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Do professional athletes choke when they don't have time to stop and (over) think?

Agustín Indaco
Carnegie Mellon University in Qatar

Ira Teqja
Carnegie Mellon University in Qatar

Abstract

Previous research suggests that professional athletes choke when performing unopposed high-pressure tasks, such as taking penalty kicks. This article extends the literature by studying whether football (soccer) players choke when they have an opportunity to score in late-game open-play situations. These situations are markedly different because in such instances players do not have time to stop and (over) think. We suggest that these situations closely resemble high-pressure professions and mirror many of the stressful scenarios we regularly experience. We find that players consistently underperform relative to expectations in late-game situations when their team is down by one goal. However, players perform to expectations when the game is tied. This finding is consistent with players being loss averse.

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Contact: Agustín Indaco - aindaco@andrew.cmu.edu, Ira Teqja - iteqja@alumni.cmu.edu.

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1 Introduction

According to economic theory, when the potential benefits are higher, individuals are motivated to exert more effort, leading to improved performance and greater output. However, behavioral economics has challenged this hypothesis and shown that *emotions* triggered in high-pressure situations might impair performance. The act of performing below expectations in high-pressure scenarios is commonly referred to as *choking*.

Naturally, social psychology has studied this phenomenon extensively. In recent years, economics has also become increasingly interested in this topic. Choking not only contradicts standard economic assumptions, but also raises important questions about whether the stakes involved affect our decision-making abilities.

Professional sports settings have been widely used to study this question. In particular, static and unopposed actions (such as free throws in basketball, putts in golf, diving competitions, and penalty kicks in football) have been used to analyze whether players underperform in high-pressure situations relative to their average performance. In general, these studies find that professional players tend to perform worse than expected in clutch moments when the game is on the line (Apesteguia and Palacios-Huerta, 2010; Arrondel et al., 2019; Pope and Schweitzer, 2011; Ferraresi and Gucciardi, 2021; Cao et al., 2011; Genakos et al., 2015). More recently, neuroimaging has shown that choking occurs in this context because players *overthink*. In particular, fNIRS recordings show that task-irrelevant areas in the brain are activated when participants are placed in high-pressure situations (Slutter et al., 2021). This raises the question of whether individuals also choke in high-pressure situations where they do not have time to think about the outcome and consequences of their actions[1]. Once again, sports provide a useful context for studying this question.

In this paper, we study whether professional football (soccer) players falter under pressure when faced with scenarios when they don't have time to stop and overthink. In particular, we study athletes' performance in clutch situations when they have a chance to score in open-play opportunities (i.e. shots that are not the product of penalty kicks or free kicks). These open-play situations are markedly different from penalty kicks in that players presumably do not have time to consider the (positive and/or negative) consequences of their actions. In other words, open-play actions require players to make split-second decisions in terms of where to shoot, how to position their body, with what force to impact the ball, etc. In this context, players do not have time to pause and overanalyze the consequences of their actions.

[1]For reference, according to Professional Golf Association (PGA) rules, players have up to 40 seconds to analyze their putt once they reach the ball. Similarly, in professional football, as much as four to five minutes may pass between the referee awarding a penalty kick and the player taking the shot (Jordet, 2024).

We argue that these scenarios more closely mirror the high-pressure decision-making environments faced by professionals such as surgeons, air traffic controllers, and firefighters. For example, they resemble responding to a medical emergency in the operating room or making split-second decisions when a burning building's roof is on the verge of collapse. While protocols may guide actions in such situations, the chaotic and unpredictable nature of these events often requires professionals to make rapid, high-stakes judgments under extreme stress.

We further argue that these scenarios (i.e. open-play shots) better capture the pressures of everyday high-stakes situations, such as oral exams, public presentations, and sensitive conversations, where individuals must react to unforeseen challenges with little or no time to deliberate. To the best of our knowledge, this is the first paper to examine performance under pressure in such real-time, high-stakes contexts.

