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Abstract

This paper investigates the role of payroll and its distribution in determining the seasonal performances of Italian football teams playing in Serie A. The novelty of our investigation lies in the introduction of a new extent upon which to compute traditional measures of dispersion of payroll. We calculate the coefficient of variation on real wages, on corrected wages and on weighted wages, using players' characteristics, so that the players' own perceived differences are considered. This aids us in testing for the role of envy in determining the teams' performances. We exploit a data set on Serie A from 2007 to 2019, exploring the wages of 1,509 players in different seasons, to produce 4,633 total observations. Since Serie A is an open league with seasonal relegations and promotions, we have unbalanced panel data derived from 220 observations of 35 teams over 11 seasons. We use the percentage of points achieved by teams and a measure associated to the position of the team (rank) at the end of the first round of each season as dependent variables, and then we employ panel data techniques to estimate fixed effect models. We find a statistically significant association of team performance with relative wages and with previous results, while the salary dispersion seems to have no effect on performances. Moreover, by restricting our sample to teams that have never been relegated, and so balancing the panel, our empirical investigation validates the cohesion theory, since more equally weighted wages are associated with better on-field performances.

Keywords: relative wage, payroll distribution, sport performance, Italian Serie A

JEL classification: Z20, Z22, Z21, L83, J49

1. Introduction

This paper investigates the role of payroll and its distribution in determining the seasonal performances of Italian football teams playing in *Serie A* across the period 2007–2019. The idea behind this work is that uneven pay levels may have a direct impact on team performance because of the feelings of envy that can take shape among players as a result, undermining cooperative behaviors and consequently team capabilities. This idea is gaining attention in team sport literature in particular, because the topic is suitable for empirical investigation.

Individuals evaluate themselves in comparison with others, and it is well-known that relative income affects human behavior in regards to several economic choices (see Clark, Frijters & Shields [2008], among others)¹. When considering team sports, it might be assumed that players evaluate themselves in relation to teammates. In fact, negative emotions like envy can emerge when players believe that their talent is not adequately rewarded with respect to others'. Therefore, individual choices shaped by negative emotions like envy have a direct impact on the collective outcome, namely the sport performance. As suggested by Torgler and Schmidt (2007), the pay level may have an impact on individual effort, and then on the performance of the team, because "*soccer players compare themselves to other players, especially their team-mates*" (Torgler & Smith, 2007, p. 2361). A rational player not only compares the net wages of other teammates, but also the differences in ability inferred by the accessible information. Franck and Nüesch (2011) also support this idea: "*Since individuals tend to judge their own salary in relation to the income of the other team-mates, the intra team compensation structure is a highly strategic issue, particularly in teams in which workers affect the productivity of their co-workers*" (p. 3037). The way talent is rewarded inside a team might not fit the way in which that talent is perceived, particularly by teammates. As suggested by Depken and Lureman (2018), "*salary inequality can engender envy which, in turn, can lead to free riding or sabotage on the part of those in the lower portion of the salary distribution*" (p. 192).² In fact, envy can reduce the group outcome if the wage paid to others enters directly in the utility function of each member. In practice, pay dispersion is used as an indirect measure of such scenarios. In brief, this growing literature largely suggests that team performance can be affected by pay dispersions, and that a lower dispersion ought to be associated positively with performance. In light of this perspective, team managers have the responsibility to choose the optimal payroll structure in order to minimize the risks emerging from such reactions. This proposition, however, has to be handled with care because there is no conclusive literature on this point yet. It is also likely that other factors are associated with the comparison made by players. First, in some cases it is likely that the payroll information is private. Second, it is also likely that rational players do not only consider pay levels, but also consider and evaluate the talent and the experience of teammates. In practice, for example, since individual performance and careers are easily observable, it is also likely that players can feel such envy only when

¹ This is in line with the proposition in Festinger's (1954) social comparison theory, also evoked by Wood (1989), stating that people compare themselves with similar others.

² The key is "envy," a negative emotion emerging when one's talent and ability is perceived to compare (and be paid) poorly with those of another individual, leading to a reduction in self-esteem (Parrott, 1991). The so-called Salieri Syndrome (Duffy & Shaw, 2000) has a relevant place in the study of the consequences of negative emotions on organizational outcomes, such as performance, employee withdrawal, sabotage, and turnover (Vecchio, 2000). For example, Rees (1993), writing about his experience with the wage stabilization policies under the Nixon and Ford administrations, emphasizes that in opposition to the neoclassical prescriptions, what was relevant in the bargaining was that "[...] *fairness, and fairness always seemed to be judged by making some kind of wage comparison: with another union, with another employer, or with another person*" (p. 244).

considering peers, and not when considering either younger or elder teammates. Hill, Aime, and Ridge (2017) point out that this similarity hypothesis has not usually been acknowledged in the study of the relationship between pay dispersion and firm performance.

Needless to say, such a perspective recalls the competing hypotheses acknowledged in economic literature on efficiency and productivity within firms, namely the tournament theory proposed by Lazear and Rosen (1981) and Lazear (1989) and the cohesion theory proposed by Akerlof and Yellen (1988), Levine (1991), Ramaswamy and Rowthorn (1991), Milgrom (1988), and Bose, Pal and Sappington (2010). The first suggests that a wide disparity in wages stimulates competition among members and incentives to make greater efforts to obtain higher salaries. This way, the effort of the whole group increases, raising the level of joint production. The second theory states that the organizations can increase productivity by reducing wage dispersion among workers, since this policy improves the cohesiveness of the group. Here, cohesiveness has to do with i) the within-group harmony; ii) the force that keeps the members from leaving the group; iii) the capacity of the group to maintain integrity; and iv) the extent to which the members reinforce each other's expectations regarding the value of maintaining the identity of the group (Stogdill, 1972). This theory relates to the fair wage-effort hypothesis as laid out in Akerlof and Yellen (1990), according to which the efforts of workers decrease as their salary falls short of their expectations. The dominance of cohesion or tournament theory is a matter for empirical investigation, and—as is clear from the growing literature on the subject—professional team sport is in fact an appropriate context in which to test for it because wage distributions and team results are easily distinguishable. In addition, as mentioned before, professional team sports could present peculiarities.

