther Levitt released a study on February 18, 2004 confirming that NHL teams lost a combined $273 million last season [Brehm, 2004, para 1]. Levitt discovered that 19 teams posted numbers in the red while 11 clubs earned

an average of $6.4 million. The most remarkable statistic is the make-up of league costs; approximately 75 percent of all revenue went to players in the form of salaries, bonuses, and benefits. Levitt found player costs to equal approximately $1.5 billion, nearly 67 percent of total operating costs [Brehm, 2004, para 5]. Revenues have increased in the last ten years; player costs have just increased more.

Owners argue that salary inflation has gotten out of hand and that the economic structure of the league is detrimental to its future. Players contend that owners have an incentive to exaggerate the impact of salaries on franchise costs. The Collective Bargaining Agreement between the NHL and the NHL Players' Association runs out on September 15, 2004. There are no restrictions on player mobility other than a comprehensive entry draft and free agency system. Unlike other professional sports, the NHL has not enacted any kind of salary cap or tax on player salaries and less revenue is shared among franchises in the NHL than in any other professional sport. NHL owners are threatening to lock out the players in the fall if a new Collective Bargaining Agreement cannot be reached that includes some kind of salary restraint.

Another problem for the NHL is its limited TV revenue. The league's $120 million per year rights fee is expected to drop by 50 percent when a new deal with ABC is announced shortly. This is far from the contracts held by the National Football League, Major League Baseball, the National Basketball Associaton and NASCAR. Each of these has multiyear contracts that exceed $1 billion. The NHL has no leverage with the networks because ESPN and ESPN2 hockey ratings are down 17 percent from last season. [Zulgad, 2004, 1]

The NHL needs to control its costs quickly, before it sinks.

III. MRP Theory

Economic theory provides insight into why owners spend so much on player salaries. Player talent is an input into team performance. Managers and owners can choose to field a lower quality team or a higher quality team [Fort, 2003, 106]. Fort measures quality with team winning percentage. This is an accurate measurement because conference standings in professional sports are determined by a team's wins and losses. The NHL is slightly different from other professional sports organizations because it uses points to establish conference standings and play-off spots. Teams receive two points for a win, one point for a tie,

and no points for a loss in the regular season.

A belief generally held by sports fans, owners, and economists is that higher quality costs more than lower quality. "The more an owner wants to win, the more it is going to cost" [Fort, 2003, 105]. The marginal revenue product, or MRP theory, explains the logic behind this viewpoint. The MRP for labor is defined as: MRP = MP * MR. In the context of the NHL, MP is the player's contribution to the team's winning percentage and MR is the marginal revenue produced by the player's contribution to winning. An MRP in this case represents the player's contribution to revenue earned by the team owner [Fort, 2003, 184]. In a competitive market, salaries should equal a player's MRP. Owners would compare the cost of winning and an athlete's MRP to determine whether the player is worth hiring. A player's salary should rise for one of two reasons under the theory–the team's revenue increases or a player's contribution to revenue increases. Players in all professional sports get paid close to their MRP [Fort, 2003, 186].

One problem with the MRP approach is that most players enter into lengthy contracts at the beginning of a season, before revenue or team performance has been determined. As a result, it is difficult to calculate a player's expected MRP. Many factors, including experience, past performance and injuries, age, and team performance, enter into the calculation. Owners and general managers are expected to have a clear understanding of a player's expected contribution to a team before he joins the team. They are ridiculed when a player on their team under-performs and praised when an athlete exceeds expectations. Owners and general managers are assumed by sports economists to have perfect information about a player's past performance and injuries. Information that is unavailable to owners and economists but crucial to performance is a player's psychological condition or tendency toward injury. Player characteristics that are difficult to quantify may inhibit the owner from making a correct decision.

Athletes make millions of dollars because those with high MRPs are in limited supply. For example, there is only one Jaromir Jagr. Jagr earned the crown of top scorer from 1997-2001 and was recently traded to the New York Rangers from the Washington Capitals. He will make $11 million per year. There are players everyone wants but everyone cannot have. As a result of the limited supply, salaries skyrocket.

Teams with higher payrolls are paying for a higher winning percentage. If this held up on the rink, the Detroit Red Wings should have lost to the New York Rangers in the Stanley Cup finals last year because they had the highest payrolls in the league, $68.0 and $69.2

million, respectively.[1] Yet the Rangers did not make the playoffs and the Red Wings lost four consecutive games in the first round. Conversely, the New Jersey Devils, with the eighth highest payroll, won the Stanley Cup over the Anaheim Mighty Ducks, who were 17th. The Minnesota Wild became semifinalists with the lowest payroll. Apparently, payroll is not the only factor that determines team quality–Minnesota showed that it is possible for a small market team to turn a profit while staying competitive.