To conduct this study, we rely on a relatively new metric in football called *expected goals*, commonly referred to as xG. Using historical data from a library of previous shots with similar characteristics, these xG models estimate the probability that a shot is scored on a scale between 0 and 1. We use this metric to control for the quality of the goal-scoring opportunity created, which might be different in different late-game situations. The overall aim of this paper is to study whether players convert fewer than expected opportunities in high-pressure situations, once we control for the probability that the shot should result in a goal.

Overall, we find evidence that players do choke in late-game pressure situations. However, players only show evidence of choking when their team is behind by one goal. When the game is tied, players convert goal-scoring opportunities at their expected rate. This aligns with the idea that players are loss-averse, experiencing greater pressure in situations where their actions could prevent a *loss* rather than those where they have the opportunity to secure a *win*.

2 Data and context

We have data on all shots taken in matches for the five main male leagues in Europe (i.e. England, Italy, Spain, Germany and France) from the 2015-16 to the 2022-23 season. This data was provided to us directly through an agreement with Stats Perform[2], who collects this data. Table 1 shows the summary statistics for the data.

In order to assess whether players underperform in open-play high-pressure situations, we

[2]Stats Perform is a sports data and analytics company.

Table 1: Summary statistics

	All	Outcome-Altering Scenarios Goal Diff: 0	Goal Diff: -1
Shots	268,456	125,162	51,866
Avg. xG	0.113	0.108	0.108
	(0.154)	(0.149)	(0.150)
Goals (%)	9.040	9.495	10.155
Body part (%)			
Head	18.32	18.60	21.81
Left foot	31.89	31.86	30.11
Right Foot	49.31	49.03	47.50
After 90th min.			
Shots	14,954	4,127	3,967
Avg. xG	0.124	0.115	0.113
	(0.170)	(0.163)	(0.163)
Goals (%)	8.382	9.192	10.868
Body part (%)			
Head	19.77	22.36	27.30
Left foot	32.00	31.61	28.62
Right Foot	47.76	45.37	43.45

Notes: Table presents summary statistics. Column 1 has statistics on all shots in our dataset, columns 2 and 3 have information on the subset of shots taken when the game is tied and when the team taking the shot is down by one goal, respectively. The bottom half of the table includes statistics for shots taken in stoppage time (after the 90 minutes of regular time) for each of those scenarios.

must control for the quality of the chances they take[3]. Over the past decade, the expected goals (xG) metric has gained widespread popularity in football analytics. By accounting for various factors, – such as shot location, shooting angle, assist type, and the position and number of nearby defenders – xG estimates the probability that a given shot will result in a goal. Using an xG model trained on over 1 million shots, Stats Perform assigns an xG probability (from 0 to 1) to every shot taken in a match. We will use this xG measure to control for the quality of the goal-scoring opportunities created [4].

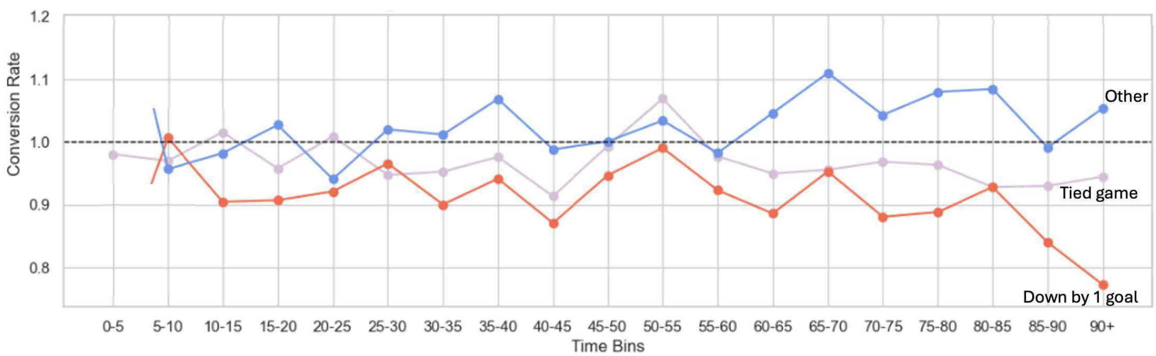
To examine whether players choke, we assess whether their performance declines in high-pressure situations compared to expectations. Equipped with the xG measure that allows

[3]It is natural to imagine that in late game situations, when a team is down by one goal, the trailing team might take low probability shots out of desperation. Thus, it is crucial to control for the quality of the goal-scoring opportunity.