We contribute to this strand of research by undertaking an empirical investigation of the top Italian soccer league, namely the Serie A. In particular, this paper analyzes the impact of relative payrolls and their dispersion on the seasonal performances of teams. We provide a detailed consideration of the relative wages, namely the ratio between the payroll of each team under investigation and the average payroll of the League in the related season. As measures of performance, we employ both the percentage of points achieved by teams and a measure associated to the position of the team (*rank*) at the end of the first round of each season. We employ the relative wages — defined as the ratio between the payroll of each team and the average payroll in the league — and the coefficient of variation as explanatory variables to capture the pay dispersion within teams. In particular, we use different proxies for wages to compute the coefficient of variation, namely *real wages*, *weighted wages*, and *corrected wages*. Specifically, *weighted wages* are computed by weighting real wages by the age and appearances of players, whereas *corrected wages* are computed through coefficients drawn from regressing real wages against a set of variables.

We employ panel data techniques, exploiting an original data set on Serie A from 2007 to 2019 to explore the wages of 1,509 players in different seasons, and produce 4633 total observations. Since Serie A is an open league with seasonal relegations and promotions, we have unbalanced panel data made derived from 220 observations of 35 teams over 11 seasons.

Our findings highlight that there is a positive and statistically significant association between the performance of teams and relative wages in Italian *Serie A*. In practice, as teams invest more in talent, their

performance levels are higher. In particular, we claim that performance is heavily influenced by the relative wage, and that such a relationship is quadratic. Secondly, pay dispersion seems to have no effect on performance. Unlike previous researchers, we do not find any evidence of an impact of pay dispersion on performance when considering the whole sample under investigation. However, the latter result changes when we restrict the sample only to teams competing in *Serie A* across the seasons under investigation; in that case, the way in which weighted wages are allocated influences performance, validating the idea of the cohesion theory.

The paper is organized as follows. Section two presents a survey of the related literature on diversity in wage levels and team performance. Section three describes the data set and the variables. The last section presents the econometric model and the related results, providing some concluding remarks.

2. Team sports performances and payroll nexus: a brief survey

Our research draws insights from the whole literature on performance in team sports, and particularly from the subset of works that focus on the relationship between pay dispersion and performance. On-field performance and success in team sports depends indisputably, outside of random effects, on the availability of talent. A wide range of papers supports this hypothesis, both theoretically and empirically. Since pioneering theoretical papers by El Hodiri and Quirk (1971) and Scully (1974), the probability of success has always been associated with teams' talent availability. In these studies, the winning ratio between two representative teams was approximated by the units of talent ratio and used to compare the competitive balance equilibrium associated to different player labor market schemes. The aforementioned contributions were eventually enriched by a number of empirical studies in which, with few exceptions (Franck & Nüesch, 2010), the payroll is considered the better approximation of talent (see, among others, Fort & Quirk, 1995; Vrooman, 1995; Késenne, 2000; Szymanski & Késenne 2004; Szymanski & Smith, 1997; Hall, Szymanski, & Zimbalist, 2002; Burger & Walters, 2003; Frick, 2007; Berri & Schmidt, 2010; Frick, 2013; Rodríguez, Késenne, & García, 2013; Szymanski, 2013; Simmons, 2018). However, the salaries-performance relationship is not only explored by considering the *wages-talent-victories* nexus, but also the payroll structure. As briefly discussed in the introduction, the way to distribute wages among employees in a group has been scrutinized in the industrial organization literature as it can be supposed to affect the productivity of companies. On the one hand, tournament theory states that the differentiation of the reward schemes would enhance competition between employees, thus improving group/firm/team productivity. On the other, according to cohesion theory, the group/firm/team is expected to improve productivity through equal wages, because an even distribution may contribute to strengthening relationships and solidarity among employees.

In this respect, different results emerge depending on the sports analysed, timespan, and the measures of variability used, as confirmed by Simmons (2018), who recently assessed the situation from the econometric point of view.³ One of the most inspected professional team sports has been baseball, and particularly Major

³ See Simmons (2018, p.126) and Kahane (2018, p.144-148) for a survey of empirical results on the relationship between pay dispersion and team performance.

League Baseball. Empirical investigations in this area show predominantly negative relationships between pay dispersion and performance, validating cohesion theory (Richards & Guell, 1998; Bloom, 1999; Wiseman & Chatterjee, 2003; Depken, 2000; De Brock, Hendricks & Koenker, 2004; Jewell & Molina, 2004; Avrutin & Sommers, 2007; Annala & Winfree, 2011; Breunig, Garrett-Rumba, Jardin & Rocaboy, 2014; Tao, Chuang & Lin, 2016), with few exceptions in favor of tournament theory (Hill, Aime & Ridge, 2017) or arguing for a concave relationship between pay dispersion and performance, with an optimal level of heterogeneity (Papps, Bryson & Gomez, 2011). Opposite results arise from research on the National Basketball Association, in which tournament theory is validated by several studies (Frick, Prinz & Winkelman, 2003; Simmons & Berri, 2011; Schouten, 2012), although some inconclusive results emerge in other cases (Berri & Jewell, 2004; Katayama & Nuch, 2011). In the National Hockey League, the association between salary dispersion and performance appears to be negative, thus validating cohesion theory (Depken & Lureman, 2018), but in some cases the results of the empirical investigations are inconclusive (Sommers, 1998; Kahane, 2012; Cyrenne, 2018). Cohesion theory is dominant in the National Football League context (Frick, Prinz & Winkelman, 2003; Mondello & Maxcy, 2009).

