

**Team Effects on Compensation: An
Application to Salary Determination
in the National Hockey League**

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Abstract

Studies of salary determine largely model pay as a function of the attributes of the individual and the workplace (i.e. employer size, job characteristics, and so forth). This paper empirically investigates an additional factor that may influence individual pay, specifically coworker productivity. Data from the National Hockey League are used since both salary and teammate performance measures are readily available. We find that team attributes have both direct effects on an individual's pay, and indirect effects by altering the rates at which individual player productive characteristics are valued.

I. Introduction

When complementarity exists between labor inputs, individual productivity may be poorly measured by treating the individual worker separately from the character of the organization, or team, within which he works. Namely, the same individual may have different measured productivity when working in different settings since his co-workers will offer different degrees of help.¹ If such complementarity between human capital inputs is present, say a team dynamic, it will imply the existence of both team and individual effects on productivity, and hence compensation.

Although these team effects cannot generally be captured without information on co-workers, including managers, much of this requisite information is available in the context of professional sports teams. As such, we use data from professional hockey to investigate team effects on compensation (see Kahn, 1991, for a recent survey of the literature on pay differentials in professional sports). The central goal of this paper is therefore to empirically assess the effect of complementarities between labor inputs on individual compensation. That is, by situating the worker in an organizational environment where co-workers have an impact on individual productivity, we examine the separate effects of individual and team productivity on salary determination. The general question asked is whether or not individual attributes are valued, or rewarded, differently in different work environments -- or, in our specific case, on different teams. This study will investigate these questions by empirically assessing the effects of co-worker productivity, i.e. the effects of the quality (productivity) of teammates, on the compensation of individuals on the team.

The remainder of the paper is organized as follows. Section II outlines the empirical framework used to analyze the posited team effects. Section III describes the data used in the analysis. Section IV reports the empirical results, and Section V reports our conclusions and directions for further work.

II. Team and Co-worker Effects

In order to empirically capture team effects on individual salary we employ the following econometric model:

$$\ln(\text{Salary}_i) = \beta_0 + \beta_1 X_i + \beta_2 t_X_i + \beta_3 X_i * t_X_i + \beta_4 Z_i + \epsilon_i \quad (1)$$

where X_i represents a vector of individual player performances measures, t_X_i represents the corresponding team performance measures, Z_i represents additional regressors and ϵ_i is an iid random error. The effects of an individual player's performance on his salary is given by:

$$\partial \ln(\text{Salary}_i) / \partial X_i = \beta_1 + \beta_3 t_X_i \quad (1.1)$$

Expression (1.1) has two components -- a direct productivity effect represented by β_1 and an indirect effect, β_3 , which measures the effect of average co-worker productivity on the rate at which individual player productivity is valued. The multiplicative specification of the team effect captures the possibility that worker attributes will be differentially rewarded in different work environments if the cross-partial effect, β_3 , is not zero.²

Thus, we have three possibilities: (1) if $\beta_3=0$ then the effect of individual attributes on productivity, or salary, are invariant to team quality, i.e. production is strictly additive in its inputs, (2) if $\beta_3>0$ then individual attributes are rewarded more on

good team, i.e. inputs are complementary, and (3) if $\beta_3 < 0$ then individual attributes are rewarded less on good teams, i.e. on higher quality teams the marginal contribution of another unit of player quality is lower than on lesser teams, and hence is valued less.

III. Data Description

Our data are drawn from two primary sources. First, *The Hockey News*, (February 8, 1991), provides data supplied from the NHL Players Association on compensation. Second, *The Hockey News Complete Hockey Book* (various years) provides data on individual player performance. Our dataset contains information on 509 players for the 1990-91 season. Players are included if they played at least two years in the NHL and twenty-six or more games in at least one year prior to the 1990-91 season, and if a salary is reported for the player.³ All performance data are for regular season play.

