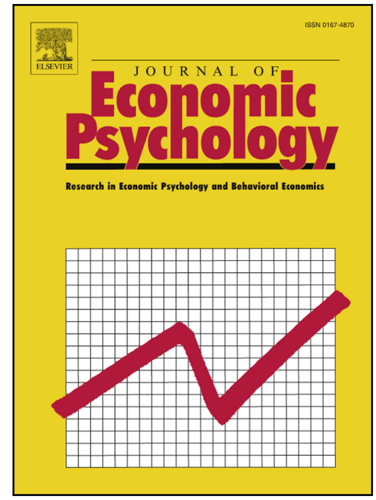
Accepted Manuscript



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PII: S0167-4870(17)30712-2
DOI: https://doi.org/10.1016/j.joep.2018.11.005
Reference: JOEP 2126

To appear in: *Journal of Economic Psychology*

Received Date: 22 November 2017
Revised Date: 18 October 2018
Accepted Date: 29 November 2018

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Abstract

Despite the prevalence of the momentum concept, the literature is still divided on whether psychological momentum actually exists. We aimed to detect psychological momentum in the specific setting of overtime in basketball games. We collected data from 11 NBA seasons and identified all games that were tied after the end of regulation time. Comeback during basketball games is perceived to be a catalyst for momentum. In contradiction to such common beliefs, we found that teams that came from behind to tie the game did not have higher chances to win in overtime. Interestingly, however, home advantage and the number of season wins of the teams did affect the chances to win in the 5-minute overtime.

Keywords: success breeds success; momentum; sports; basketball; performance

PsycINFO classification codes: 2330, 2900, 3000, 3400, 3720
JEL classification codes: D91, Z20

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1. Introduction

The concept of momentum, meaning that a positive trend in performance is likely to lead to additional improvement (and vice versa for a negative trend), is a central idea in management and behavioral sciences (Iso-Ahola & Dotson, 2014). Momentum is one of the most frequently discussed phenomena in the context of performance dynamics among both laypeople and experts, such as sport professionals, business or political analysts, etc. This is especially apparent, for example, when listening to sports pundits, or reading newspapers or commentaries about performance of companies and managers or the chances of political candidates towards elections.

The contest literature outlines two distinct types of momentum: strategic momentum and psychological momentum (Cohen-Zada, Krumer, & Shtudiner, 2017). A prevalent point of interest in the strategic momentum literature, for instance, is the accelerating effect of innovation experience. This effect implies that accumulating experience from prior innovations helps organizations reduce the marginal cost of executing activities associated with innovation. In this way a greater number of prior innovations positively affect firms' subsequent innovativeness (Turner, Mitchell, & Bettis, 2013).

Mago, Sheremeta and Yates (2013) conducted experiments to distinguish between the patterns of effort produced by the two types of momentum (strategic and psychological); they defined strategic momentum as a shift in the exerted effort that is generated due to strategic incentives inherent in the contest. Mago et al. posited that in a best-of-three contest, where the first player to win two rounds is the contest winner, the winner of the first round has a higher effective value associated with winning the second round, and hence will try harder than his opponent. On the other hand, psychological momentum was viewed by these researchers as phenomenon based on the maxim "success breeds success." That is, a prior win affects players' confidence (psychological state), and thus improves their subsequent performance.

Coates and Herbert (2008) discuss the elevated level of performance among traders. They accentuated psychological and physiological responses (levels of testosterone and cortisol) to initial success and their subsequent impact on human behavior, phenomenon also known in the biological literature as the "winner effect." Coates and Herbert suggest similarity between the behavior of traders and athletes after experiencing initial success (i.e., psychological momentum). Cohen-Zada, Krumer and Shtudiner (2017) supported this claim by finding that psychological momentum advantage significantly and substantially affects performance among male judo fighters, proposing increased levels of testosterone as the underlying mechanism.

Scholars in economics and management alike have recently begun to comprehend the untapped potential of professional sport as a platform for studying human behavior, as well as its various advantages. First, the rules of the game are often better defined than those in domains such as business and politics and so is the definition of success and failure. Second, a great deal of data is regularly documented and is available for analysis. Third, athletes often have huge incentives to make correct decisions, and they are also experts in making these decisions – as opposed to participants in many lab experiments.

