Technische Universität München

# Predicting Transfer Fees in Professional European Football Before and During COVID-19

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## Background

In professional football, talented players are the clubs' most valuable resources. Player registrations give clubs the exclusive rights to a player's services and these registrations can be exchanged (purchased or loaned) on the international market. In 2021, more than 18,000 international permanent transfers were made with revenues of almost US$ 5 billion (FIFA, 2022).

Previous studies commonly rely on simple linear regressions and explore a rather limited set of variables for comparably small samples (Carmichael & Thomas, 1993; McHale & Holmes, 2022).

### Research Questions

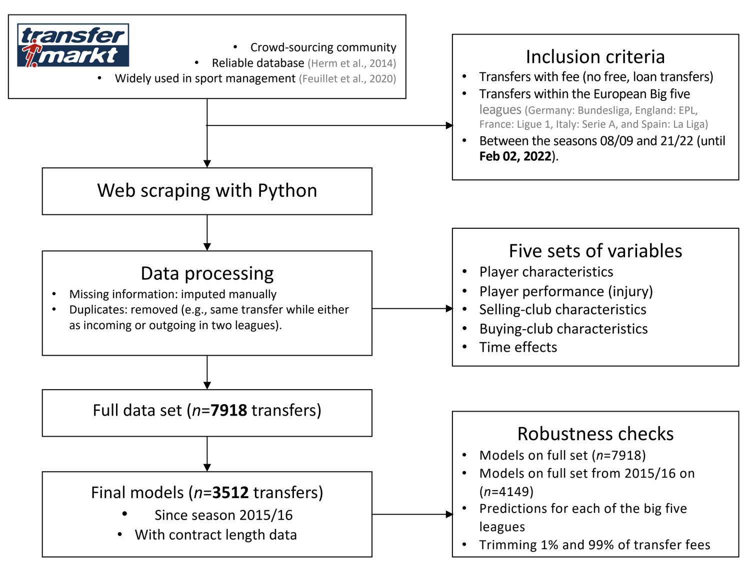
- What are the key determinants of transfer fees?
- How can we make comparably accurate predictions for such fees?
- Did the COVID-19 pandemic affect the relevance of common predictors and the accuracy of predictions based on pre-COVID-19 evidence?

### Aims

Our study aims to extend findings from previous efforts exploring the factors associated with transfer fees to and from all big five league clubs in European football (men) by building upon advances in machine learning, which allow to depart from linear functional forms. Moreover, we provide a simple test of whether the transfer market has changed since the beginning of the COVID-19 pandemic.

## Methods

### Sample




### Variables

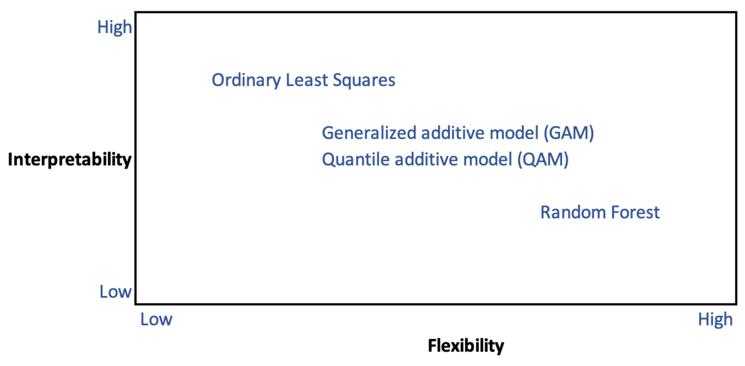
| Player characteristics | Time effects |
|---|---|
| - Age<br>- Height<br>- Nationality: Europe, Asia, Africa, South America, North America<br>- Position: Defender, goalkeeper, attacker, midfielder<br>- Remaining contract length (days) | - Season 08/09 – season 21/22<br>- Season 15/16 – season 21/22<br>- Transfer window (summer, winter) |
| **Selling & buying club characteristics** | **Player performance** |
| - Arrivals of players<br>- Departures of players<br>- Transfer income<br>- Transfer expenditure<br>- Spectators<br>- UEFA club coefficients<br>- League ranking<br>- Leagues (13 types)<br><br>*Note. All variables refer to previous season or player career history* | - UEFA Champions League<br>- Appearances<br>- Substitution on<br>- Substitution off<br>- Minutes played<br>- Points (/1000 MP)<br>- Goals (/1000 MP)<br>- Assists goal (/1000 MP)<br>- Yellow cards (/1000 MP)<br>- Player injury history: (Injury days/injury frequency)/age |