One problem that arises is that some players played for more than one team in a single year (some, in fact, played for three teams in a single season). Since salary data was not generally available for the player for each team that he played with during the season, comparison of multiple movers is tenuous. Nevertheless, players are considered in our data set as members of the team reporting his salary in a given year.

IV. Empirical Analysis

The variables that comprise the vectors X_i and t_X_i are described in Table 1 below. Note that career performance measures for individual players use data up to and including the year prior to the year for the dependent variable, the natural log of salary.

This is because player performance variables in the prior year determine management's expectations about performance and hence salary. Note further that the interactions with t_X use the same year team performance measures as salary. The idea being that current year team values best capture the quality of a team since factors such as changes in rosters, anticipated changes in health (e.g. a player may have been ill during the previous season but is expected to be healthy in the current season), and so forth, are best measured with current year values.

Individual Player Variables

The expected signs for the variables that compose the vector X_i are shown in Table 1. Following Jones and Walsh (1988), we employ a variety of variables designed to characterize a player's skill. Skills acquired through general occupational experience are captured by a quadratic in the number of games played over the player's career -- following the general literature on wage profiles (Mincer, 1974) an inverted U-shaped experience effect is predicted.

The primary variable representing offensive ability (ptspg) is expected to have a positive coefficient since, all else equal, greater offensive contribution by a player increases the likelihood that the team will win a game and thus he should be rewarded with a greater salary.⁴ Similarly, star players who demonstrate unusual skill which attracts fans should earn greater salaries, all else equal. In order to account for star status we use a variable (altro) which is calculated for each player by adding the number of his career all star appearances and the number of major trophies won. We expect a

positive coefficient for this variable.

The variable representing penalty minutes per game (pmpg), is expected to capture a player's intensity of play and defensive skills. As noted in Jones and Walsh (1988), a more intense (perhaps intimidating) player demonstrates a willingness to make the sacrifices required for the team's success. This being the case, a positive coefficient is expected.

Another variable we use to represent both a player's offensive and defensive skill is the plus-minus statistic (avgplm). The plus-minus statistic is calculated by awarding a player a plus 1 if he is on the ice when his team scores a full-strength goal; he is awarded a minus 1 if he is on the ice and his team gives up a full-strength goal. Career plus-minus statistics are not calculated for players and thus a game-weighted average over the previous three seasons is calculated for use as a proxy for a player's career plus-minus statistic. *Ceteris paribus*, we expect a positive coefficient for this variable.

In order to control for various physical attributes which may affect player performance, and which are not captured by other performance variables, we include measures for a player's height and weight. Other things equal, physically larger players may be more effective offensively and defensively as they can use their size to gain strategic position during play. A larger player may also be able to use his size to attract and "tie up" the play of opponents thus "freeing up" his teammates for potential scoring opportunities. This being the case, we expect these variables to have a positive impact on a player's salary.

To the extent that initial playing skill is a reliable indicator of future performance,

players that begin their NHL career with a greater stock of ability are expected to start their professional career with a larger salary. This initial salary differential may be reflected later in the player's career salary path. In order to control for differences in initial ability we have constructed a dummy variable, (*dumdrft*), which takes the value of 1 if a player was selected in the first or second round of the rookie draft, 0 otherwise. As defined, we expect a positive coefficient for this variable.

In order to control for differences in compensation for player position, we use a dummy variable, (*forward*), which takes the value of 1 if a player is a forward (center or winger), 0 otherwise. All else equal, including scoring ability, a defenseman is expected to earn a *greater* salary. That is, a defenseman with the same scoring ability as a forward would earn a higher salary because the defenseman has the added ability to prevent opponents from scoring.⁵

Lastly, we include a dummy variable, (*fa*), which takes the value of 1 if the player was a free agent in the year previous to current salary year. The role of this variable to control for any performance difference the player may have demonstrated during the season of his free agency. The logic behind this variable is that players who will become a free agent at the end of a season may play with a greater effort and intensity than they might otherwise in order to impress potential employers. Following this reasoning then, we expect a positive coefficient for this variable.