When empirical investigations on football/soccer are scrutinized, interesting results emerge from professional leagues all over the world. Torgler and Schmidt (2007), searching for the determinants of performance at the single player level, analyse data on the *Bundesliga* from 1995 to 2004. They find that the distance between teammates' average salaries and player's individual salaries reduces the (single) performances measured by goals and assists. Franck and Nüesch (2011), investigating the teams appearing in the first German soccer league from the 1995/96 to 2006/07 seasons, allow for potential non-linearity in the relationships between wage inequality and performance. They use the winning ratio as dependent variable and a modified league standing at the end of the season, alternatively. As proxy for pay dispersion, they consider the Gini coefficient and the coefficient of variation, both linear and squared. Adding other variables such as the talent heterogeneity, the wage expenditures, and the roster size, they estimate a 2SLS model with team fixed effects. A U-shaped relationship emerges, so that teams having either a high or low level of pay dispersion are more successful than teams with a medium level of wage distribution. Lee and Harris (2012) focus on the determinants of salaries of athletes playing Major League Soccer (MLS) in the period 2007–2009. They introduce salary dispersion among the factors influencing performance by using the percentile ratio, the Gini coefficient, and the Theil index. They show that more equal income distribution is associated with relatively high team performance. Coates, Frick, and Jewell (2016) support the same idea in favour of cohesion theory, analysing data on 19 teams playing in the MLS from 2005 to 2013. They estimate a model using the points achieved as a measure of the on-field seasonal performance; the relative wage, both linear and squared, as proxy for talent; and the Gini coefficient and coefficient of variation, alternatively, as proxy for pay dispersion, in both linear and squared forms. The authors find that performances are negatively correlated with the increase in salary inequality, and non-linearity in the wage dispersion-performance relationship is excluded. Yamamura (2015) analyses the wages dispersion-performance relationship of the Japanese professional football league (J-League) using data from 1993 to 2011, and distinguishes two periods: developing (1993–1997) and developed stages (1999–2010), where the qualification of the Japanese national team at the World Cup in 1998 is

considered as the turning point between the two periods. The author estimates both a panel fixed effects model and an Arellano-Bond type dynamic model, to control for endogeneity bias and unobservable fixed team effects. He uses the seasonal winning ratio as a proxy for the on-field performance, the average annual salary as a proxy for talent, and the Herfindahl-Hirschman index associated to the inter-team annual salary as a proxy for the wage dispersion. In the whole-period estimation, the coefficient associated to the wage dispersion is statistically significant and negative, but only in the fixed effects model. When the estimation distinguishes between developing and developed stages, it emerges that cohesion theory holds during the first stage, whereas the on-field performance is not influenced by wage dispersion in the developed stage, either in the fixed effects model or in the dynamic panel approach. Nonlinearity in the wage level-performance nexus is not explored. Finally, Bykova and Coates (2020) investigate the moderating effect of the coach on the relationship between wage differentiation and team performance, using the Gini coefficient and coefficient of variation as proxies for wage dispersion. The focus is on the MLS, and they find that wage dispersion does not have an exclusive role in determining on-field performance, but it is important when combined with the experience of coaches at the time they were players.

Another related strand of literature focuses on the determinants of performance in Italian football. Only a few studies have empirically investigated the determinants of performance in Italian professional football (Di Betta & Amenta, 2010; Szymanski, 2004; Simmons & Forrest, 2004), and — to the best of our knowledge — only one article deepens the analysis of the role of pay dispersion in team performance (Buccioli, Foss & Piovesan, 2014). In particular, the authors focus on teams' performance in *Serie A* from 2009 to 2011, collecting a unique dataset of 666 observations at the single match level. They estimate a probit model in which the dependent variable is a dummy (1 if team wins), and the pay dispersion is captured by means of the Theil index. Among covariates, they consider team characteristics, the quality of the opponents, coaches' peculiarities, and other controls. The novelty of the contribution is the different definition of team. They consider: *i*) the *active team members* (ATM), which refers to the players who played at least one minute in the match (weighting for the number of minutes played); *ii*) the *unweighted* ATM; *iii*) the *potential* players, which refers to the starter players and substitute players; and *iv*) the whole *roster*. After making such distinctions, they calculate the Theil index for each definition of team, obtaining conflicting results with respect to the effect of wages dispersion on performance. The coefficient associated to pay dispersion is negative and statistically significant when the Theil index is calculated on ATM, both weighted and unweighted. It is negative but not statistically significant when calculated on *potential* team, and is positive and statistically significant when calculated on *roster*. In addition, they also find that the negative effect of pay dispersion on performance can be ascribed to worse individual performance rather than to a reduction of team cooperation.

3. *The empirical strategy*

3.1 The model

In our empirical investigation, we aim at testing the determinants of Italian teams' seasonal performance, particularly if salary dispersion within the roster of Italian teams influences the on-field performance, and the sign of such relationships. Our empirical strategy consists of developing two baseline models, A and B, to

estimate, using two alternative measures of performance as dependent variables: the points percentage (*points_pct*) and a measure associated to the teams' positions in the standings (*rank*). Among the explanatory variables, our focus is mainly on the role of teams' relative wages and dispersion of wages within the payroll, in addition to other control variables usually applied by the literature on this theme. Following the results of the Welch F, Breusch-Pagan, and Hausman tests, we consider the Panel OLS with Fixed Effect as the best estimator, and we then estimate:

$$dep_var_{i,t} = \beta_0 + \beta_1 relative_wages_{i,t} + \beta_j X_j + \beta_k cv_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

where $dep_var_{i,t}$ denotes either *points_pct* or *rank* of team i in season t ; β_0 is the intercept term; β_k is the coefficient associated to our dispersion measure, namely the coefficient of variation (*cv*); the β_j s are the coefficients associated to the control variables; μ_i is the unobserved team fixed effect; and $\varepsilon_{i,t}$ is the random error term.

