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Wage disparity and team productivity: evidence from major league baseball

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Abstract

Using data describing baseball teams from 1985 to 1998, it is found that Levine's [Levine, D.I., 1991. Cohesiveness, productivity and wage dispersion. Journal of Economic Behavior and Organization 15, 237–255] team-cohesiveness hypothesis is supported over Ramaswamy and Rowthorn's [Ramaswamy, R., Rowthorn, E., 1991. Efficiency wages and dispersion. Economica 58, 501–514] danger-potential hypothesis. The implication is that teams with greater wage disparity experience a reduction in team performance.

Keywords: Labor shirking; Relative wage hypothesis; Team cohesion; Wage compression

JEL classification: J31; L20

1. Introduction

Wage disparity has long been a favorite topic of the popular and academic press. Most studies focus on explaining or combating the sources of wage differentials. This paper addresses how wage disparities affect teamwork on professional baseball teams. The dramatic increase in baseball salaries has fueled concern that intrateam wage disparity may cause a breakdown of team cohesiveness and performance. As team productivity is objectively defined and accurate measures of player salaries are available, it is relatively easy to test two competing hypotheses of wage disparities on team performance.

Using data describing major league baseball (MLB) from 1985 to 1998, a panel-data approach is used to test the effect of wage disparity on team performance. The results support the 'fairness' claim raised by Akerlof and Yellen (1988), Akerlof and Yellen (1990), and formalized by Levine (1991) in

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contrast to the 'damage-potential' hypothesis offered by Ramaswamy and Rowthorn (1991). The implication is that greater wage disparity reduces overall team performance.

The remainder of this paper is structured as follows. Section 2 outlines the basic intuition of two competing hypotheses dealing with productivity and wage dispersion and their connection to professional baseball. Section 3 describes the data and empirical methodology employed. Section 4 reports the empirical results and the final section offers concluding remarks.

2. Wage disparity and productivity

A 'team' can be defined as a group of workers (two or more) who perform specific tasks, either together or separately, that lead to a final output. The more complementary (substitutable) the tasks of workers, the more (less) 'team work' necessary to ensure successful completion of the team's assigned task.

David Levine (1991) develops a model with two labor types in which greater wage disparity between high-skill and low-skill workers causes a breakdown in team cohesiveness and in overall team production. As the tasks of workers become more complementary, the greater the marginal effect of labor shirking on team productivity. Levine's analysis indicates that wage disparity should have a negative impact on team production.

An alternative model is offered by Ramaswamy and Rowthorn (1991) in which different labor types can justify wage disparity. Their intuition is that differentiated labor introduces 'damage potential' or worker-specific risk to efficient firm (team) production. Workers with greater damage potential should be paid more so as to mitigate their desire to inflict damage on the team's productivity. This implies that wage disparity should have a non-negative impact on team productivity.

Prior to 1976, the reserve clause in MLB granted teams a monopoly on their players' actual and potential production. After arbitration challenges by Andy Messersmith and Dave McNally in 1975, the reserve clause was replaced with a system of free-agency which granted players limited autonomy.[1] While there is some evidence that free-agency did not alter the distribution of talent in the league, supporting Coase's invariance principle (e.g., Drahozal, 1986; Hylan et al., 1996), it is universally understood that baseball salaries dramatically increased after the change in property rights.

The first one-million dollar per year contract was offered to Nolan Ryan in 1980 by the Houston Astros. By 1990, the highest salary was $3.2 million per year, paid to Robin Yount by the Milwaukee Brewers, while the league minimum was $100,000. By 1994, the highest yearly salary was $6.3 million per year, paid to Bobby Bonilla by the New York Mets, while the league minimum was $109,000. By 1998, the highest salary was $10 million per year, paid to Gary Sheffield by the Florida Marlins, while the league minimum was $170,000. In late 1998, Kevin Brown signed a contract with the Los Angeles Dodgers for $15 million and Mike Piazza signed with the New York Mets at a 'bargain' $13 million per year. Upcoming free agents, such as Juan Gonzalez of the Texas Rangers, have proposed salaries of at least $20 million per year.