Team Variables

As noted above, the vector t_X_i contains corresponding team measures of

performance, with the individual player's contribution removed. For example, we calculate average points per game for the team as a whole, excluding the individual player i 's points per game statistic. This provides us with an approximate measure of the quality of players around any individual player i . Our hypothesis is that, other things equal, an individual player's scoring ability will be greater when he plays in a team environment that has a greater scoring ability. This being the case, we expect that the team performance measure will have a positive effect on an individual player's salary.⁶ We follow the same procedure to construct team measures for the variables ptspg, pmpg, avgplm, height, weight and altro. A positive coefficient is expected for each of these variables.⁷

Included in $t_{-}X_i$, with no corresponding measure in X_i , are performance measures for the team's coach. This approach follows Kahn (1993) and hypothesizes that quality coaching can enhance player performance and hence salary. Ice hockey coaches make numerous decisions which can affect team and player performance, including composing player lines, special team assignments and match-ups with the opposing team's player lines.⁸ It is hypothesized that coaches with greater experience and coaching talent will be able to enhance the individual player's (and team) performance by utilizing players in such a way that maximizes the team's likelihood of winning a game. We use two variables to control for differences in coaching quality. The first is the number of seasons the team's coach has coached in the NHL, (coachy). It is assumed that greater experience in coaching would lead to greater coaching ability and as such we expect a positive sign for this variable. Second, we calculate the coach's career percentage of

points won while coaching in the NHL (coachpct). Coaches with a demonstrated ability to coach teams to victory should have a positive effect on player performance and hence salary. The two coaching quality variables are constructed using data for the current year coach. Current year data is used because coaching strategy (and the resulting effectiveness of the strategy) depends on the composition of the specific team line-up being coached.⁹

Lastly, the vector Z_i contains franchise variables which are assumed to have independent effects on player salary. In particular, total franchise revenues are included in Z_i in order to control for differences across teams in their available funds that can be used to compensate players. As with the coaching variables, current revenues are used since they should best represent management's expected revenues generated by a team's current composition. We expect that greater revenues should be associated with greater player salaries, all else equal.

Estimation Results

Table 2 reports salary regressions for specifications with and without team variables. Player salaries are first regressed on measures of their own-productivity, X_i . We then add team measures, first coaching quality, and then the average productivity of co-workers (i.e., teammates), t_X_i . If the coefficients on own-productivity fall when team measures are added, then we interpret this result as indicating that part of the measured effect of player characteristics on their salary is due to other players', or team, contributions to their productivity¹⁰. Further, if other player's productivity affects the

wages of the individual player directly, namely not through the route of increasing the individual player's productivity per se, then this may be because the manager realizes that other player productivity is partly due to the contributions of the individual player in question.¹¹ Finally, we next include interactions of individual attributes and corresponding team averages in order to evaluate whether or not co-worker productivity affects the valuation of individual attributes.¹²

Looking now at the basic specification in column (1) we see that all of the regressors have the expected signs and each is statistically significant, with the exception of player weight and *dumdrft* -- results consistent with other studies (see, for example, Jones and Walsh (1987, 1988); Lavoie, et al., 1987, 1992; Mclean and Veall, 1992.). In column (2) we add the first set of team variables, namely franchise revenue (*totrev*) and proxies for coaching quality (*coachy*, *coachpct*). Surprisingly, while *totrev* has the expected positive effect on player salaries, it is only marginally significant (at the 11% level).¹³ Coaching quality, though, is seen to have a significant effect on player salaries. Comparing changes in the magnitude of the player attribute effects, we see that there is little change in most of the coefficients with the exception of a 28% decline in the effect of (*avgplm*). Apparently, the effect of (*avgplm*) is upwardly biased when coaching quality is not included in the regressions. As noted above, this is consistent with the positive coaching effects on salary, and a positive effect of coaching quality on player plus-minus statistics.