3.2 The dependent variables

The equation (1) has been estimated by exploiting a data set on Italian *Serie A* from the 2007/08 to the 2018/19 seasons. Our analysis of teams' performances is at the seasonal level, so that given relegations and/or promotions to/from the second league (*Serie B*), we have 220 observations of 35 teams over 11 seasons.⁴ It is worth noting that only nine teams participated in all the seasons under investigation. The dependent variable summarizes the seasonal results of teams. Since we are searching for the relationships between wage payroll and results, we must pay attention to the timing of the performances. However, using final standing data could be misleading. Data published in September in *La Gazzetta dello Sport* refer to the rosters at the end of the players' summer transfer market, which is to say at the start of the season. Unfortunately, a winter window of the transfer market opens for about a month at the end of the first round. This allows teams to change their rosters, often significantly. As an example, consider the 2018/19 winter transfer market in *Serie A* in which 137 transfers from one team to another occurred, involving top players too.⁵ This implies that the rosters and payrolls at the end of the season differ from those at the beginning. In the light of that, we use data on performance at the end of the first round. We compute two different variables; as in Franck and Nüesch (2011), the first dependent variable is the percentage of points achieved by each team:

$$points_pct_{i,t} = \frac{points_{i,t}}{points_t}$$

⁴ Data on wages for the season 2008/2009 have not been provided.

⁵ Data on transfers retrieved on <https://sport.sky.it/calciomercato/tabellone.html> (February 2019).

where $points_{i,t}$ are those gained by team i in the half-season t , and $points_t$ are the maximum points achievable in the first round of season t (57); therefore, $points_pct_{i,t}$ denotes the ratio between half-season cumulated points and 57. Note that we consider the count of points actually obtained by teams, without taking into account penalties imposed by the league.⁶

The second dependent variable used to proxy the on-field performance is:

$$rank_{i,t} = -\log\left(\frac{P_{i,t}}{N+1-P_{i,t}}\right),$$

where $P_{i,t}$ is the position of team i at the end of the first round in season t , and N is the number of teams in the championship. Szymanski and Smith (1997) first suggested this formulation to emphasize the gap between top-and bottom-positioned teams with respect to the middle-placed teams in the standing. Higher values of $rank$ indicate better team performance.⁷

3.3 The independent variables

The first independent variable relates to the teams' economic power as the main source of sport performance, and payroll its best approximation (Hall, Szymanski & Zimbalist, 2002; Frick, 2007; García del Barrio & Szymanski, 2009). As in Bykova and Coates (2020), Coates, Frick, and Jewell (2016), and Tao, Chuang, and Lin (2016), we prefer conditional measures and use the seasonal relative position of team payroll, instead of levels. We divided each payroll of team i in the period t by the average payroll in the season t , thus obtaining the *relative_wages*. As an example, the data associated to A.S. Roma in the season 2010/11 is 2.186. It is obtained by dividing the seasonal aggregate net wages paid to the subsample players of A.S. Roma with a minimum of 19 appearances up to the end of season 2009/10 (46.55 mln/€) by the average aggregate wages paid in *Serie A* in the same season (425.91 mln/€ divided by the number of teams). Relative wages are introduced in both linear and squared form. Data on wages are drawn from the Italian sport newspaper *La Gazzetta dello Sport*. Since 2007/08, it has released data on players' wages at the beginning of the season, just after the end of the (summer) transfer market window (except for 2008/09).

The second independent variable is the coefficient of variation, and it is intended to capture the pay dispersion within teams. A novelty of our contribution is the use of different proxies for wages with which to calculate the dispersion. This is motivated by the evidence of several factors effecting wages.⁸ We do consider the distribution of *real wages* inside the roster, but also two additional measures: the *weighted wage* and the

⁶ In fact, some teams have been fined: Bologna (3 points in the season 2010/11); Atalanta (6 points and 2 points, respectively, in 2011/12 and 2012/13); Sampdoria (1 point in 2012/13); Siena (6 points in 2012/13); Torino (1 point in 2012/13); and Chievo (3 points in 2018/2019).

⁷ Note that the correlation between the two dependent variables is 0.968.

⁸ A key factor is the organization of the labor market for professional players (Rottenberg, 1956; Fort, 2005). Then, there is a set of personal characteristics of players, like age, experience, position in the field, contract parameters, performance, and team effects (Idson & Kahane, 2000; Vincent & Eastman, 2009; Link & Yosifov, 2012; Deutscher & Büschemann, 2016). In addition, a novel approach considers variables associated with non-cognitive skills and personality traits that have potential impact on wages (Deutscher, 2018), along with many other variables over which the player (or his agent) does not have control and power (Berri, Buiramo, Rossi & Simmons, 2016; Rossi, Semens & Brocard, 2016). The identification of determinants of wages is a crucial question, since the way in which the players are rewarded may influence single performances, and thus teams' results.

corrected wage. The first is obtained by dividing the real wages by the ratio between the number of career appearances and the player's age. We consider the ratio between appearances and age as a proxy for the relative strength of the players, which they compare to that of other teammates. We have data on 1,509 players in different seasons, for 4,633 total observations, once the sample is restricted to the players with at least 19 appearances in order to prevent potential outliers due to the shortage of appearances. The minimum threshold selected (19) corresponds to the fraction of the season (half) that we consider to evaluate the team performance. At this threshold, about 80% of the total players in the rosters are included. We collect each player's age and number of total career appearances in the top leagues worldwide up to the end of the previous season, as reported in the *Almanacco del Calcio – Panini*, a yearly publication that provides information about Italian professional football organizations and results. The *Almanacco* includes details about the teams playing in *Serie A* and the composition of rosters. The data are those officially provided by the teams to the league at the end of October. The *corrected wages* data have been obtained by an OLS regression on single players' data, using the real wages as the dependent variable and including among the covariates the players' age, appearances, and role on the field. We consider both teams and seasonal effects. We then use the estimated coefficients to calculate the corrected wages. Take one more time the example of A.S. Roma in the 2010/2011 season, and the outline of the superstar Francesco Totti. Since at the start of the season Totti (forward) was 34 years old and had a cumulated 442 appearances in Serie A, his corrected wage is 2.005 mln/€, calculated as $Corrected\ Wage = 0.875 + 0.004 * (appearances) - 0.034 * (age) + 0.389 (forward)$. Differently, Totti's weighted wage is calculated as the ratio between his real wage (at 2018prices) and the appearances-age ratio: $Weighted\ Wage = \frac{5.37}{\left(\frac{442}{34}\right)} = 0.413$.

