

Do Timeouts Matter? A Study of Euroleague Basketball

Beamer Presentation

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Outline

- 1 Introduction and Motivation
- 2 Data and Definitions
- 3 Descriptive Evidence on Time-Out Usage
- 4 Time-Out Efficiency in PbP Data
- 5 The Four Factor model
- 6 Conclusion

- Time-outs are crucial in basketball for in-game tactical management.
- Coaches often call time-outs to shift momentum and organize end-of-game plays.
- However, prior research (Vergara 2025; Eurohoops 2021; Eurohoops 2020) yields mixed conclusions on their effectiveness.
- **We investigate:** Do time-outs truly matter for game outcomes and, more broadly, for season performance?

Vergara (2025)¹:

- **Focus:** Investigates whether a time-out can halt a negative run using NBA data.
- **Method:** Defines a run as an uncontested scoring stretch by one team.
- **Key Finding:** Timeouts *can* be effective in shifting momentum, but the *timing and context* of a time-out are critical.

¹<https://medium.com/@ivm9816/analyzing-nba-timeouts-29df987f076a>

Eurohoops (2020)²:

- **Coaching Perspective:** In an interview series, Dimitris Itoudis (CSKA Moscow) highlighted how defeats offer learning opportunities and strategy adaptations.
- **Implication:** Acknowledges the role of time-out decisions in a team's broader game strategy.

²<https://www.eurohoops.net/en/trademarks/1277233/euroleague-can-a-time-out-stop-a-negative-run/>



Key Questions:

- Do time-outs alter momentum effectively (i.e., halt runs)?
- Do time-outs lead to improved season-long performance (i.e., more wins)?

- Develop *Run Stoppage Efficiency* and *Score Differential Impact* metrics.
- Test time-out efficiency within the *Four-Factor Model* of wins.
- Conclude that time-outs can limit losses but do **not** reverse games nor predict final standings.

- We analyze the efficiency of timeouts and their empirical relationship with team wins in the Euroleague.
- Two data sources^{3 4}:
 - **Play-by-Play (PbP) data**: detailed log of events (timestamp, play type, event details, score updates).
 - **Game box-score data**: enriched set of variables including player stats and aggregated team stats.
- Regular season games from 2021–2022 to 2023–2024.
 - Over 900 games.
 - Over 4000 time-outs.

³[https : //www.euroleaguebasketball.net/en/euroleague/](https://www.euroleaguebasketball.net/en/euroleague/)

⁴**R package**: <https://cran.r-project.org/web/packages/euroleaguer/euroleaguer.pdf>  

- **Runs:** Uncontested scoring stretches by one team.
 - A timeout is *successful* if it halts the opposing run in the first possession after the timeout.
- **Score differential impact:** Difference between points scored and points conceded in the minute before vs. after a timeout.
 - A timeout is *successful* if this difference is positive.
- These measures allow us to gauge local (immediate) effectiveness of timeouts.

The Challenge of Selection Bias

- **Selection bias** arises when we only observe the difference in outcomes between treated and untreated groups, rather than the average treatment effect on the treated.
- Example: A binary treatment $D_i = [0, 1]$ affects an outcome Y_i .
- Standard solution: Randomization ensures both groups are statistically similar, removing selection bias.

The Formal Definition of Selection Bias

Observed difference in average outcome

$$E[Y_i \mid D_i = 1] - E[Y_i \mid D_i = 0]$$

equals the sum of:

$$\underbrace{E[Y_{1i} \mid D_i = 1] - E[Y_{0i} \mid D_i = 1]}_{\text{Average treatment effect on the treated}} + \underbrace{E[Y_{0i} \mid D_i = 1] - E[Y_{0i} \mid D_i = 0]}_{\text{Selection bias}}$$

Timeouts as a Treatment

- **Timeout as treatment:** We treat each team-year as a distinct “individual.”⁵
- Using Play-by-Play (PbP) data, we can observe team performance *both with and without* timeouts.
- This helps mitigate selection bias because performance changes can be compared before and after timeouts.