Specification (3) additionally includes a second vector of team variables that measure the average playing quality of teammates. As with the comparison between

specifications (1) and (2), we see that inclusion of team averages produces little change in the direct effects of player attributes on their salaries, though (fa) does decline somewhat and declines from 1% to 5% in significance. Nevertheless, while most of the direct team effect variables are individually insignificant, they do achieve joint significance at the 13% level. Furthermore, while the coaching variables remain jointly significant at the 5% level, the individual effect of coachpct becomes insignificant - possibly this is because the positive effect of coaching ability on individual player salaries operates through assembling a certain quality team (see Porter and Scully, 1983; Clement and McCormick, 1989; Chapman and Southwick, 1991; Kahn, 1993).¹⁴

Finally, specification (4) allows the productivity attributes of players to have differential effects on player salaries based on the quality of their teammates. As seen from the joint significance tests, allowing the effect of team values to vary across the characteristics of the players raises the joint significance of the direct team effects from 15% to 5% significance. Furthermore, the vector of interactions achieve joint significance at the 10% level, indicating that taken as a whole, individual player attributes are differentially valued based on the productivity attributes of teammates. Inclusion of the interactions, though, does produce rather pronounced collinearity problems with certain variables, particularly (pmpg), (height), and (weight), as evidenced by more than 10-fold increase in standard errors. As a result, inferences about these individual estimated effects becomes tenuous.¹⁵

Nevertheless, while the interactions are mostly individually insignificant, we see that they tend to have a negative effect. If we take these negative coefficients as

meaningful, (i.e. different from zero), then this would mean that individual player productivity is rewarded at a lower rate on teams with better players, i.e. labor inputs appear to be weakly gross substitutes rather than complements.¹⁶ What this might be reflecting is diminishing returns to quality across a given team, so that if teammates are of higher quality then the management views additional units of quality as relatively less valuable for the team and accordingly will pay relatively less for such additional value. In other words, if the team already has some great scorers, then the value to the team of an additional first-rate scorer is less than if the team were lacking in scorers.¹⁷

To the extent that the generally negative pattern in the interactions is being caused by the above possibility, it raises the question of just to what extent these results generalize to industrial settings, especially relatively large firms. An industrial setting that is perhaps closest to NHL teams might be a small firm that has, say two high quality engineers and thus feels that there will be relatively little gained by investing in another first-rate engineer -- similar considerations might apply within divisions of larger firms or for certain positions near the top of a managerial hierarchy. Yet in larger firms where larger teams are assembled at different points in the production process, greater returns to complementarity in talent may be present as redundancy in skills become less important (see Kremer, 1993). As such, there may be distinct differences in the effects of co-work quality on compensation in different team production settings, and in different size firms.¹⁸

V. Conclusions

This paper has investigated the general question of the effects of co-worker attributes on the compensation of individuals in an organization. Our specific empirical focus has been on professional hockey because data is available for both players and coaches, thereby allowing for the construction of a partial vector of management productivity and co-worker productivity variables. Our central findings are that team attributes have both direct effects on individual player compensation and indirect effects through altering the rates at which individual player productive characteristics are valued.¹⁹

Although the effects are neither uniform nor of large magnitude, when team variables are incorporated into the regressions there occurs a decline in certain individual productivity effects. This result indicates that estimates of the effects of individual attributes on compensation are somewhat upwardly biased when team effects are not taken into account in standard salary regressions. Furthermore, it appears that on average, players seem to be weakly gross substitutes in the production process in professional hockey. This latter result is somewhat at variance with our priors that labor inputs will tend to be complementary factors, though it might be that certain combinations of positions are gross complements, and that positive interactions might follow if certain positions are paired. Such an analysis may be a fruitful future subject of research.