As an example, table A1 in the appendix highlights the real wages, corrected wages, and weighted wages for the whole roster of A.S. Roma, together with the seasonal associated coefficient of variation. Table 1 shows the top and bottom value of relative wages (in parentheses) in each season and the seasonal average of the coefficients of variation.

Table 2 below shows the correlation matrix among the coefficients of variation calculated on the three measures of applied wages: on real wages (cv_rw), on corrected wages (cv_cw), and on weighted wages (cv_ww).

Table 1. Top and bottom Relative Wages and averaged coefficients of variation by season

<i>Season</i>	<i>Top relative_wage</i>	<i>Bottom relative_wage</i>	<i>cv_rw</i>	<i>cv_cw</i>	<i>cv_ww</i>
2007/08	3.952 (A.C. Milan)	0.206 (Empoli F.C.)	0.507	0.574	0.576
2009/10	3.817 (Inter F.C.)	0.286 (U.S. Livorno)	0.500	0.555	0.550
2010/11	3.381 (A.C. Milan)	0.182 (Cesena A.C.)	0.524	0.558	0.595
2011/12	3.490 (A.C. Milan)	0.151 (Novara Calcio)	0.498	0.559	0.610
2012/13	2.611 (A.C. Milan)	0.220 (Pescara Calcio)	0.530	0.545	0.649
2013/14	2.693 (Juventus F.C.)	0.133 (U.S. Livorno)	0.512	0.541	0.631
2014/15	2.610 (Juventus F.C.)	0.108 (Empoli F.C.)	0.506	0.579	0.611
2015/16	3.000 (Juventus F.C.)	0.108 (Frosinone Calcio)	0.461	0.590	0.658
2016/17	3.374 (Juventus F.C.)	0.173 (F.C. Crotone)	0.444	0.570	0.612
2017/18	3.700 (Juventus F.C.)	0.201 (F.C. Crotone)	0.552	0.614	0.702
2018/19	4.126 (Juventus F.C.)	0.207 (Empoli F.C.)	0.536	0.591	0.573

Table 2. Correlations among the measures of dispersion adopted

	<i>cv_rw</i>	<i>cv_cw</i>	<i>cv_ww</i>
<i>cv_rw</i>	1	-0.077	0.018
<i>cv_cw</i>		1	0.202
<i>cv_ww</i>			1

3.4 Control variables

The control variables are drawn from the established literature on sports performances (Scully, 1974; Kahn, 2000; Burger & Walters, 2003; Berri & Schmidt, 2010; Simmons & Berri, 2011; Bryson, Rossi & Simmons, 2014). We introduce, alternatively, *rank_previous* and *points_pct_previous* to take into account the effect of past performances on current performance.⁹ We expect a positive relationship. Please note that this does not introduce dynamics in our model, since the two mentioned independent variables refer to the final standings in the previous season, while our dependent variables are taken at the end of the first round. We also include a dummy, *promoted*, in the set of controls to denote the teams promoted from the *Serie B* in the previous season. They can be considered less experienced, and therefore we expect a negative sign of the associated coefficient. The fourth control variable (*aristocracy*) proxies the history of the team in the *Serie A* (Di Betta

⁹ Note that for teams promoted in Serie A, we use the corrected formula, considering that Serie B included 22 teams. The same is done for the points percentage.

& Amenta, 2010). We use the count of seasons in the top league of each team, including the season under investigation. An additional control, *population*, measures the market size of the town hosting the team, and we expect a positive sign of the associated coefficient since the market size reflects the potential revenues of the team.¹⁰ We collect the resident town population on December 31 of the referring year, as provided by Italian Institute of Statistics (ISTAT).¹¹ We also add a variable to capture the quality of coaches. We compute the ratio between won and drawn matches and total matches (*coach_record*) for the coach of team *i* at the start of season *t* in his career, for which we expect a positive sign of the associated coefficient. The last control is *injuries*. It is a dummy variable equal to 1 if one of the first three top players (the highest paid) suffered injuries in the first part of the season, leaving them off field for at least one month.¹² We expect a negative sign of the related coefficient. Descriptive statistics, definitions, and measurements of the variables are shown in tables 3 and 4, respectively.

Table 3. Descriptive statistics

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
<i>rank</i>	240	0	1.498	-2.996	2.996
<i>points_pct</i>	240	0.457	0.164	0.07	0.93
<i>relative_wages</i>	220	1	0.918	0.108	4.126
<i>cv_rw</i>	220	0.506	0.152	0.143	1.256
<i>cv_cw</i>	220	0.570	0.122	0.340	1.090
<i>cv_ww</i>	220	0.615	0.161	0.331	1.549
<i>rank_previous</i>	240	0.716	1.339	-1.447	3.091
<i>points_pct_previous</i>	240	0.509	0.129	0.298	0.895
<i>promoted</i>	240	0.15	0.358	0	1
<i>aristocracy</i>	240	47.95	27.527	1	87
<i>population</i>	240	710,496	779,018	40,813	2,873,494
<i>coach_record</i>	240	0.695	0.110	0	1
<i>injuries</i>	240	0.233	0.424	0	1

¹⁰ On the role of population size in determining sport success, see, among others, Di Domizio (2008), Castellanos García, Dopico Castro and Sánchez Santos (2007), and Hoffmann, Lee and Ramasamy (2002).

¹¹ Data are retrievable from www.demo.istat.it (December, 2018).

¹² Data about injuries were retrieved in trasfermkt.com (July, 2019), and are available under request.