The increase in salaries has raised concerns that small market teams, with limited revenues and cash reserves, may be unable to field competitive teams. Furthermore, intra-team wage disparity may cause

[1] Current rules allow a player to become a free-agent only after six years of major league experience.

a breakdown of team morale, and lead to a reduction in team productivity. This could occur if lower paid players feel they must make themselves as individually productive as possible, perhaps inconsistent with the team's best interests.[2]

3. Data and empirical methodology

An empirical test between these two hypotheses is developed using MLB teams. Levine (1991) postulates that with two types of labor, high-skill and low-skill, team productivity can be written as $Q = C(w_L/w_H)f(L_L,L_H)$, where Q is team output, $C(\cdot)$ is a team cohesiveness measure, the ratio of low to high-skill wages (w_L/w_H) is a measure of income disparity, and $f(L_L,L_H)$ is a production function, characterized by some level of labor complementarity.[3] Levine assumes $C' > 0$ or that less wage disparity results in greater team cohesiveness and thus more efficient team production.

I use team win percentage as a measure of team production, following Porter and Scully (1982) and others. As it is difficult to judge high-skill and low-skill workers directly, I use the intrateam Herfindahl–Hirschman index (HHI), which measures salary dispersion, instead of the simple ratio suggested by Levine. The HHI is calculated as $\text{SALHHI} = \Sigma_{i=1}^{N}(\text{SHARE}_i)^2$, where N is the number of paid players on a team and SHARE_i is the ith player's share of a team's total salary expenditure.[4]

I use total team salary as an instrument for the production function because a team's production function is subject to many unobservable inputs (see Scully, 1989). One may question whether baseball salaries are consistent with (near) efficiency wages. However, there is no statistical evidence of shirking by players who have recently signed a contract with a team (Krautman, 1990), and many studies have related player salaries to player specific production statistics, for example Marburger (1996) and Gius and Hylan (1996).

A panel describing MLB teams from 1985 to 1998 is employed.[5] Because baseball has expanded twice during this time period (1993 and 1998), the panel is unbalanced. I estimate the fixed effects model

$$\text{WINPER}_{it} = \alpha_i + \beta_1\text{TOTSAL}_{it} + \beta_2\text{SALHHI}_{it} + \beta_3\text{TIME}_{it} + \epsilon_{it}\,, \tag{1}$$

where α_i are constants that vary across teams, the β's are parameters constant across teams, and ϵ is a stochastic term that varies over teams and time. The dependent variable is the winning percentage of team i in year t. The independent variables are total player-salary expenditures in millions of dollars (TOTSAL), the intrateam salary disparity (SALHHI), which also accounts for any second-order effects of total salary expenditures on team performance, and a monotonic time trend, included because of the trend in TOTSAL, thereby ensuring consistent estimates. Following the intuition

[2] An example would be a player who felt that he had to hit more home runs than sacrifice bunts. While sacrifice bunts may help the team win, they may not enhance the self-perceived value of the player.

[3] Akerlof and Yellen (1990) and Ramaswamy and Rowthorn (1991) use similar production functions.

[4] See Depken (1999) and Kamerschen and Lam (1975) for detailed discussions of various concentration measures and their relationships. Following common convention, $\text{SALHHI} \in [0,\ 10\,000]$.

[5] The data were obtained from various issues of *Sports Illustrated* and *USA Today*, and from Sean Lahman's baseball archive, located at www.baseball1.com. Salaries for Canadian teams have been converted to current U.S. dollars.

Table 1
Descriptive statistics of the data used in the study (1985–1998)

Variable	Description	Mean	Std. Dev.	Minimum	Maximum
WINPCT	Team winning percentage	0.500	0.066	0.327	0.704
TOTSAL	Total team salary expenditure ($m)	24.197	14.412	4.263	68.988
SALHHI	Intrateam salary Herfindahl	789.084	218.330	441.271	2158.320

outlined by Hsiao (1986) and Greene (1997), the fixed effects model may be appropriate because all teams are included in the sample. However, as team effects may be random because of unknown or unmeasurable influences on team performance, I also estimate a random effects model. Descriptive statistics of the data are reported in Table 1.