[4]In Appendix A we corroborate the accuracy of this measure across different scoring probabilities.

us to have an indication of the likelihood with which a particular shot should have been converted, we can define under-performance as converting fewer goals than expected. For this, we construct a conversion rate measure which is given by: $CR = \frac{\sum Goals}{\sum xG}$. Figure 1 provides initial evidence that players do choke: When their team is trailing by one goal, their conversion rate drops significantly in the final minutes of the match. This does not occur for other results (which include situations in which their team is winning or losing by more than one goal). Interestingly, we do not find evidence of choking when the game is tied and a player has an opportunity to give his team the lead.

Figure 1: Conversion rate by time of match and goal difference



Notes: The figure plots the conversion rate ($CR = \frac{\sum Goals}{\sum xG}$) for shots taken in different times of the match. The orange line represents the conversion rate for shots taken when the team of the player taking the shot was down by one goal. The pink line represents scenarios in which the game was tied. The blue line includes all other scenarios. A conversion rate of 1 indicates that the number of goals scored is in line with the expected number of goals scored given by the xG measure. Conversely, a conversion rate below (above) 1 indicates that fewer (more) goals were scored than expected.

However, the decline in performance in late-game situations when trailing by one goal may be driven by factors unrelated to pressure. One possibility is that teams protecting a one-goal lead strengthen their defense against the opposing team's top players in the final minutes, forcing less skilled teammates to take the remaining shots, which lowers the overall conversion rate. In the next section, we will analyze this more rigorously, using player fixed effects and other controls to isolate the true impact of pressure on performance.

3 Empirical strategy

The main objective of this paper is to understand whether players underperform in open-play goal-scoring opportunities in high-pressure situations. We define high-pressure situation as late-game situations that occur in stoppage time (i.e. the time added to a match by the referees once the 90 minutes of regular time has been completed)[5]. Given that the potential gains and losses are different when your team is behind by one goal relative to when the game is tied[6], we include a dummy variable for different goal difference possibilities at the time the shot took place[7].

We formalize this comparison with the following model:

$$Goal_{ict} = \delta_c + \alpha_t + \theta_1 GoalDiff_i + \theta_2 Post90_t + \sum_k \beta_k (GoalDiff_i \times Post90_t) + \gamma_1 xG_{ict} + \gamma_2 Home_{ict} + \epsilon_c \tag{1}$$

where $Goal_{ict}$ is a dummy variable indicating whether shot i taken by a player c at time t resulted in a goal. δ_c are player fixed effects to control for the unobserved heterogeneity in the quality of players and α_t are year fixed effects to control for unobserved heterogeneity across years in terms of individual player characteristics (e.g. players gaining more experience, or teams and players' expectations changing) and also to capture years in which Covid-19 disrupted the presence of fans in stadiums. $GoalDiff_i$ indicates the goal difference at the time the shot was taken. $Post90_t$ is a binary variable that equals 1 if the shot was taken during stoppage time (after the 90th minute) and 0 otherwise. The interaction of $GoalDiff_i$ and $Post90_t$ is our key variable of interest. Specifically, we focus on cases where $GoalDiff_i = 0$ (the game is tied) and $Post90_t = 1$, or where $GoalDiff_i = -1$ (the team is trailing by one goal) and $Post90_t = 1$. These interactions capture situations that we define as high-pressure moments. We control for the expected probability of shot i being converted using xG. Additionally, we include a binary variable indicating whether the shooter, player c, was playing at home or away. ϵ_c is the error term clustered at the player level. Given that our dependent variable is binary, we estimate (1) using both a linear probability model and a Logit model.