IV. Evaluating the Teams

There is a mixture of profitable large and small market teams, but many are sinking into the red. They are all part of the same league, work under the same collective bargaining agreement, and share the same rules on the ice. The differences lie in management and player skills, fan preference, government backing, and a host of other factors. The analysis will highlight teams that have effectively used their limited resources and some that have not.

Recently, franchises with high payrolls have not been more competitive or shown higher operating revenue at the end of the season. Small market teams have a difficult time in professional sports, especially in the NHL, where only 12 percent of the league's revenue is shared among its 30 teams. In comparison, the National Football League (NFL) splits 62 percent of revenue [Egan, 2003, 94]. Last season the St. Louis Blues lost $29 million, the Mighty Ducks of Anaheim dropped $11 million, and the Carolina Hurricanes posted a $13 million loss [Egan, 2003, 94]. In its fourth year of existence, the Minnesota Wild surprised many people by recording the largest profit in the league, $20 million. Doug J. Risebrough, Minnesota's general manager, controlled costs by not overspending on players.

Risebrough did his own MRP calculation. He figured a star player in the National Basketball Association (NBA) might play 40 of 48 minutes in a game, handle the ball on most of his team's possessions, and take 25 shots per game. The Wild's best player, 21-year-old right wing Marian Gaborik, probably plays 18 of 60 minutes, has the puck a minute of that time, and takes approximately three shots a game. [Farber, 2003, 100]. Risebrough refused to pay his players like athletes in other sports because the marginal revenue would not exceed the marginal cost. The Wild has sold out every game since its inception. That is important in the NHL where 50 percent of revenue, including play-off games, comes from gate receipts [Brehm, 2003, 6]. Playoff games are also a significant source of

revenue. A team is almost guaranteed to make a profit if it can make the playoffs with a low payroll [Badenhausen, 2003a, 4]. "People are looking at [Minnesota] as a model franchise–not overspending, playing well, selling out tickets, and selling out their suites," said Gordon Saint-Denis, President of Triton Sports Association, a professional sports valuation company [Egan, 2003, 94]. That was last year. This season Minnesota finished the season in 10th place in the Western Conference, eights points from a play-off bid. Minnesota was competitive in the short run; it is questionable whether the team can maintain its profits in the long run given its low-cost strategy.

The New York Rangers are a team that has been consistent in the long run. They have consistently paid near top salaries in the NHL but have not made the playoffs for seven consecutive seasons. This is in a league where 16 of the 30 teams qualify to compete for the Stanley Cup. In the NFL there is room for 12 of the 32 teams in the play-offs and in Major League Baseball (MLB) only eight of the 30 have a shot in the postseason. The Rangers' performance level is extremely low.

Forbes, a financial magazine, developed the Team Relative Productivity Score (TRPS) to compare pay versus performance for NHL teams. The statistic looks at the number of wins per player payroll relative to the rest of the NHL. Playoff wins are counted twice as heavily and ties are counted half as much. The Rangers score of 42 means the team achieved 58 percent fewer victories per dollar of payroll than the league average. Table 1 shows the best and worst NHL teams in terms of TRPS, according to Forbes [Badenhausen, 2003a, 4].

Table 1

Best		Worst	
Team	TRPS	Team	TRPS
Ottawa Senators	201	New York Rangers	42
Minnesota Wild	199	Carolina Hurricanes	66
Tampa Bay Lightening	154	Detroit Red Wings	68
Vancouver Canucks	154	Montreal Canadiens	68
Anaheim Mighty Ducks	149	San Jose Sharks	71

Saint-Denis, founder of the sports valuation firm Triton Sports Association, said the ratio of player costs and performance "is something that is very important when we value franchises. It's an indication of management's strength" [Badenhausen, 2003a, 4]. What a high TRPS rating does *not* indicate is positive operating income. Anaheim lost $10.8 million in operating revenue and Ottawa was in the red $2 million. Vancouver stayed afloat, posting $700,000 in operating revenue. All of the teams in the lower TRPS bracket lost money during the 2002-03 season. Furthermore, the TRPS rating does not illustrate total points. Detroit led its division with 110 points and led the league in scoring [Diamond, 2003, 219]. In the first round of the playoffs, Anaheim upset Detroit in a four-game series. Sports statistics cannot explain everything.