One would expect a positive parameter estimate on total salary expenditures, that is, greater salary levels purchase better players. However, the parameter of interest is the coefficient on SALHHI. The team-cohesiveness hypothesis predicts β_2 to be negative, while the damage-potential hypothesis predicts β_2 to be non-negative.

4. Empirical results

Table 2 reports the results of estimating Eq. (1) in levels and log–log form for both the fixed and random effects model. The results are corrected for group-wise heteroskedasticity, inherent in an unbalanced panel, and autocorrelation. The Hausman (1978) test between the random and fixed effects model supports the random-effects model, but there is no qualitative difference between the estimates obtained in either approach.

Overall, the empirical results support the team-cohesion hypothesis over the damage-potential

Table 2
Panel estimation results: dependent variable is winning percentage

Form	Variable	Fixed effects model		Random effects model	
		Coefficient	Standard error	Coefficient	Standard error
Linear	Intercept	–	–	527.6750	13.831*
	TOTSAL	1.6526	0.466*	1.7638	0.396*
	SALHHI	−0.0639	0.019*	−0.0630	0.018*
	TIME	−2.6030	1.727	−3.1827	1.557*
	Hausman (H_0: R.E. vs. F.E.)	2.38			
	N	378		378	
Log–Log	Intercept	–	–	6.9027	0.227*
	TOTSAL	0.0608	0.021*	0.0678	0.017*
	SALHHI	−0.1359	0.039*	−0.1307	0.033*
	TIME	−0.0047	0.003	−0.0047	0.003
	Hausman (H_0: R.E. vs. F.E.)	3.27			
	N	378		378	

* Indicates significance at the 5% level.

alternative. The estimated coefficient on total salary is positive and statistically significant, as would be expected. However, hiring high-skilled, high-wage players does come with an extra cost. As intrateam wage disparity increases, overall team performance is reduced, but it is possible for a team to have a very high total salary but a relatively low salary disparity, and vice-versa.

For example, the 1998 World Series champion New York Yankees had a total payroll of $63.46 million, a relatively low concentration measure of 703.929, and one of the best regular season records in the history of baseball, winning just over 70% of their games. However, the 1998 Montreal Expos had a league-low total salary of $9.16 million dollars, a moderately high concentration level of 925.422 and a losing season, winning just over 40% of their games.

Large market teams, able to pay high salaries to most of their players, can avoid wage disparity and are the more successful teams, *ceteris paribus*. On the other hand, a small market team that hires a 'ringer' at a salary above the team's average salary necessarily increases wage disparity. The negative externalities caused by the increased wage disparity might outweigh the marginal impact of the 'ringer.'

As large market teams bid for the best players in the league, salaries paid to high-skilled labor will continue to increase, forcing teams to spend more in order to field competitive teams. Indeed, no team participated in the 1998 playoffs without spending at least $30 million in player salaries. While some small market teams occasionally play in the post-season, e.g., the 1998 San Diego Padres and the 1997 Florida Marlins, these teams face two distinct pressures to divest their high-wage players.

First, small market teams cannot maintain high salaries for a substantial period of time because of their lower total revenues. Indeed, the San Diego Padres lost money during the 1998 season even though they played in the World Series. Further pressure to divest highly-paid players comes through the wage-disparity effect.

This offers support for the antagonism between large and small-market teams in baseball. As large-market teams find it easier to afford the higher salaries the best players in the league command, they maintain their relative competitiveness. On the other hand, small market teams, who might affordably hire only one or two high-skilled, high-wage players, face the trade-off between higher marginal productivity and the negative impact on productivity introduced through increased wage disparity.