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Table 1: Variable Definitions^a (n=509)

<i>Variable</i>	<i>Definition</i>	<i>Mean (Std. Dev.)</i>	<i>Expected Effect on Salary</i>
I. Individual player variables			
games	Total number of games played over the player's NHL career	316.405 (251.031)	+
ptspg	Career points per game (goals and assists)	.506 (.321)	+
pmpg	Career penalty minutes per game	1.379 (1.118)	+
avgplm	Game-weighted average plus-minus statistic	-.271 (.102)	+
height	Players' height (in inches)	72.515 (1.870)	+
weight	Players' weight (in pounds)	189.984 (13.164)	+
altro	The number of times the player was selected as an all star plus the number of NHL trophies he has won	0.334 (2.049)	+
dumdrft	=1 if the player was selected in the first or second draft round, 0 otherwise	0.418 (0.494)	+
forward	=1 if the player is a forward, 0 otherwise	0.637 (0.481)	-
fa	=1 if the player was a free agent prior to the current salary year, 0 otherwise	0.077 (0.266)	+
II. Team/Coach variables			
totrev	The total team revenues	24.568 (5.723)	+
coachy	The number of seasons the team's coach has coached in the NHL	5.045 (4.586)	+
coachpct	The coach's career percentage of points won ^b	0.511 (0.090)	+

a. The salary data are for the 1990-91 season and were obtained from *The Hockey News* (February 8, 1991, p.46-47); mean (std. dev.) of player salaries are 232,098 (200,139). Performance data for players and coaches were taken from *The Sporting News Complete Hockey Book*, various years. Data on team revenues was obtained from *Financial World*, (July, 1992). Information on free agents was obtained from the NHL.

b. In the NHL a win is worth 2 points, a tie one point and a loss 0 points. The variable coachpct is calculated for each coach as the percent of points won out of total points possible, over the coach's career.

Table 2: Salary Regressions
 Dependent Variable = log (salary), n=509

<i>Variable</i>	(1)	(2)	(3)	(4)
<u>1. Individual Player Variables</u>				
games x10 ²	0.166 ^a (0.016)	0.116 ^a (0.016)	0.167 ^a (0.016)	0.171 ^a (0.016)
games ² x10 ⁵	-0.126 ^a (0.018)	-0.125 ^a (0.018)	-0.126 ^a (0.018)	-0.130 ^a (0.018)
ptspg	0.709 ^a (0.055)	0.712 ^a (0.055)	0.713 ^a (0.055)	0.837 ^a (0.343)
pmpg x10	0.437 ^a (0.121)	0.440 ^a (0.119)	0.487 ^a (0.125)	1.005 (1.364)
avgplm x10 ²	0.533 ^a (0.124)	0.373 ^a (0.133)	0.387 ^a (0.143)	0.372 ^a (0.144)
height x10	0.187 ^b (0.083)	0.176 ^b (0.082)	0.176 ^a (0.083)	40.455 ^a (10.395)
weight x10 ²	0.022 (0.118)	0.067 (0.118)	0.049 (0.122)	-13.575 ^c (8.086)
altro x10	0.493 ^a (0.071)	0.489 ^a (0.070)	0.500 ^a (0.070)	0.499 ^a (0.100)
dumdrft x10	0.250 (0.257)	0.250 (0.253)	0.208 (0.254)	0.286 (0.255)
forward	-0.143 ^a (0.029)	-0.142 ^a (0.028)	-0.142 ^a (0.028)	-0.140 ^a (0.028)
fa	0.103 ^b (0.046)	0.101 ^a (0.045)	0.092 ^b (0.045)	0.095 ^b (0.045)
<u>2. Team/Coach Variables</u>				
totrev x10 ²		0.381 ^d (0.244)	0.096 (0.351)	0.023 (0.355)
coachy x10 ²		0.400 ^d (0.267)	0.603 ^d (0.376)	0.551 ^d (0.381)
coachpc ^t		0.346 ^b (0.158)	0.268 (0.208)	0.298 (0.215)

(Cont.)