One potential issue with this specification is that it treats situations where a team is leading by two or more goals as the baseline for comparison. Although we control for the quality of the goal-scoring opportunity, chances created in these lopsided scenarios may differ qualitatively from those generated in closely contested matches. To address this, we will now focus on a subset of shots taken in high-pressure situations – specifically, when the game was tied or the shooting team was trailing by one goal. Using this restricted sample, we estimate the probability of a shot resulting in a goal, with game minutes binned into

[5] As a robustness check, we re-estimated our main model using alternative end-of-game cutoffs at the 85th and 80th minutes. The results remained qualitatively unchanged, confirming that the observed decline in player performance late in the game is not driven by the specific cutoff choice.

[6] Since 1995, FIFA has formally adopted a point system in which teams obtain 3 points for a win, 1 point for a draw and 0 for a defeat.

[7] These are always from the perspective of the team taking the shot. We bin these goal differences as $\geq$ +2, +1, 0, -1, and $\leq$ -2

15-minute intervals. We estimate the following linear probability model:

$$Goal_{ict} = \delta_c + \alpha_t + \theta_1 GoalDiff_i + \theta_2 15min_t + \sum_t \beta_t (GoalDiff_i \times 15min_t) + \gamma_1 xG_{ict} + \gamma_2 Home_{ict} + \epsilon_c \quad (2)$$

In this case, we are interested in examining whether players underperform in the later stages of the game compared to the first 15 minutes, within each goal difference category ($GoalDiff_i = 0$ and $GoalDiff_i = -1$).

4 Results

The main findings are presented in Table 2. Column 1 reports the results from the Logit model, showing that players score roughly 22% fewer goals than expected when trailing by one goal in stoppage time. However, we find no significant effect in stoppage time when the game is tied. Columns 2-4 shows results for the OLS model. Column 2 replicates the same specification as column 1 for comparison purposes. Columns 3 and 4 add player and year fixed effects. Overall, we find that when a team is down by one goal and in stoppage time, the probability that a shot results in a goal decreases by roughly 2.1 percentage points. Given that the probability that any given shot results in a goal is 10%, this effect represents a 21% decrease in the probability of scoring. As for when the game is tied, the results show that players' performance is not significantly affected.

Taken together, these results seem to suggest that players are loss-averse. It may be natural for players to have a tie as a reference point. Consequently, they might feel more pressure when they have a goal-scoring opportunity while trailing, since their action can prevent a loss. On the other hand, when the game is tied, they could feel less pressure in similar situations, as failing to score might only prevent a win, rather than avert a loss.

The results in Table 2 stem from comparing players' performance in stoppage time when their team is down by one goal (or tied) to when their team is up by two goals or more. Although we control for the quality of the goal scoring opportunity (xG), it could be the case that the scoring opportunities created in those two scenarios are qualitatively different in a way not entirely captured by the xG measure. As a robustness check, we examine how players' ability to convert goal-scoring opportunities evolves throughout the game within a given goal difference. Specifically, we analyze a pooled sample of game-altering situations – when the game is tied or the shooting team is trailing by one goal – and compare conversion rates within each game state. This allows us to assess how effectively players capitalize on these scoring chances as the remaining time in the match becomes more pressing. We estimate this using (2).