It is not clear how MLB can solve this problem consistent with a relatively free labor market. Policies such as salary caps, further restrictions on drafts and free-agency, luxury taxes and revenue sharing do not address intrateam salary disparity. Indeed, anecdotal evidence from the National Football League indicates that salary caps did not reduce, and may have enhanced, wage disparity. The labor dispute that postponed the start of the 1998–1999 National Basketball Association season was caused by disagreements over player salaries even though the NBA operates under a salary cap.

5. Conclusions

This paper addresses the effect of wage disparity on the performance of professional baseball teams. The team-cohesiveness hypothesis, as developed by Levine (1991), predicts that greater wage disparity motivates jealousy and mistrust amongst workers in a firm (team) and a possible reduction in overall team performance. An alternative is the damage-potential hypothesis developed by Ramaswamy and Rowthorn (1991) in which workers whose shirking has the greatest impact on the efficient

operation of the firm (team) should be paid the greatest. Contrary to the team-cohesion hypothesis, the damage-potential hypothesis predicts wage disparity has a non-negative impact on team production.

The effect of salary differentials on baseball team performance offers a straightforward and easily implemented test of these two competing hypotheses. Using data describing team performance, overall salary levels and the Herfindahl–Hirschman index of intrateam salary concentration, panel-estimation indicates that higher total salary levels improve team performance and greater wage disparity reduces team performance.

The best system to deal with salary problems is still open to debate. Policies such as salary caps and luxury taxes may curtail total spending by teams in the league, but do not directly address the intrateam disparity of player salaries. Attempts to limit salary disparities in the National Football League and the National Basketball Association have not been encouraging. How individual players react to intra- and interteam wage disparity is an avenue for future inquiry.

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References

Akerlof, G.A., Yellen, J.L., 1988. Fairness and unemployment. American Economic Review 78, 44–49.

Akerlof, G.A., Yellen, J.L., 1990. The fair wage/effort hypothesis and unemployment. Quarterly Journal of Economics CV, 255–283.

Depken, C.A., 1999. Free-agency and the competitiveness of major league baseball. Review of Industrial Organization 14, 205–217.

Drahozal, C.R., 1986. The impact of free agency on the distribution of playing talent in major league baseball. Journal of Economics and Business 38, 113–121.

Gius, M.P., Hylan, T.R., 1996. An interperiod analysis of the salary impact of structural changes in major league baseball: evidence from panel data. In: Fizel, J., Gustafson, E., Hadley, L. (Eds.), Baseball Economics: Current Research, Preager Publishers, Westport, CT.

Greene, W.H., 1997. Econometric Analysis, 3rd Edition, Prentice Hall Publishers, Upper Saddle River, New Jersey.

Hausman, J.A., 1978. Specification tests in econometrics. Econometrica 46, 1251–1271.

Hsiao, C., 1986. Analysis of Panel Data, Cambridge University Press.

Hylan, T., Lage, M.J., Treglia, M., 1996. The Coase theorem, free agency and major league baseball: a panel study of pitcher mobility from 1961 to 1992. Southern Economic Journal 27, 1029–1042.

Kamerschen, D.R., Lam, N., 1975. A survey of measures of market power. Rivista Internazionale di Scienze Economiche e Commerciali 22, 1131–1156.

Krautman, A.C., 1990. Shirking or stochastic productivity in major league baseball. Southern Economic Journal, 961–968.

Levine, D.I., 1991. Cohesiveness, productivity and wage dispersion. Journal of Economic Behavior and Organization 15, 237–255.

Marburger, D.R., 1996. A comparison of salary determination in the free agent and salary arbitration markets. In: Fizel, J., Gustafson, E., Hadley, L. (Eds.), Baseball Economics: Current Research, Preager Publishers, Westport, CT.

Porter, P.K., Scully, G.W., 1982. Measuring managerial efficiency: the case of baseball. Southern Economic Journal, 642–650.

Ramaswamy, R., Rowthorn, R.E., 1991. Efficiency wages and wage dispersion. Economica 58, 501–514.

Scully, G.W., 1989. The Business of Major League Baseball, The University of Chicago Press, Chicago, IL.