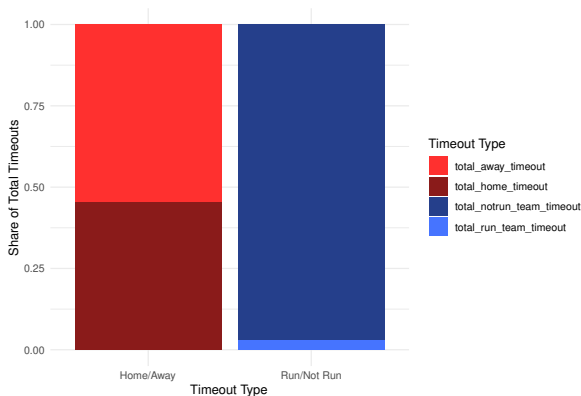
⁵For instance, Real Madrid in 2021–2022 is different from Real Madrid in 2022–2023.

- Box-score data retrieved via the official Euroleague GameCenter API.
- Contains:
 - Team names, coaches.
 - PlayerStats, TeamStats.
- Complements PbP data by allowing analysis of global performance measures.
- We go beyond local (immediate) effects of timeouts and assess potential season-long impact.

Our Use of Box-Score data

- Standard four-factor model of wins Oliver 2004
- We propose adding a **fifth factor: timeout efficiency**.
- Hypothesis: A team's ability to use timeouts effectively (halt runs, improve score differential) enhances their overall success in terms of wins.

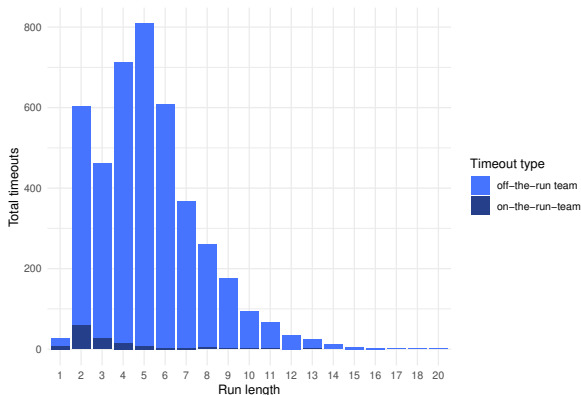
When Are Time-outs Called?



Observations:

- Being home or away has little effect.
- Over 95% of time-outs are called when the team is off a run.

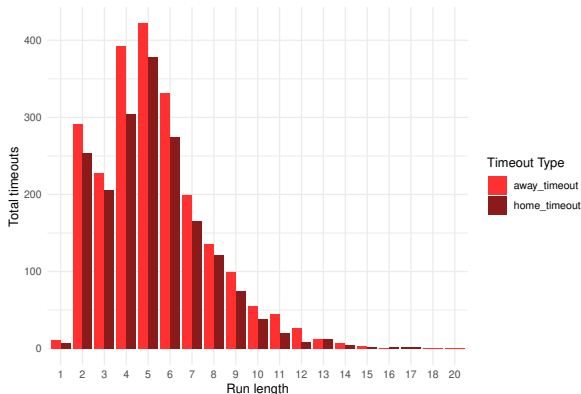
Time-outs by Run Length



Key Takeaways:

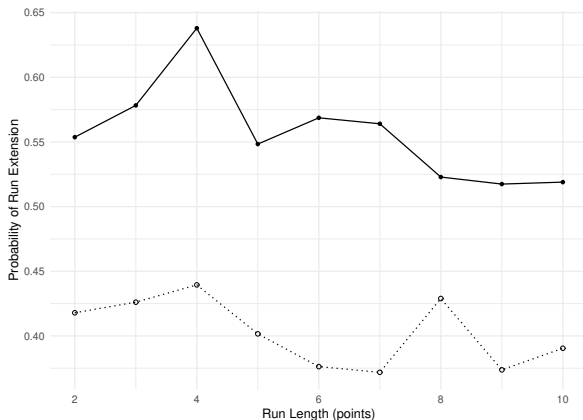
- Most time-outs cluster around runs of 4–6 points.
- Coaches appear highly sensitive to 2–3 possessions going unanswered.