Table 2: The impact of pressure on goal conversion rates

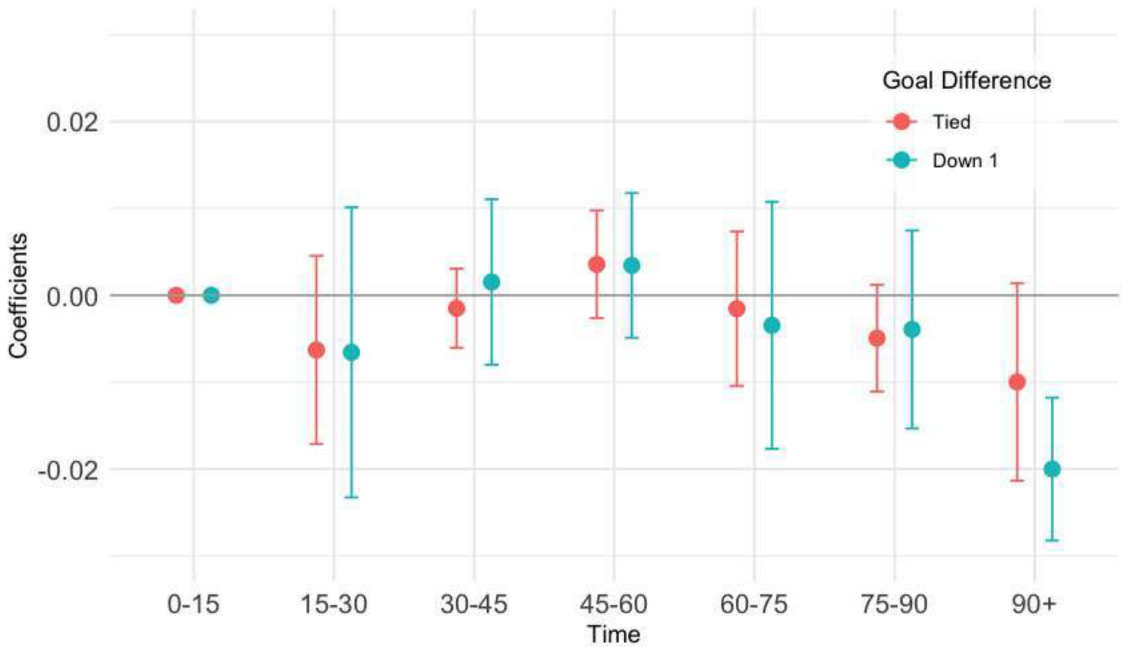
	Logit	OLS		
	(1)	(2)	(3)	(4)
(Intercept)	-2.869***	0.025***		
	(0.025)	(0.002)		
xG	6.290***	0.935***	0.934***	0.935***
	(0.041)	(0.006)	(0.006)	(0.006)
Home	-0.012	-0.001	-0.001	-0.001
	(0.014)	(0.001)	(0.001)	(0.001)
Post 90	0.036	0.005	0.008	0.008
	(0.077)	(0.008)	(0.008)	(0.008)
GDiff +1	-0.156***	-0.013***	-0.012***	-0.011***
	(0.028)	(0.003)	(0.003)	(0.003)
GDiff 0	-0.257***	-0.020***	-0.016***	-0.016***
	(0.025)	(0.002)	(0.002)	(0.002)
GDiff -1	-0.339***	-0.026***	-0.021***	-0.021***
	(0.029)	(0.003)	(0.003)	(0.003)
GDiff -2	-0.339***	-0.025***	-0.019***	-0.019***
	(0.035)	(0.003)	(0.003)	(0.003)
GDiff +1 × Post 90	0.080	0.007	0.009	0.009
	(0.105)	(0.011)	(0.011)	(0.011)
GDiff 0 × Post 90	-0.078	-0.008	-0.010	-0.010
	(0.100)	(0.009)	(0.009)	(0.009)
GDiff -1 × Post 90	-0.256**	-0.019**	-0.021**	-0.021**
	(0.106)	(0.009)	(0.009)	(0.009)
GDiff -2 × Post 90	-0.075	-0.006	-0.009	-0.009
	(0.115)	(0.009)	(0.010)	(0.010)
Num.Obs.	268,456	268,456	268,452	268,452
R2		0.176	0.192	0.192
R2 Within			0.166	0.166
FE: Player			X	X
FE: Year				X

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Notes: Results from estimating Logit (column 1) and linear probability models (columns 2-4) where the dependent variable is 1 if the shot resulted in a goal and 0 otherwise. Columns 3 and 4 show results for different combinations of fixed effects. Robust standard errors are clustered at the player level in columns 3 and 4. In all cases, the reference group is shots taken by a team up by 2 or more goals.

