The impact of referees on match outcomes in professional sports: Evidence from the German Football Bundesliga

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Referees in football should behave as a neutral and impartial observer. But often player, manager and fans suppose that referees make biased decisions or do not act as this neutral monitor. Aim of this study is to find evidence whether referees and their decisions systematically influence the result of a football match.

1. Data

The data-set contains 4,590 matches from 1st Bundesliga in Germany from season 1993/94 until 2007/08. Further, there are 67 referees with up to 20 years of experience and at least two matches in the data-set.

Figure 2: Distribution of referees and teams within a referee’s career

2. Individual Effects

\[ y_{ijt} = \beta_0 + \alpha_i + \gamma_t + \beta_1 \cdot \chi_{ijt} + \beta_2 \cdot \chi_{ijt}^2 + \beta_3 \cdot \chi_{ijt}^3 + \beta_4 \cdot \chi_{ijt}^4 + \beta_5 \cdot \chi_{ijt}^5 + \beta_6 \cdot \chi_{ijt}^6 + \beta_7 \cdot \chi_{ijt}^7 + \beta_8 \cdot \chi_{ijt}^8 + \beta_9 \cdot \chi_{ijt}^9 + \beta_{10} \cdot \chi_{ijt}^{10} + \varepsilon_{ijt} \]  

- \( y_{ijt} \): Variables for match outcomes and referee decisions
- \( \alpha_i \): Season fixed effects
- \( \gamma_t \): Team fixed effects (i=home, j=away)
- \( \chi_{ijt} \): Team fixed effects (i=home, j=away)
- \( \chi_{ijt}^2 \): Vector of time-varying performance variables
- \( \tau_i \), \( \tau_j \): Relative budget within a season
- \( \rho_{ij} \): Relative budget within a season
- \( \theta_{ij} \): Number of drives within a match
- \( \lambda_{effic} \): referee fixed effects

To estimate individual referee effects, equation (1) is first run without the dummy variables for referees. After that, equation (1) is repeated with referee fixed effects. Evidence for influence of referees on match outcome is found if the adjusted \( R^2 \) increases after referee fixed effects are included and moreover the F-test for joint significance of these referee dummy variables must be significant. Further, equation (1) is run for home and away teams.

3. Referee Styles

If referees have a significant effect on match outcome or referee decisions, does this effect influence other referee decisions?

\[ F.E. \left( y_{ijt} \right) = \alpha + \beta F.E. \left( z_{ijt} \right) + \varepsilon_{ijt} \]  

\( F.E. \left( y_{ijt} \right) \) and \( F.E. \left( z_{ijt} \right) \) are fixed effects for match outcome and referee decisions where a significant individual referee effect is found.

4. Referee Characteristics

\[ y_{ijt} = \beta_0 + \alpha_i + \gamma_t + \beta_1 \cdot \chi_{ijt} + \beta_2 \cdot \chi_{ijt}^2 + \beta_3 \cdot \chi_{ijt}^3 + \beta_4 \cdot \chi_{ijt}^4 + \beta_5 \cdot \chi_{ijt}^5 + \beta_6 \cdot \chi_{ijt}^6 + \beta_7 \cdot \chi_{ijt}^7 + \beta_8 \cdot \chi_{ijt}^8 + \beta_9 \cdot \chi_{ijt}^9 + \beta_{10} \cdot \chi_{ijt}^{10} + \varepsilon_{ijt} \]  

- \( \alpha_i \): Referee’s national association
- \( \gamma_t \): Referee’s age in years
- \( \chi_{ijt} \): Referee’s height in centimeter
- \( \chi_{ijt}^2 \): Referee’s national association
- \( \chi_{ijt}^3 \): Referee’s height in centimeter
- \( X_i \): Referee’s national association
- \( Y_i \): Referee’s professional job

- Observable referee characteristics cannot explain individual referee effects.
- Small evidence that referees follow career concerns in home matches.
- Professional jobs can slightly explain referee’s behavior in away matches.