Home vs. Away Timeouts by Run



- Distribution is **similar** for home and away teams.
- Venue does *not* significantly alter time-out calling patterns.

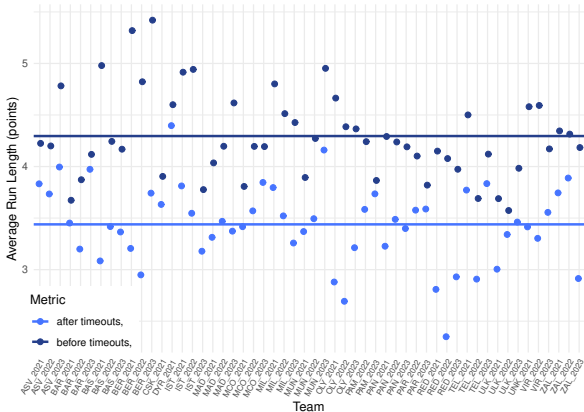
Run Stoppage Efficiency



Details:

- We compare probability that a run of length n becomes $n + 1$.
- Time-outs **consistently reduce** the chance of run extension by about 10+ percentage points.

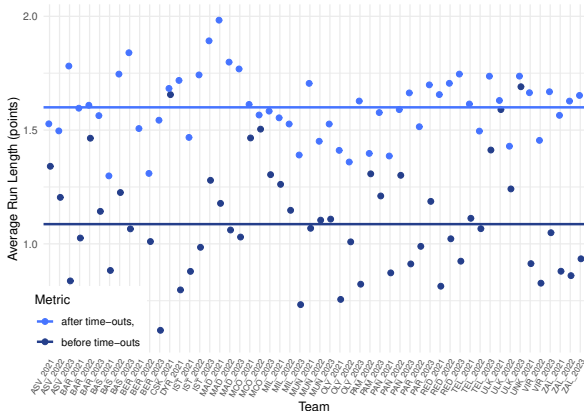
Off-Run Adjustment



Interpretation:

- ORA = difference in average length of an off-the-run streak in the minute before vs. after a time-out.

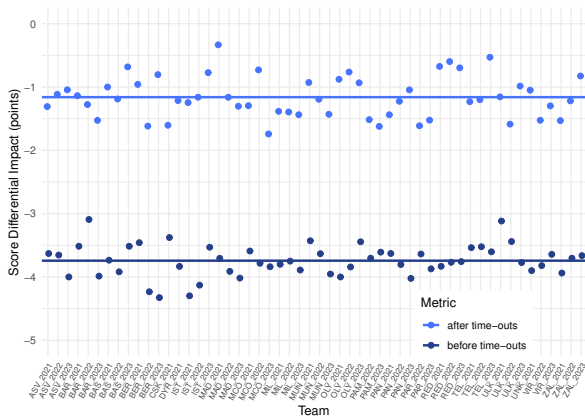
On-Run Adjustment



Interpretation:

- ORA^+ = difference in average length of on-the-run streaks in the minute before vs. after a time-out.

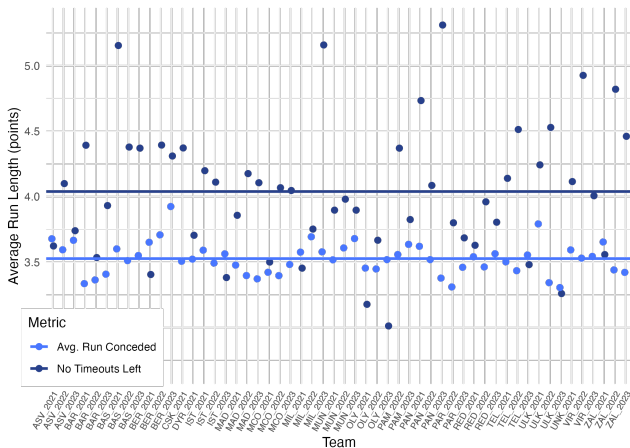
Score Differential Impact



Key Finding:

- Time-outs **reduce the deficit** but rarely turn it positive.
- They *mitigate* losses; do not usually flip the score.