Results are shown in Figure 2 and in Appendix B. Once again, we find evidence that when their team is down by one goal, players significantly perform worse than expected in stoppage time (e.g. after the 90th minute of regular time). This is not the case when the game is tied. In this scenario, performance is pretty consistent throughout the match.

Figure 2: Trends in probability that shot results in a goal as match progresses



Notes: Coefficient estimates (and their 95% confidence intervals) of the linear probability model are reported. The dependent variable is a binary indicator of whether the shot resulted in a goal or not. The regression includes player and year fixed effects, as well as other controls that can be seen in (2).

5 Conclusion

Our analysis of choking in open-play scoring opportunities contributes to the existing literature by showing that players underperform in high-pressure situations, even when forced to make split-second decisions without time to overthink.

These findings may suggest that once players perceive a situation as high-pressure, they enter a sustained state of stress that impairs their decision-making abilities, even when having to make split-second decisions almost instinctively, as in open-play situations.

The high-pressure scenarios analyzed in this paper closely resemble critical decision-making moments in inherently stressful professions, such as emergency medicine and stock trading. For example, paramedics must make life-or-death decisions under extreme time constraints. While protocols exist to guide their actions, the unpredictability and chaotic nature of these situations often force them to rely on instinct and immediate judgment rather than deliberate analysis.

Similarly, we argue that open-play scoring opportunities in football better reflect these high-stakes professional decisions than structured set-piece situations, such as penalty kicks in football or free throws in basketball. In set-piece situations, the game is paused, giving players time to stop, think, and carefully plan their actions, whereas open-play scenarios demand rapid, instinctive decision-making under pressure.

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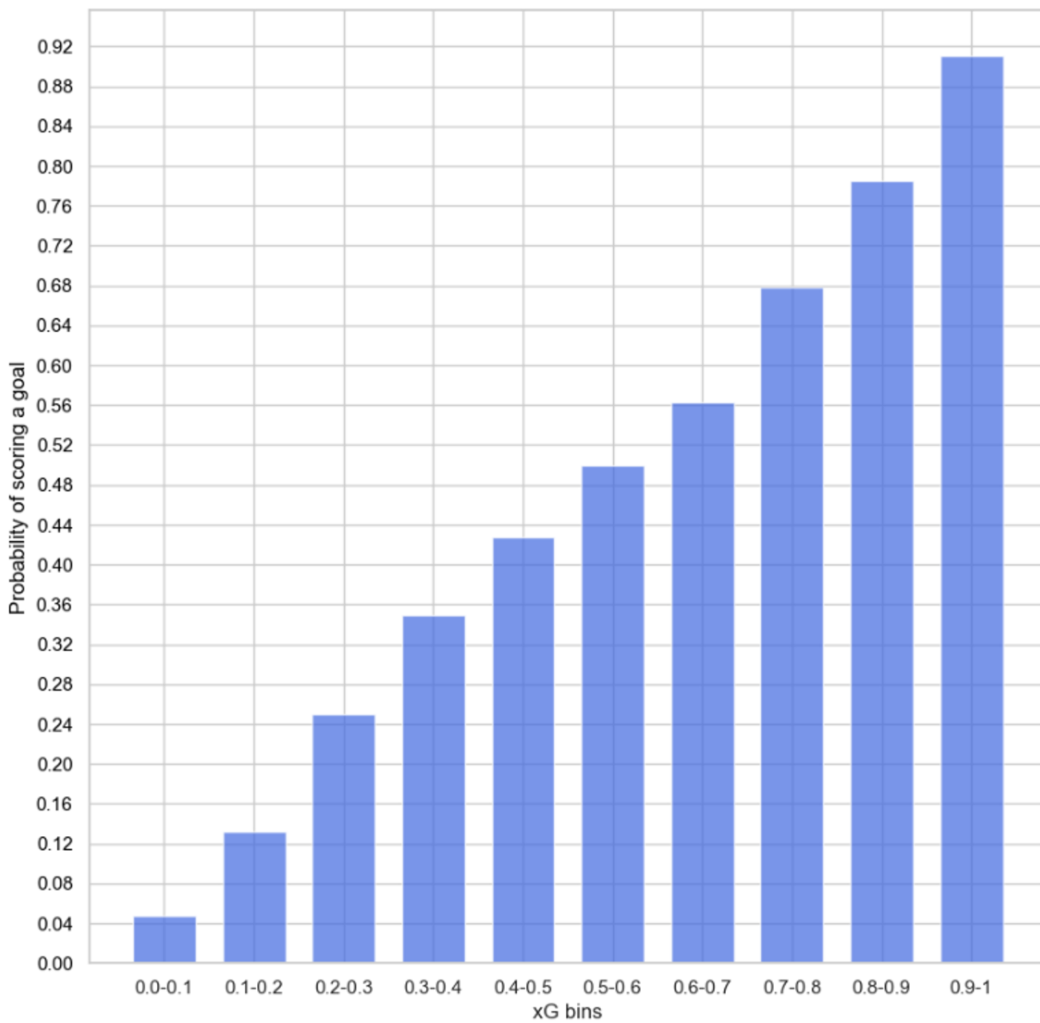
A Precision of xG measure