### Modelling

$$\textit{Logged transfer fee} = \beta_0 + \beta_1\text{*(player characteristics)} + \beta_2\text{*(player performance)} + \beta_3\text{*(selling-club characteristics)} + \beta_4\text{*(buying-club characteristics)} + \beta_5\text{*(time effects)} + \varepsilon$$

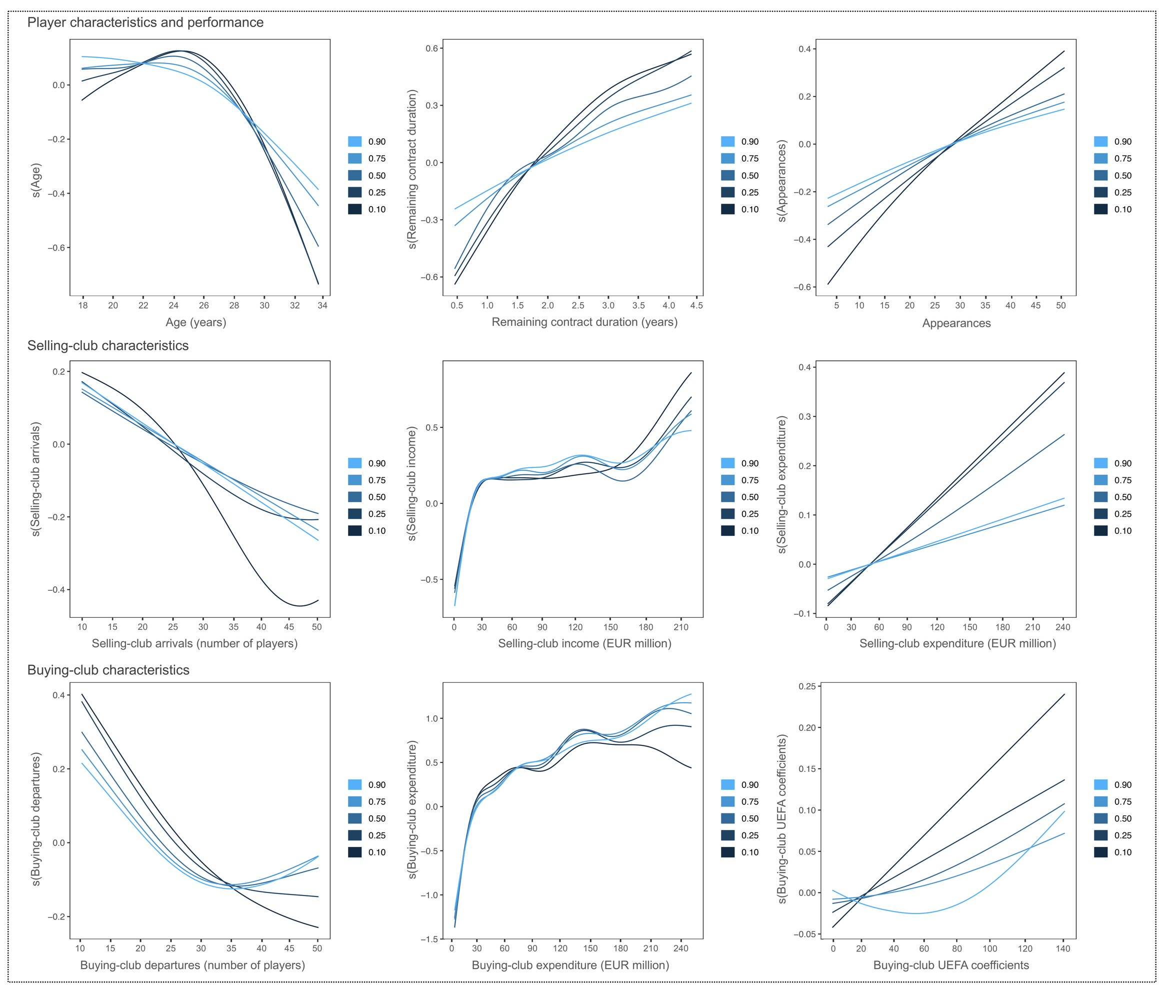
### Supervised Machine Learning Framework

- Go beyond linear functional forms of OLS (machine learning; James et al., 2013)
- Random data splitting ($n$ = 3,512): training ($n$ = 1,903), testing ($n$ = 816), during COVID-19 ($n$ = 793)
- 10-fold cross-validation
- Evaluating model performance: testing $R^2$ and RMSE (Root Mean Square Error)