Average run when no timeouts are left



Paired t -Test

- **Goal:** Compare two related (paired) groups to see if there is a significant difference in their means.⁶
- **Key Assumptions:**
 - Paired observations (dependent samples).
 - Differences $d_i = X_{i,1} - X_{i,2}$ are *approximately normally distributed*.
 - Measurement scale is interval or ratio.

- **Test Statistic:**

$$t = \frac{\bar{d}}{s_d / \sqrt{n}}, \quad \bar{d} = \text{mean of differences}, \quad s_d = \text{std. dev. of differences}$$

- **Hypothesis:**

- H_0 : No difference in means (i.e., $\bar{d} = 0$).
- H_1 : One-tailed (timeouts have a *positive* impact).

⁶See Student (1908). Modern treatment in Hogg et al. (2015).

Wilcoxon Signed-Rank Test

- **Non-parametric** alternative to the paired t -test, robust when normality is violated.⁷
- **Key Assumptions:**
 - Paired observations, continuous or ordinal data.
 - The distribution of differences $d_i = X_{i,1} - X_{i,2}$ is *symmetrical* around the median.
- **Procedure:**
 - Compute nonzero differences d_i and rank $|d_i|$ from smallest to largest.
 - Sum ranks of the *positive* differences, R_+ .
 - Test statistic $W = \sum R_+$ is compared against its theoretical distribution (approximated by the normal for large samples).
- **Hypothesis:**
 - H_0 : Median difference is zero.
 - H_1 : One-tailed (timeouts improve performance).

⁷Wilcoxon (1945). For textbooks, see Hollander (1999) and Gibbons (2010).

Paired Tests for ORA, ORA⁺, SDI, NO TO

Table: One-sided Paired Tests for ORA, ORA⁺, and SDI

(Paired t-test and Wilcoxon signed-rank test, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$)

	ORA	ORA ⁺	SDI	NO TO
Paired t-test	0.84/0.07***	-0.51/0.03***	-2.58/0.05***	-0.51/0.07***
Wilcoxon test	54***	0***	0***	54***

Comment:

- Both *parametric* (paired t-test) and *non-parametric* (Wilcoxon) tests confirm time-outs help **limit losses** (SDI becomes less negative).
- The effect on run-related measures (ORA, ORA⁺) is also statistically significant.

Regression: Four-Factor vs. Five-Factor

Table: Four-Factor and Five-Factor Models of Wins

	Dependent variable: W_{it}	
	Four-Factor Model	Five-Factor Model
Intercept	16.95*** (0.33)	16.97*** (0.32)
$D_t^{2021-2022}$	-0.94 (0.60)	-0.96 (0.60)
D_t^{RUS}	-2.83* (1.27)	-2.98* (1.26)
$F1_{it}$	105.02*** (9.06)	103.50*** (9.03)
$F2_{it}$	-101.49*** (14.54)	-100.51*** (14.40)
$F3_{it} - 1$	50.26*** (8.34)	52.28*** (8.37)
$F4_{it}$	15.32* (5.74)	17.07** (5.81)
$F5_{it}$ (TO factor)		-0.99 (0.69)
Observations	54	54
Residual Std. Error	1.94 (df=47)	1.96 (df=46)
R² (adj.)	0.84	0.84
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$		

Comment:

- **Four-Factor** model already explains 84% of variation in team wins.
- Adding **TO efficiency** ($F5$) does *not* improve model fit.
- Time-outs **not** a significant factor for long-term performance.

- **Time-outs mitigate losses:**
 - They reduce the chance of run extension by 10–20%.
 - Help limit the deficit around the point of the call.
- **But they rarely reverse games:**
 - SDI remains negative on average, even after a time-out.
 - No additional power in explaining final season wins.

Takeaway

Yes, time-outs matter in stopping runs. But no, they do not turn the game around nor explain season success.

Policy Implications for Coaches:

- Time them to *interrupt* short but dangerous runs of 2–4 points.
- Do not expect a single time-out to drastically flip the momentum or final outcome.
- Over a season, the **Four-Factors** still dominate time-out efficiency in explaining team records.