Table 4. Definition and measurement of variables

<i>Variables</i>	<i>Definition</i>
<i>Dependent</i>	
<i>rank</i>	<i>Rank of team i at the end of the first round of season t calculated as: -ln[(position)/(N+1-position)]</i>
<i>points_pct</i>	<i>Points gained by team i at the end of the first round of season t divided by the maximum points achievable</i>
<i>Independent</i>	
<i>relative_wages</i>	<i>Relative wages of team i in the season t calculated as the ratio between the cumulative wages paid by team i and the average payroll of the league in the season t, on the basis of players with at least 19 appearances in top leagues</i>
<i>cv_rw</i>	
<i>cv_cw</i>	<i>Coefficients of Variation of team i in the season t calculated on real wages, corrected wages, and weighted wages of the players with at least 19 appearances in top leagues</i>
<i>cv_ww</i>	
<i>Control Variables</i>	
<i>rank_previous</i>	<i>Rank of team i at the end of the season t-1</i>
<i>points_pct_previous</i>	<i>Points gained by team i at the end of the season t-1 divided by the maximum points achievable</i>
<i>aristocracy</i>	<i>Number of participations of team i in Serie A up to the current season t included</i>
<i>Population</i>	<i>Resident population of city hosting team i on 31st December of the year across the season t</i>
<i>coach_record</i>	<i>Number of wins and draws in the career of the coach of team i at the start of season t divided by the number of matches attended</i>
<i>Promoted</i>	<i>Dummy variable equal to 1 if the team i has been promoted from Serie B in season t-1</i>
<i>injuries</i>	<i>Dummy variable equal to 1 if one of the three top players suffered for injuries leaving him out for at least one month in the first round of the season under investigation</i>

3.5 Empirical results

Results of the estimation and tests on heteroscedasticity and normality of residuals are reported for all models in tables 5 and 6. A quadratic relationship between relative wages and team performance emerges from our estimation. As shown in figures 1 and 2, the peak is around 3.6 in model A and 4.3 in model B. Being the first value around the 97th percentile of relative wages distribution, only 6/7 cases out of 220 are in the descending section of the parabola in the domain of relative wages (0.108 – 4.126) in figure 1. Generally, both *rank* and *points_pct* increase as relative wages increase, but at a decreasing rate. Considering models A1 and B1, a rise in one unit of standard deviation of relative wages increases rank and points percentage, respectively, by about 1.68 and 0.16 points. As an example, suppose that a club like Fiorentina, with relative wages around 1 in the 2009/2010 season, increases the relative wages up to 1.1 in the following season (10%). Fiorentina would have been expected to increase its rank by 0.2 points, and its points percentage by about 5 per cent in the 2011/2012 season.

Table 5 – FE Panel Estimation – Dependent variable: *rank*

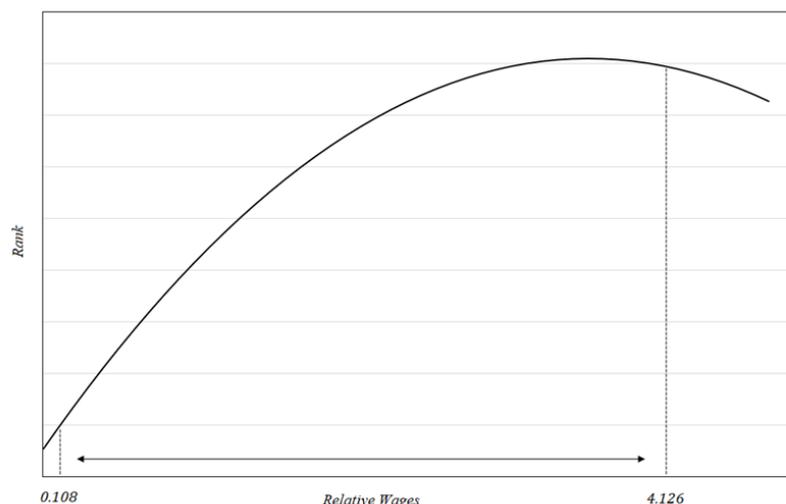
	<i>A1</i>	<i>A2</i>	<i>A3</i>	<i>A4</i>
<i>relative_wages</i>	2.099*** (0.631)	2.087*** (0.635)	1.972*** (0.635)	2.096*** (0.633)
<i>relative_wages_sq</i>	-0.291** (0.124)	-0.290** (0.124)	-0.267** (0.124)	-0.291** (0.124)
<i>rank_previous</i>	0.195** (0.090)	0.194** (0.090)	0.180** (0.090)	0.194** (0.090)
<i>cv_rw</i>		0.115 (0.521)		
<i>cv_cw</i>			-1.158 (0.776)	
<i>cv_ww</i>				-0.045 (0.463)
<i>promoted</i>	-0.220 (0.341)	-0.218 (0.342)	-0.127 (0.346)	-0.218 (0.343)
<i>aristocracy (log)</i>	-0.240 (0.439)	-0.240 (0.441)	-0.327 (0.442)	-0.242 (0.441)
<i>population (log)</i>	-2.002 (2.486)	-1.956 (2.502)	-1.600 (2.492)	-1.997 (2.494)
<i>coach_record</i>	-0.432 (0.608)	-0.426 (0.610)	-0.573 (0.613)	-0.438 (0.612)
<i>injuries</i>	-0.108 (0.152)	-0.111 (0.153)	-0.081 (0.153)	-0.107 (0.153)
<i>constant</i>	25.260 (31.762)	24.615 (31.983)	21.225 (31.768)	25.233 (31.853)
<i>Obs.</i>	220	220	220	220
<i>Teams</i>	35	35	35	35
<i>Seasons</i>	11	11	11	11
<i>R² - within</i>	0.153	0.153	0.164	0.153
<i>R² - between</i>	0.344	0.338	0.283	0.343
<i>R² - overall</i>	0.109	0.103	0.063	0.108
Test				
<i>Welch F</i>	1.51**	1.51**	1.52**	1.50**
<i>Breusch-Pagan</i>	0.93	0.93	1.05	0.91
<i>Hausman</i>	35.99***	36.08***	37.44***	35.86***
<i>Wald</i>	2.3e+32***	2.7e+32	1.4e+32	2.2e+32
<i>Normality</i>	0.308	0.304	1.062	0.323
<i>Robust standard errors adjusted for clusters in teams. Statistical significance: ***1%, **5%, *10%.</i>				