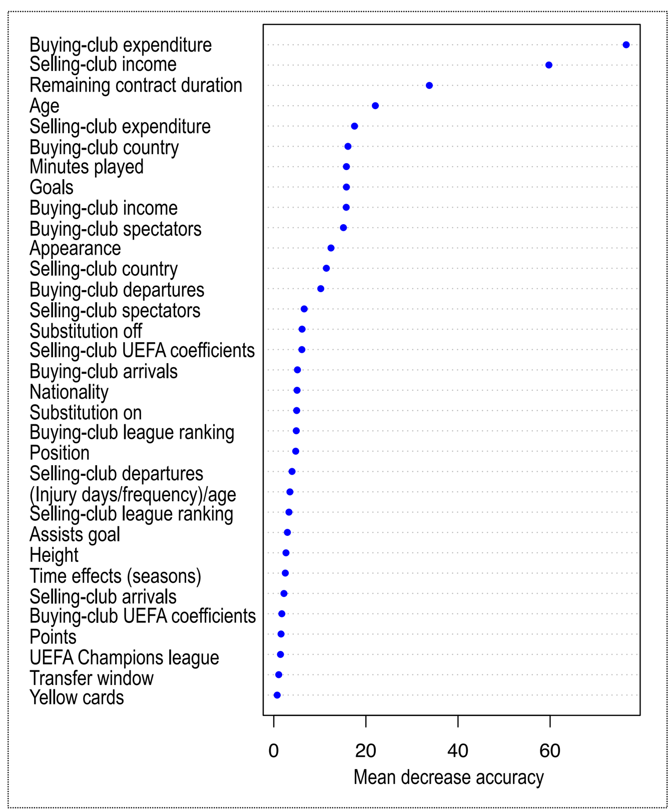



## Results

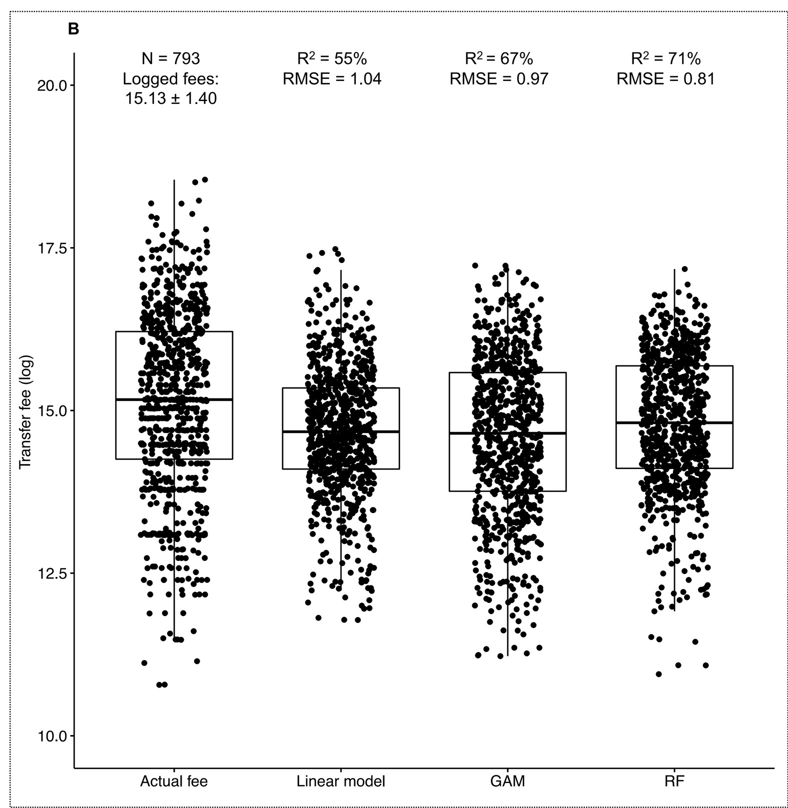
### Moving Beyond Linearity: Quantile Additive Non-linear Effects of Predictors