The Edmonton Oilers have two strikes against them in the NHL; they are a small-market team in Canada. Canadian teams frequently complain about lack of government support and about their weak dollar in relation to the United States' dollar. Despite Canada's love for the game, the Quebec Nordiques became the Colorado Avalanche in 1995, the Hartford Whalers relocated to North Carolina and the Winnepeg Jets moved to Phoenix in 1997. Nevertheless, the Oilers have been able to attain a consistent degree of success. Edmonton has made the play-offs in six of the last eight seasons. The Oiler's management strategy is recycling and bargain hunting for younger athletes. Recycling involves trading skill-developed, expensive players for cheaper players with a high potential. Player turnover is high, but Kevin Lowe, the team's general manager, said fans recognize that Oiler management does its best and the stadium is nearly full at every game [Greenburg, 2003, 22]. The Oilers prove fan loyalty and point totals do not have to come at the expense of the bottom line. Edmonton only lost $100,000 in operating income for the 2002-03 season, much less than more than half of all NHL teams [Badenhausen, 2003b]. Former Edmonton General Manager Glen Sather, now with the Rangers, surprisingly agrees with Lowe. "At some point the field is going to level out. We're learning guys making big dough are not better than guys making $2 million. I wish I had young players like Edmonton does" [Greenburg, 2003, 22].

The Detroit Red Wings have the best of all worlds, or so it seems. Detroit is a large market team with a sound fan base and a history of winning. They have played in the post season every year since 1990, winning three Stanley Cups in the last seven seasons. Detroit also has the highest payroll in the NHL this season. Detroit is "Hockeytown" and has

been for more than three-quarters of a century. In the 2001-02 season the Red Wings used veterans and the best players on paper to win the Stanley Cup, after finishing the regular season with 116 points, 15 more than the next best club [Diamond, 2003, 267]. Detroit got what it paid $64.4 million for–a championship team. The Red Wings are to hockey what the New York Yankees are to baseball, except that the Yankees bank a positive operating income. Detroit lost $13.7 million in the 2002-03 season [Badenhausen, 2003b].

It may be that Detroit is prone to diminishing returns to a variable input. Given a level of fixed inputs, increasing the use of variable inputs eventually results in decreased marginal product [Fort, 2003. 96]. The most significant variable input, in terms of cost, is players on an NHL team. In the short run–a season–the stadium expenses are fixed and owners can trade up or down to increase or decrease their player costs. It is not possible for Detroit to sell an extra ticket to an already soldout stadium or vie for more TV revenue once a contract is signed. Unless adding a higher-priced player to the roster gets Detroit one game further in the playoffs, the Red Wings' profit decreases. If Detroit already has enough talented players to win the Stanley Cup, adding another top-dollar athlete has no benefit. This is a dilemma all General Managers face.

The NHL is evolving. More teams are putting top draft picks on the roster, instead of sending them to junior leagues. Three of the top five goal scorers at midseason this year have played fewer than 200 NHL games and the average age of the top 10 NHL scorers has dipped from 30.8 in 2001-02 to 28.6 in the last two years [Farber, 2004, 42]. "This NHL generational shift has been tectonic. Fresh faces have made the learning curve flatter than Saskatchewan" [Farber, 2004, 42]. This should be delightful news to owners; the opportunity for free agency increases with experience in the NHL. There are six levels of free agency in the NHL. As a player's age and experience increase, the restrictions on his mobility weaken. More teams can bid on a player with some level of free agency, so it is almost certain that such athletes will have higher salaries. Players with restricted mobility, mainly younger players, do not have this bargaining power. One way small market, low payroll teams can catch a bargain is if they draft well.

There are many ways to manage an NHL franchise, although few were profitable last season. Edmonton and Minnesota have shown that small-market teams can make a profit with a winning team by controlling player costs. No one disputes the fact that the Rangers have serious

problems, while Detroit, also a large market team, dominates on the ice but not in operating revenue. Evaluating individual franchises provides insight into management performance, but economic research may shed light on the broader picture.

V. Granger Causality[2]

The coefficient of correlation between total points and team payroll was calculated for all years for which data was available. There is a moderate positive relationship between the two variables, as shown in Table 2.

Table 2

Year	Coefficient of Correlation
1998	0.278
1999	0.545
2000	0.528
2001	0.581
2002	0.416
2003	0.303

Although the coefficient of correlation is a good measure of the relationship between team payroll and team performance, it cannot be used to determine causality. The belief in professional sports is that team payroll is a predictor of team performance. This assumption needs to be statistically tested for the NHL. Identifying causality with econometric tools has always been a problem, but a Granger causality test can be used to determine precedence.