Table 6 - FE Panel Estimation – Dependent variable: *points_pct*

	<i>B1</i>	<i>B2</i>	<i>B3</i>	<i>B4</i>
<i>relative_wages</i>	0.197*** (0.066)	0.194*** (0.067)	0.186*** (0.067)	0.197*** (0.067)
<i>relative_wages_sq</i>	-0.023* (0.013)	-0.023* (0.013)	-0.021 (0.013)	-0.023* (0.013)
<i>points_pct_previous</i>	0.306*** (0.092)	0.308*** (0.030)	0.297*** (0.0092)	0.307*** (0.092)
<i>cv_rw</i>		0.028 (0.055)		
<i>cv_cw</i>			-0.099 (0.082)	
<i>cv_ww</i>				0.003 (0.049)
<i>promoted</i>	-0.033 (0.030)	-0.033 (0.030)	-0.026 (0.031)	-0.033 (0.030)
<i>aristocracy (log)</i>	-0.014 (0.046)	-0.014 (0.047)	-0.021 (0.047)	-0.014 (0.047)
<i>population (log)</i>	-0.044 (0.263)	-0.033 (0.265)	-0.007 (0.265)	-0.044 (0.264)
<i>coach_record</i>	-0.064 (0.064)	-0.063 (0.064)	-0.076 (0.065)	-0.064 (0.065)
<i>injuries</i>	-0.011 (0.016)	-0.012 (0.016)	-0.009 (0.016)	-0.012 (0.016)
<i>constant</i>	0.811 (3.365)	0.657 (3.381)	0.444 (3.370)	0.815 (3.370)
<i>Obs.</i>	220	220	220	220
<i>Teams</i>	35	35	35	35
<i>Seasons</i>	11	11	11	11
<i>R² - within</i>	0.211	0.212	0.217	0.211
<i>R² - between</i>	0.385	0.496	0.622	0.381
<i>R² - overall</i>	0.471	0.528	0.584	0.469
Test				
<i>Welch F</i>	1.36	1.36	1.40	1.35
<i>Breusch-Pagan LM</i>	1.61	1.58	1.86	1.53
<i>Hausman</i>	34.63***	34.83***	36.02***	34.74***
<i>Wald</i>	1.2e+31	1.1e+31	6.7e+30	1.2e+31
<i>Normality</i>	1.022	1.008	0.418	1.033
<i>Robust standard errors adjusted for clusters in teams. Statistical significance: ***1%, **5%, *10%.</i>				

The results confirm the idea presented in Caruso, Di Domizio, and Rossignoli (2017) about the role of relative wages in determining a team's position in the standings. With regard to the role of dispersion, we note that no coefficients of variation are statistically significant. This contradicts the outcome of Bucciol, Foss, and Piovesan (2014) study, in which, at roster level, the relationship between dispersion and performance is statistically significant and positive, although only for single matches.

Figure 1. Relative wages - rank relationships



In sum, our results show that the performance of teams depends predominantly upon relative wages. In other words, the availability of talent is the dominant factor in determining sport performance in Italian *Serie A*. Control variables exhibit the expected signs. First, past performances are positively associated with the current ones, both if we consider the rank and/or if we consider the percentage of points. If we consider the points percentage, it is possible to maintain that an increase of one per cent in *points_pct_previous* determines about 0.3 adding percentage points in the first round of the following season. With respect to the variable *rank*, an increase of one standard deviation in the rank of previous season is reflected in about 0.18 points of gain at the end of the first round in the following season. The dummy *promoted* has the expected negative sign, though it is not statistically significant in all models. The *coach_record* variable is not statistically significant. All other covariates appear to be marginal.

3.5.1 Alternative estimation

In order to check for robustness of our results, in what follows we reduce the sample by taking only teams that have always competed in *Serie A* in the period under investigation. In other words, we exclude teams promoted from the lower league. Then, we employ a panel made up of 9 teams, namely Fiorentina, Genoa, Inter, Juventus, Lazio, Milan, Napoli, Roma, and Udinese, for 11 seasons, for a total of 99 observations. The results of models C and D are reported in tables 7 and 8, and confirm that relative wages¹³ is the only variable that is always statistically significant, regardless of the dependent variable used.

¹³ The quadratic relationship between relative wages and performance disappears in the reduced sample, in which we introduce the relative wages linearly. Results are available by request.

Table 7. FE Panel estimation - Restricted sample. Dependent variable: *rank*

	C1	C2	C3	C4
<i>relative_wages</i>	0.780*** (0.227)	0.754** (0.247)	0.763*** (0.219)	0.741*** (0.209)
<i>rank_previous</i>	0.101 (0.096)	0.103 (0.095)	0.104 (0.096)	0.080 (0.102)
<i>cv_rw</i>		0.349 (0.543)		
<i>cv_cw</i>			-0.463 (0.610)	
<i>cv_ww</i>				-1.200** (0.520)
<i>aristocracy (log)</i>	-1.626 (2.247)	-1.577 (1.791)	-1.673 (1.770)	-0.619 (1.856)
<i>population (log)</i>	2.247 (2.657)	2.371 (2.593)	2.337 (2.700)	1.519 (2.526)
<i>coach_record</i>	0.010 (0.510)	0.037 (0.528)	-0.015 (0.484)	-0.066 (0.442)
<i>injuries</i>	0.066 (0.248)	0.038 (0.252)	0.076 (0.249)	0.093 (0.224)
<i>Constant</i>	-24.202 (32.663)	-26.274 (31.852)	-24.956 (32.861)	-17.660 (31.658)
Obs.	99	99	99	99
Teams	9	9	9	9
Seasons	11	11	11	11
R ² - within	0.204	0.207	0.205	0.239
R ² - between	0.371	0.369	0.362	0.481
R ² - overall	0.225	0.222	0.219	0.303
Test				
Welch F	1.320	1.267	1.285	1.226
Breusch-Pagan	1.11	0.672	0.898	0.525
Hausman	44.32***	165.32***	60.19***	41.923***
Wald	16.472*	13.215	17.578**	13.192
Normality	2.486	2.704	2.951	1.446

Robust standard errors adjusted for clusters in teams. Statistical significance: ***1%, **5%, *10%.