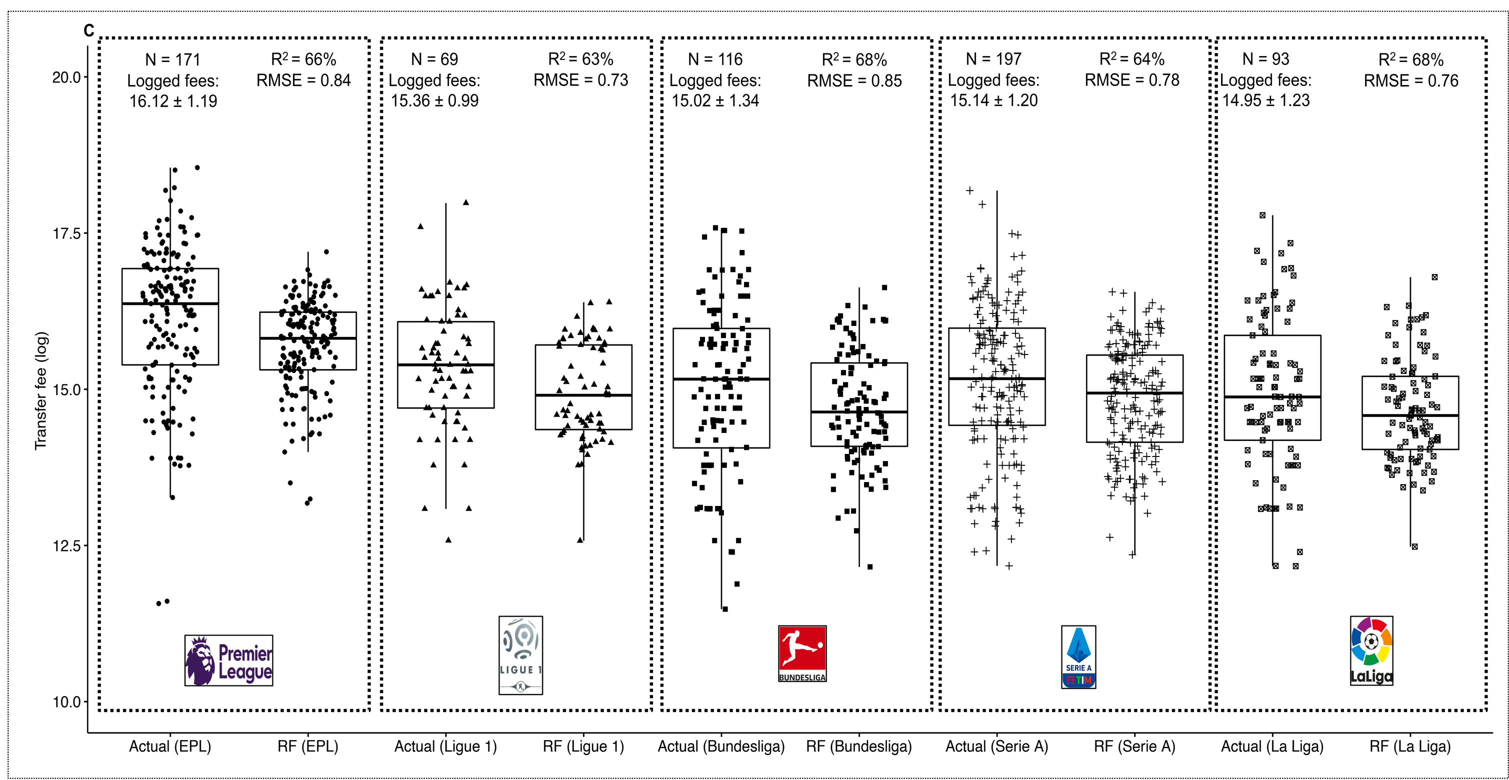

### Random Forest-based Variable Importances




### Predicted vs. Actual Transfer Fees During COVID-19




### European Big Five Leagues: Predicted vs. Actual Transfer Fees During COVID-19




## Conclusions

- We showcase how moving beyond linearity and modeling quantiles can be revealing for both research and practice.
- The models trained with *before*-COVID-19 data significantly **underestimate** the actual transfer fees paid *during* COVID-19 particularly for high- and medium-priced players, thus questioning any cooling-off effect of the transfer market.


## Selected References

- Carmichael, F., & Thomas, D. (1993). Bargaining in the transfer market: Theory and evidence. *Applied Economics*, 25(12), 1467-1476. https://doi.org/10.1080/00036849300000150
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- James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). An introduction to statistical learning (Vol. 112). Springer.



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# TUM SCHOOL OF MANAGEMENT POSTER COMPETITION

## Yanxiang Yang, Joerg Koenigstorfer, Tim Pawlowski

presented at the
TUM School of Management Research Fest 2022 a poster on

## Predicting Transfer Fees in Professional European Football Before and During COVID-19

Joachim Henkel
Vice Dean of Research & Innovation
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