Hall, Syzymanski, and Zimbalist, three leading sports economists, performed a Granger causality test with Major League Baseball (MLB) relative payroll and performance data. Granger causality does not test for theoretical causality. Granger causality is a circumstance when one time-series variable consistently and predictably changes before another variable does [Studenmund, 2001, 423]. If one variable precedes another it does not guarantee that the first variable causes the second but more than likely the opposite is not true. The study concluded that team performance Granger causes relative team payroll in MLB. They also used complementary data from English soccer, which produced conflicting results. They concluded that differences in the way soccer and

baseball markets operate are due to the variations in the institutional rules that govern them. MLB imposes restrictions on trade, player mobility, roster sizes, and player spending, much like in the NHL. English soccer, on the other hand, is more of a free labor market.

I performed a Granger Causality test using NHL data from 1998 to 2003. Hall, Syzamanski, and Zimbalist calculated that their variables from MLB and English soccer were stationary, so I assumed that team performance and team payroll in the NHL were stationary as well. A stationary time series is one whose basic properties do not change over time [Studenmund, 2001, 424]. The market for NHL labor closely parallels that of MLB labor. Results of the test were consistent with those of the MLB Granger causality test mentioned above. I am unable to reject the hypothesis that team performance Granger causes team payroll; however, I can reject the hypothesis that team payroll Granger causes team performance.

My regression equation is:

$$Y_{t,t} = \alpha_1 + \beta_1 y_{t_{t-1}} + \beta_2 x_{t,t-1} + \mu_{t,t}$$

y_i is the dependent variable and x_i is the independent variable. "A variable z can be said to Granger cause a variable w if the coefficient $_2$ for the regression with w on the left hand side (LHS) is economically and statistically significant, whereas the coefficient $_2$ for the regression with z on the LHS is economically and statistically insignificant" [Hall, 2002, 161].

The test using NHL data was completed in two steps. In the first step team points were regressed against lagged team points and lagged relative team payroll, giving estimates of $_2$. Relative team payroll was then regressed against lagged relative team payroll and lagged team points, giving estimates of $_2$ in step two. The results of this estimation are given in Table 3.

Table 3

Estimates of B_2: 1998-2003 for National Hockey League

Dependent Variable	Coefficient for β_2	t-statistic	p-value
Team points	-2.19	-0.395	0.6934
Relative team payroll	0.00545	3.72	0.0003

$_2$ is not significant when team points is the dependent variable. The p-value is clearly too large for lagged relative team payroll to be statistically significant as $x_{i,t-1}$. In step two $_2$ is statistically significant at greater than the 1% level with a p-value of .0003. This occurs when relative team payroll is the dependent variable and team points is $x_{i,t-1}$. One implication is that team points Granger causes relative team payroll. Of greater importance is that relative team payroll does not Granger cause team points. In other words, there is no evidence that relative team payroll precedes team points. This is consistent with the results from MLB.

VI. Further Econometric Work

A question arises from the results of the Granger causality test: Why are NHL salaries increasing at a substantial rate if payroll does not influence team performance? Salary is determined by player skills and team revenue. Kahane uses a hierarchical linear model to address this. He proposes that the salary of a player is not only determined by his attributes but by team-level qualities. Kahane concludes that players on a team with higher revenues are compensated more than players on a lower revenue team, all things being equal [Kahane, 2001, 631]. Thus, teams with higher payrolls may or may not have better players, but just have more money to spend on their players. This is one way team performance could Granger cause payroll. If an NHL team is successful in the short-run and makes it to the play-offs revenues will increase. According to Kahane, as revenues increase so will a team's payroll expenditures. It appears that NHL owners and general managers overestimate revenues.

Richardson proposes a different reason for escalating NHL salaries. Richardson uses 1993-94 data from the NHL to test the relationship between marginal revenue products and salaries while estimating a revenue equation. The research supports the hypothesis that higher paid players have higher MRPs and that winning regular season games and making the playoffs significantly increases team revenues [Richardson, 2000, 402]. He also measures competitive balance in the NHL using winning percentages and play-off games. The correlation coefficient for winning percentage and one or two year lags is high. In the long run, on the other hand, the trend is toward more competitive balance. The lag coefficients for play-off games are much weaker than those for winning

percentages; playoff games show no evidence of imbalance. Richardson argues that the financial payoff to a winning team and the competitive balance in the league encourages the bidding up of players' salaries [Richardson, 2000, 412]. The limitation of this study is that it was performed with data from 10 years ago. Current data should be analyzed to determine if changes in the league, specifically the escalation of salaries, have influenced competitive balance or the calculation of players' MRP.