Table 8. FE Panel estimation - Restricted sample. Dependent variable: *points_pct*

	D1	D2	D3	D4
<i>relative_wages</i>	0.088** (0.027)	0.081** (0.029)	0.085** (0.025)	0.087** (0.026)
<i>points_pct_previous</i>	0.293** (0.095)	0.301** (0.096)	0.296** (0.095)	0.267** (0.097)
<i>cv_rw</i>		0.070 (0.069)		
<i>cv_cw</i>			-0.058 (0.072)	
<i>cv_ww</i>				-0.075 (0.065)
<i>aristocracy (log)</i>	0.071 (0.243)	0.081 (0.240)	0.064 (0.240)	0.133 (0.275)
<i>population (log)</i>	0.220 (0.284)	0.242 (0.278)	0.230 (0.289)	0.182 (0.288)
<i>coach_record</i>	-0.041 (0.041)	-0.036 (0.044)	-0.044 (0.038)	-0.045 (0.041)
<i>injuries</i>	0.001 (0.030)	-0.004 (0.032)	0.002 (0.032)	-0.002 (0.030)
<i>Constant</i>	-3.010 (3.283)	-3.390 (3.197)	-3.096 (3.292)	-2.690 (3.253)
Obs.	99	99	99	99
Teams	9	9	9	9
Seasons	11	11	11	11
R ² - within	0.287	0.294	0.288	0.295
R ² - between	0.458	0.448	0.445	0.508
R ² - overall	0.291	0.283	0.282	0.325
Test				
Welch F	1.386	1.302	1.337	1.202
Breusch-Pagan	0.757	0.431	0.530	0.396
Hausman	123.40***	464.60***	209.44***	751.63***
Wald	20.403*	15.495*	22.900***	26.315***
Normality	2.750	2.711	2.688	2.434

Robust standard errors adjusted for clusters in teams. Statistical significance: ***1%, **5%, *10%.

Moreover, these results show a negative and statistically significant association of *rank* with the coefficient of variation calculated on weighted wages. They also show that high dispersion of the weighted wages is associated with a lower position in the standing. The effect appears to be substantial, because an increase by one unity of standard deviation of the coefficient of variation of weighted wages turns into a reduction of about 0.2 points in *rank*. This result validates the cohesion theory hypothesis in *Serie A*, in opposition to previous empirical investigations. That is, cohesion theory appears to hold only for teams with a long-lasting participation in the top league.

In sum, if we consider only teams playing in *Serie A*, results confirm that relative wages are statistically significant, and their associations with performance at the seasonal level are approximately linear, but inelastic. In addition, the way in which weighted wages are distributed in the payroll influences the teams' performances, supporting the idea of cohesion theory dominance in *Serie A*.

Conclusions

Economists have long recognized and analyzed the relationship between wage allocation strategy and individual efforts when working in teams. This topic attracts even stronger interest if we consider the implication of these issues on firms' performance. Here, we have investigated the impact of such strategy on the performance of football teams in the Italian *Serie A* between the 2007/2008 and 2018/2019 seasons. In line with the prevailing literature, we have employed both the percentage of points achieved by teams and a measure associated to the position of the team (rank) at the end of the first round of each season as measures of team performance. Then, we have considered the relative payroll of teams as a proxy for talent in both linear and squared form. As a measure of pay dispersion, we have employed the coefficient of variation of wages within each team. We have used different proxies for wages to compute the coefficient of variation, namely *real wages*, *weighted wages*, and *corrected wages*. The weighted wages have been computed weighting real wages by the age and appearances of players, whereas the *corrected wages* have been computed through coefficients drawn from regressing real wages against a set of variables. In sum, the main results we would claim for this work are:

1. There is a positive association between relative wages—defined as the ratio between the payroll of each team and the average payroll in the league—and team performance. This relationship appears to be quadratic.
2. Unlike previous researchers, we do not find any evidence of an impact of pay dispersion on performance when considering the whole sample under investigation.
3. If we restrict the sample to the teams always competing in *Serie A* in the period under investigation—those teams never relegated to *Serie B*—the association between the coefficient of variation and sport performance measured by *rank* is negative and statistically significant, validating the cohesion theory hypothesis rather than the tournament theory hypothesis in the Italian football context.

We maintain that our results provide interesting insights that serve as prompts for further research on this topic. In particular, it seems that the relationship between pay dispersion and performance can be further investigated by deepening the characteristics of teams.

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Appendix

Table A1. *Real Wages* (mln/€ 2018), *Corrected Wages* and *Weighted Wages* of A.S. Roma – 2010/11 – and associated Coefficients of Variation

Player	Real Wage	Corrected Wage	Weighted Wage
Burdisso G.	0,438	0,264	0,219
Rosi	0,548	0,328	0,188
Julio Sergio	0,767	0,111	0,336
Loria	0,767	0,069	0,280
Borriello	2,847	1,005	0,498
Menez	1,643	0,862	0,230
Castellini	0,548	0,523	0,096
Doni	2,519	0,651	0,407
Vucinic	2,628	1,256	0,336
Burdisso N.	2,409	0,782	0,316
De Rossi	5,037	0,970	0,615
Adriano	3,121	1,273	0,392
Cassetti	1,095	0,665	0,161
Cicinho	2,409	0,791	0,313
Taddei	1,752	0,912	0,228
Lobont	0,548	0,826	0,073
Brighi	0,986	1,052	0,112
Pizarro	1,971	1,040	0,227
Baptista	2,847	1,116	0,305
Juan	2,847	1,001	0,306
Mexes	3,176	1,127	0,302
Simplicio	1,095	1,236	0,108
Perrotta	1,862	1,280	0,180
Riise	1,752	1,277	0,152
Totti	5,366	2,005	0,413
Coefficient of Variation	0.641	0.477	0.481

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