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The effect of talent disparity on team productivity in soccer ☆

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ABSTRACT

Theory predicts that the interaction type within a team moderates the impact of talent disparity on team productivity. Using panel data from professional German soccer teams, we test talent composition effects at different team levels characterized by different interaction types. At the match level, complementarities are expected due to the continuous interaction of the fielded players. If the entire squad is analyzed at the seasonal level, substitutability emerges from the fact that only a (varying) selection of players can prove their talent in the competition games. Holding average ability and unobserved team heterogeneity constant, we find that the players selected to play on the competition team should be rather homogeneous regarding their talent. However, if we relate talent differences within the entire squad to the team's league standing at the end of the season, talent disparity turns out to be beneficial.

1. Introduction

Team production is typically characterized by the fact that the total is more than the sum of its parts (Alchian & Demsetz, 1972). Thus, not only does the simple aggregation of members' task-relevant abilities matter, but the intra-team talent composition is likely to influence team productivity as well. Scholars both in social psychology (Steiner, 1972) and economics (Kremer, 1993; Prat, 2002) argue that the interaction type moderates the optimality of talent disparity. In the extreme case that production technology is strictly multiplicative, all conjunctive tasks must be completed successfully for the product to have full value. Hence, the optimal strategy is to combine workers of similar skill levels into a team. In the other extreme case of entirely disjunctive tasks, where individual inputs serve as substitutes for team production, team output depends on the most productive team member. Here, heterogeneous teams should have a clear advantage. In addition, talent disparity is beneficial whenever mutual learning is an important part of team collaboration, as it enables the less skillful team members to learn how to execute tasks more efficiently from their more talented teammates (Hamilton, Nicherson, & Owan, 2003).

This paper empirically tests the effect of talent disparity on team productivity in a setting in which different interaction types are expected on different team levels within the same overall context, namely professional soccer. At the match level, only a (varying) selection of players competes in the single games that make up the championship race. The interaction type within the competition team is likely to be conjunctive: the team's outcome depends on the complementary skills and on the continuous interaction of all fielded players performing up to some standard. If the entire team is analyzed at a seasonal level, a clearly substitutive relationship between the reserve and the fielded players is introduced. The different team levels in soccer also represent different stages of team production with unequal importance of mutual learning: the preparatory stage and the competition stage. Whereas at the preparatory stage all players of the squad are involved in an ongoing process of exercising and training, only winning matters at the competition stage.

Using extensive panel data from German soccer teams, we proceed in two steps. On the one hand, we only analyze the fielded players and relate the talent composition of the competition team to the likelihood of winning the game. On the other hand, we examine the influence of talent disparity of the entire squad in a given season on the team's (inverted) league standing at the end of the season as the ultimate measure of long-term team effectiveness.

In this paper, we use productivity data to proxy a player's ability. Individual productivity, however, is affected by inborn talent as well as time-varying aspects, like physical fitness or injuries. Since we assume that player inputs combine in a non-additive manner to produce the team's output, productivity is also influenced by the playing ability of the other teammates. We therefore define a player's talent by his *permanent* productivity, purged of possible intra-team spillover effects. First, we compute individual productivity as a weighted sum of various detailed performance statistics that affect winning. Then we model individual productivity as a function of player fixed effects, reflecting the unobserved talent of a player, of the average productivity of the rest of the team to incorporate intra-team spillovers, and of an idiosyncratic error term that captures unexplained productivity variation beyond playing ability and spillovers. The fixed effects obtained by fitting this model serve as talent proxies. As a second approach to proxy individual talent, we rely on expert evaluations.

Using match-level data from all games in the German soccer league *Bundesliga* over a period of six seasons (i.e. 1836 games), we find evidence that homogeneous competition teams are more likely to win a game than heterogeneous teams, all else being equal. Talent disparity within the competition team decreases sportive performance. The empirical results of the second model including all team members at the seasonal level confirm that talent disparity improves a team's standing in the championship race, holding average playing ability and other confounding factors constant. Hence, although team-work is usually characterized by complementarities – otherwise, team output would be less, not more, than the sum of the individual contributions – talent disparity may still be beneficial when necessary substitutes and the training activities are taken into account.

The remainder of this paper is structured as follows: Section 2 lays the theoretical foundations and presents related empirical papers. Subsequently, we explain team production in professional soccer and frame our hypotheses. In Section 4, we test our hypotheses. First, we explain how individual talent is measured. Then, the main features of our data, the estimation approaches and the results are illustrated. The last section presents the conclusions and general implications.

2. Theoretical foundations

It is beyond controversy that teams with more talented individual members outperform, ceteris paribus, teams with less talented members. However, due to the manifold interdependencies in team production settings, individual skill levels are likely to combine in a non-additive manner, implying that the team's output is also affected by the talent composition within the team (Tziner, 1985; Tziner & Eden, 1985).[1] Thus, we model team productivity (Y_{it}) as a function of the sum *and* the product of strictly positive individual playing abilities (x_{itp}), a vector of control variables (C'_{it}), unobserved team heterogeneity (δ_i) and an idiosyncratic error term (ε_{it}):

$$Y_{it} = \alpha + \beta_1 \sum_{p=1}^{p=n} x_{itp} + \beta_2 \prod_{p=1}^{p=n} x_{itp} + \beta C'_{it} + \delta_i + \varepsilon_{it}. \tag{1}$$

If individual talent combines in a strictly additive way to lead to team success, β_2 is 0, and team composition makes no difference. If player inputs are complements in team production, individual cross derivatives of productivity are positive, i.e., $\frac{\partial^2 Y_{it}}{\partial x_{itp1} \partial x_{itp2}} > 0$, $p_1 \neq p_2$. In this case, the coefficient of the hyperbolic term is positive, and team performance is maximized when individual talent disparity is minimized. If player inputs are substitutes in team production, individual cross derivatives of productivity are negative. Here, β_2 is negative, which implies that team productivity is highest when talent differences are maximized.

Hamilton et al. (2003) argue that talent heterogeneity increases team performance by facilitating mutual learning and by forming a social norm of higher productivity. Mutual learning may increase team performance, as the less skillful team members learn from their more talented teammates how to execute tasks more efficiently. Hence, the wider the ability gaps within a team, the higher the learning potential. In addition, a positive link between talent heterogeneity and team performance could also result from peer pressure and social norms of teams. Hamilton et al. (2003) assume that group norms and resulting peer pressure emerge from a bargaining process in which workers negotiate over the common effort level. As a result of

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[1] For a different perspective, see Jones (1974), who finds that individual performances combine in a strictly additive way to affect team performance.