Table 2: Salary Regressions* (cont.)
 Dependent Variable = log (salary), n=509

<i>Variable</i>	(1)	(2)	(3)	(4)
<u>3. Team Averages</u>				
t_ptspg			-0.451 (0.332)	-0.296 (0.482)
t_pmpg			0.106 (0.109)	0.160 (0.153)
t_avgplm x10 ²			0.278 (0.419)	0.260 (0.428)
t_height			0.029 (0.050)	4.477 ^a (1.400)
t_weight			-0.014 ^d (0.009)	-0.150 ^c (0.080)
t_altro			0.021 (0.035)	0.025 (0.036)
<u>4. Interactions</u>				
t_ptspg x ptspg				-0.281 (0.674)
t_pmpg x pmpg				-0.041 (0.079)
t_avgplm x avgplm x10 ³				-0.087 (0.176)
t_height x height				-0.061 ^a (0.019)
t_weight x weight x10 ³				0.717 ^c (0.425)
t_altro x altro				0.004 (0.015)
constant	10.133 ^a (0.524)	9.826 ^a (0.523)	10.585 ^a (2.984)	-286.365 ^a (98.160)
Adj. R ²	0.6672	0.6760	0.6912	0.6985
F-stat1		3.35 ^b	2.98 ^b	2.86 ^c
F-stat2			1.66 ^d	2.36 ^b
F-stat3				1.95 ^c

Notes: Parameter estimates (OLS) are reported with standard errors in parentheses. Significance at the 1%, 5%, 10% and 15% levels are denoted by superscripts a,b,c, and d. F-stat1 tests for the joint significance of the two coach variables; F-stat2 tests for the joint significance of the team averages for ptspg through altro; F-stat3 tests for the joint significance of the interactions of the team averages and the player values.

Endnotes

1. This argument is similar to the effects of complementarity of physical capital with human capital (see Griliches, 1969).
2. Team effects on compensation will not only operate through altering the rates at which productivity related attributes are rewarded, but also directly through the β_1 term. Furthermore, if $\beta_2 \neq 0$ and $\text{cov}(t_{X_i}, X_i) \neq 0$ then failure to include t_{X_i} in the regressions will bias the estimate of β_1 .
3. This follows the methodology in Jones and Walsh (1988). Rookie players (less than two years experience in the NHL) are excluded since they have no career data. Further, players that have not played at least 26 games in at least one NHL season are excluded since they do not qualify as full-time players. Goalies are also excluded from the analysis. This is because the statistics describing a goalie's performance are not comparable to that used for non-goalies.
4. In addition to improving a teams winning ability, skilled offensive players may also cause an increase in attendance by fans who wish to view skilled play, regardless of the outcome of the game.
5. Examples of defensemen with great scoring ability would include Paul Coffey (Detroit), Ray Bourque (Boston), Brian Leetch (N.Y. Rangers). Arguably the greatest offensive defenseman ever was Bobby Orr (Boston) who twice won the Art Ross trophy for leading scorer among all players in the league (1969-70 and 1974-75 seasons). In principal, all (non-goalie) players are responsible for both offensive and defensive play. Forwards, however, have the primary task of scoring goals, while the primary role of defensemen is to prevent opponents from scoring.
6. As an example of how individual performance is linked to the performance of teammates, we can consider Bernie Nicholls during his play with the Los Angeles Kings before and after the trade of Wayne Gretzky. In 1988 Wayne Gretzky, arguably the most talented hockey player in history, was traded by Edmonton to the Los Angeles Kings. He played together with Bernie Nicholls during the 1988-89 season in L.A. and Nicholls had a career high 150 points, 50 points more than he had scored in any of his previous 6 seasons in the NHL, with nearly 2 points per game. Nicholls was traded mid-way through the 1989-90 season to the New York Rangers and his scoring dropped significantly. During the 1990-91 season with the Rangers Nicholls scored 73 points and his points per game dropped to approximately 1. One can think of examples from other sports as well. For example we can consider the impact that Magic Johnson had on the scoring ability of James Worthy when they played together in the NBA for the Los Angeles Lakers. As an example of how individual performance is linked to the performance of teammates, we can consider Bernie Nicholls during his play with the Los Angeles Kings before and after the trade of Wayne Gretzky. In 1988 Wayne Gretzky, arguably the most talented hockey player in history, was traded by Edmonton to the Los Angeles Kings. He played together with Bernie Nicholls during the 1988-89 season in

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7. This, of course, assumes players are complementary "inputs", i.e. possibility (2) noted above.