To corroborate the accuracy of the xG measure across different probabilities, we bin all shots by their xG into 10 groups and examine if the total number of goals scored on those opportunities is similar to the expected number of goals for those opportunities. Figure 3 shows that the actual number of goals scored is in fact similar to the sum of the xG in each bin. The higher the attributed xG on the shot, the higher the probability that the shot was in fact converted.

Figure 3: Converted goals relative to xG



Notes: The figure plots the sum of converted goals binned by the xG attributed to the shot. We group each shot into 10 bins based on their xG.

B Alternative specification

A full version of the results from (2) can be found in Table 3. The coefficients on the interaction terms between the different Goal Difference scenarios and the 15-minute time bins are represented in Figure 2.

Table 3: Regression Results

Dep. Var.:	Goal
xG	0.94031***
	(0.00657)
Home	-0.00258*
	(0.00126)
GDiff -1	-0.00425
	(0.00521)
Min 15-30	0.00741*
	(0.00360)
Min 30-45	-0.00167
	(0.00125)
Min 45-60	-0.03141**
	(0.01129)
Min 60-75	-0.00099
	(0.00197)
Min 75-90	0.00064
	(0.00100)
Min 90+	0.00691*
	(0.00328)
GDiff 0 × Min 15-30	-0.00630
	(0.00553)
GDiff 0 × Min 30-45	-0.00150
	(0.00225)
GDiff 0 × Min 45-60	0.00356
	(0.00328)
GDiff 0 × Min 60-75	-0.00154
	(0.00490)
GDiff 0 × Min 75-90	-0.00494
	(0.00383)
GDiff 0 × Min 90+	-0.00998
	(0.00588)
GDiff -1 × Min 15-30	-0.00657
	(0.00851)
GDiff -1 × Min 30-45	0.00120
	(0.00454)
GDiff -1 × Min 45-60	0.00343

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Dep. Var.:	Goal
	(0.00425)
GDiff -1 × Min 60-75	-0.00310
	(0.00702)
GDiff -1 × Min 75-90	-0.00366
	(0.00570)
GDiff -1 × Min 90+	-0.02001***
	(0.00446)
Num.Obs.	177,028
R2	0.216
R2 Within	0.214
FE: Player	X
FE: Year	X

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$

Notes: Results from estimating a linear probability model where the dependent variable is 1 if the shot resulted in a goal and 0 otherwise. Robust standard errors are clustered at the player level. The reference group is shots taken in the first 15 minutes within each goal difference.