VII. Other factors that influence team performance

Payroll has not been shown to be the sole determinant of team performance. Wage disparity, psychological conditions, general managers, and luck play a role in the success of a team. Additional research has shown the degree of salary inequality within a team influences team production. There has been a marked increase in NHL average salaries in the last decade. In the 1980s the average salary grew by 33 percent while in the 1990s there was a 299 percent escalation [Fort, 2003, 181]. The dispersion of salaries has grown between and within teams. Wage dispersion occurs when not every player receives the same salary. Greater wage dispersion occurs when there is a large gap between the highest paid player on a team and the lowest paid player. Wage inequality within teams can be viewed as a deterrent to team performance.

Evidence from NHL data supports the hypothesis that wage compression should be a goal of managers. Gini coefficients were calculated for all 26 teams in the NHL and included in a regression with average player salaries for 1996-97. Lorenz curves measure salary distribution by plotting the cumulative percentage of players against the cumulative percentage of total salary income for a particular team. [Quirk, 1992, 235]. A straight Lorenz curve indicates no salary dispersion while one that bulges from the 45 degree line shows an unequal distribution of income. The Gini coefficient is found by calculating the area of the bulge relative to the total area below the line of income equality [Quirk, 1992, 237]. The Gini coefficient increases as a team's wage dispersion increases. Season-ending point totals by team were regressed on the team's Gini coefficient and average team salary. The regression results were as follows (t-values in parenthesis):

POINTS = 69.99 – 65.51GINI + .05SALARY

R^2 = .3 (4.73) (-1.37) (3.38) [Sommers, 1998, 119]

Salary is shown to have a positive statistically significant effect on POINTS at greater than the one percent level. This is consistent with the hypothesis that player salaries parallel the quality of player performance and that teams with higher payrolls should tally more points at the end of the season than teams with lower payrolls. The negative sign on the Gini coefficient leads one to believe that as the Gini coefficient increases, points decrease. "One can conclude that unequal salary distributions may create morale problems severe enough to affect worker productivity" [Sommers, 1998, 19]. According to Sommers' research, teams with high payrolls and relatively equal wage distribution should have more points at the end of the season than teams with high payrolls and unequal wage distribution. One should take care when evaluating these results. The sample of 26 teams is relatively small and the regression model has a small adjusted R-squared. Even so, this may be a key to successful small market teams. Teams with lower payrolls should concentrate on maintaining an equal distribution of salaries because team cohesiveness could somewhat offset the negative impact of having less money to spend.

A crucial element to any team's success is how its members interact. Rarely does a team reach its potential productivity. In 1972 Ivan Steiner developed a model to show the relation between individual abilities on a team and how team members interact [Weinberg, 2003, 167]. His model is shown by the following equation:

Actual productivity = potential productivity – losses due to faulty group processes

Steiner defined potential productivity as a team's best possible performance, given each player's ability, knowledge, and skill, as well as the demands of the task. Steiner did conclude that individual ability is more than likely the principal resource for athletic teams so the team made up of the best individuals will usually achieve the most success. Motivation losses and coordination losses, those that occur when the timing between teammates is off, are the two main kinds of faulty group processes. Teams that rely on greater interaction are more susceptible to coordination losses. [Weinberg, 2003, 167] In professional hockey, a puck travels at approximately 70-80 mph and seldom does one player

have control of it longer than a few seconds. Team interaction is a vital part of the game.

The size and speed of the puck makes luck an integral part of each and every game as well. Inches can make or break a game-winning goal. According to Sport Psychology Professor Mickey Mack from the University of Northern Iowan, luck is one of the key factors in any sporting event. Team A may be a better team than Team B statistically and have a greater probability of winning. Unfortunately for Team A, probability is insignificant when the score is 2-2 in overtime during the seventh game of the Stanley Cup finals.

VIII. Conclusion

A high payroll is not a necessity in the NHL. The teams with the highest payrolls did not go far in the playoffs, nor did they do well financially last season. Team performance is seen to Granger cause relative team payroll while the opposite can be rejected. Even still, competitive balance and increasing revenues have caused massive salary inflation in the league. Sommers found that high average salaries move with team performance but wage inequality negatively influences team performance in the NHL. Team productivity is largely affected by the interactions of team members, giving general managers an economical way to increase success. Recent developments have changed the outlook of many teams in the NHL, financially and on the ice. A larger supply of adequate young players, stabilizing or decreasing TV revenue, and severe operating revenue problems are changing the NHL. The evidence seems to suggest that owners need to assess their players' MRP more carefully before signing a contract worth millions of dollars.

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Endnotes

1. All NHL team payrolls were taken from http://hockeyzoneplus.com/$maseq_e.htm
2. AUTHOR'S NOTE: I would like to thank Dr. Ken Brown for his comments and research assistance.