8. A player "line" consists of a set of three players (a center and two wings) which play together. In addition, defensemen typically play in pairs which are determined by the coach.

9. Prior-year data would obscure the coaching effect since roster changes, (due to trades or injuries), would imply a different team composition.

10. If $\beta_2 > 0$ and $\text{cov}(t_{X_1}, X_1) > 0$ then omission of t_{X_1} will upwardly bias the estimate of β_1 .

11. Note that we cannot run own-productivity as a function of team mates productivity and simply interpret a positive coefficient as complementarity in labor inputs. This is because any observed relationship might reflect sorting, where most productive players gravitate to other more productive players.

12. Ideally we would like to measure the individual's productivity as an individual specific output plus the contributions of the individual to productivity of other players on the team, minus the contribution of other players on the team to the output of the individual. Namely, some players may produce high yields in terms of helping other players in ways that traditional productivity measures do not capture, leading to an underestimate of their productivity to the statistician, but this may be known to the team and accordingly compensated (so that the player may look like he is overpaid). Similarly, some players may have inflated measured productivity statistics since much of his "output" is due to the contributions of other players and little is contributed to them (e.g. the player get lots of shots due to being setup by other players in ways that are too general to be counted as assists), so that to the statistician he might look like he is underpaid. Data limitations, though, preclude identifying each of these separate effects for our NHL files.

13. Although this result is unexpected, it might be due to teams with higher revenues investing their funds in higher quality coaching staffs (and other support personnel), better training facilities, and so forth, all of which would then be captured by the coach and player productivity variables. Data limitations, though, preclude a direct assessment of this possibility.

14. We additionally evaluated team-level effects on own-productivity and salary by estimating a "multilevel" model (see Bryk and Raudenbush, 1992), which allows for a decomposition of the total variance of the dependent variable into the components that occur at the individual player level and at the team level. Although program parameters (we used the program ML3; see Bryk and Raudenbush, 1992) limit the number of team-level effects that can be estimated, we did estimate a multilevel model version of the specification in column (1) in Table 2 that allows for a team-level variance for points per game (ptspg) as an explanatory variable. A test of significance for the inclusion of team-level variance in "ptspg" passed at better than the 1% significance level, supporting our main hypothesis that team effects are important in explaining individual performance and salary (results available upon request).

15. Note, though, that while collinearity will tend to increase standard errors, and possibly cause counterintuitive sign changes in coefficients as occurs for the variable weight, it will not interfere with joint hypothesis tests.

16. Of course, if we take these coefficients as truly being zero, then the interpretation is that player value is invariant to the quality of the other players on the team. Of course, if we take these coefficients as truly being zero, then the interpretation is that player value is invariant to the quality of the other players on the team.

17. Other potentially important interaction effects were tested. For example, when a team is composed management may be willing to pay a premium for players who can fill particular gaps in their line-up. Thus a team with, say, a pool of talented scorers might desire to hire a player who can act as an "enforcer" or "intimidator" to complete the line-up. To test for this effect, an interaction between team points per game (t_ptspg) and penalty minutes per game (pmpg) was tested. This effect, however, was not statistically significant and was consequently dropped from the model.

18. See Idson (1995) for an empirical analysis of the relationship between team size, firm size, and compensation. See Idson (1995) for an empirical analysis of the relationship between team size, firm size, and compensation.

19. It should also be pointed out that our basic model incorporates two statistically important variables, free agent status (fa) and the plus-minus statistic (avgplm), which, to our knowledge, are not included in previous research on pay and performance in the NHL. As such, our basic model represents an improvement on the existing literature.

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