These advantages, and the observation that many behaviors that can be studied in sports have important implications for economics and business, have led to a stream of research. Some of this research has appeared in leading journals in economics and management, such as studies on mixed-strategy play in tennis serves (Walker & Wooders, 2001) and in soccer penalty kicks (Chiappori, Levitt, & Groseclose, 2002; Azar & Bar-Eli, 2011; Palacios-Huerta, 2003). Additional examples in sports include an examination of the "first-mover advantage" by studying the order of kicks in penalty kick shootouts (Apesteguia & Palacios-Huerta, 2010; Kocher, Lenz, & Sutter, 2012), psychological pressure in penalty kicks (Dohmen, 2008), corruption in Sumo wrestling (Duggan & Levitt, 2002), and deception in professional basketball (Morgulev, Azar, Lidor, Sabag, & Bar-Eli, 2014). More specifically, data of NBA games are also serving as a platform for studying economic questions. For instance, Grund, Höcker and Zimmermann (2013) examined how point differences between teams affect their subsequent risk-taking behavior, by measuring the fraction of three-point shots under different score configurations in NBA games. All of these studies – and many others – have in common the attempt to generalize findings from sports toward behavior of agents in other domains.

For a similar reason, the psychological issue of momentum was also analyzed using performance in sport. Psychological momentum in sport was viewed by Adler and Adler (1978) as an elevated state of power or intensity of movement. The whole rhythm of existence is shifted; one’s pace either accelerates to rates usually unattainable or becomes synchronized into a fluid grace. Excitement can be either built-up bit by bit, or dramatically ignited, inducing a positive impulse in the direction of a goal. This "adrenaline rush" is associated with feelings of confidence and determination. Thus, the individual or the team feels possessed by a capacity for achievement beyond their regular equilibrium state.

Den Hartigh, Gernigon, Van Yperen, Marin and Van Geert (2014) experimentally varied positive and negative psychological momentum in relation to the team goal of winning a rowing race. Rowing pairs had to compete against a virtual opponent on rowing ergometers, while a screen in front of the team manipulated the race so that the team's rowing avatar gradually progressed (positive momentum) or regressed (negative momentum) relative to the opponent. Positive and negative shifts in collective efficacy and task cohesion were detected under progression and regression setting adequately. The authors suggest that the upward and downward dynamics of collective efficacy and task cohesion indicate that these variables characterize the psychological experience of positive and negative momentum.

Thus, increased levels of testosterone (Cohen-Zada, Krumer, & Shtudiner, 2017), task cohesion (Eisler & Spink, 1998), and confidence and efficacy (Iso-Ahola & Dotson, 2014), are all proposed in the literature as physiological and psychological mechanisms underlying psychological momentum.

Coming from behind (closing a significant score gap against the opponent team) is a particular case of enhanced level of performance, which allegedly possesses the potential to evolve into ongoing psychological momentum. Perceptions of such an effect were elicited via questionnaires by Vallerand, Colavecchio, and Pelletier (1988), who used hypothetical scenarios, a written scoring configuration that reflected particular dynamics of games won in a set of tennis (e.g., Robert was depicted as taking a five games to one lead before Luc won four consecutive games to level the match at five games all). Players were then required to respond to questions such as "who has the momentum?" or "who seems to be the most motivated?" Later, Perreault, Vallerand, Montgomery, and Provencher (1998) set up a bogus bicycle race to examine the momentum-performance relationship. These researchers manipulated the experiment to create a situation where the participant was coming from behind to tie an opponent. The results showed that coming from behind elicited changes in perceived momentum, which in turn was associated with a boost in performance.

In this context, Gauriot and Page (2018) stated that as opposed to strategic momentum, ideas about psychological momentum often suggest a path dependent phenomenon whereby the timeline of past performance matters for future performance. Scoring before the end of period is perceived to be one of such path dependent momentum facilitators. If that holds true, then for similar scorelines at half-time, the timing of the last score will matter for how the game unfolds in the following period (Gauriot & Page, 2018). Ball games in general, and basketball in particular, provide us with highly illustrious examples of scoring in last seconds and coming back from behind, where commentators and reporters often reflect on the intense psychological momentum allegedly experienced by the "comeback team" (the team that closed the score gap).

Berger and Pope (2011) assessed the correlation between the halftime and final game results in basketball. As expected, the further teams are ahead at halftime, the more likely they are to win the game. However, around zero they observe a discontinuity in this positive correlation between score gap and win ratio, and teams behind by one point at halftime are actually more likely to win than teams ahead by one point. They explain this as a result of increased motivation and effort. In this regard Lehman and Hahn (2013), who exploited games in the NFL to study momentum and organizational risk taking, suggested that a team that trailed behind in the first half – for instance by 5 to 10 points – but succeeded in reducing the gap to a minimum of one point by the end of it will probably experience the situation differently from a team that led all the way but ended up being behind by one point. According to Lehman and Hahn (2013), two teams that are both trailing behind by one point may share quite different psychological states, depending on the game dynamics. However, Merrit and Clausett (2014) proposed an alternative explanation for the trailing behind at halftime effect (Berger and Pope, 2011): when a team is leading, the coaches often substitute out their stronger players to let them rest and avoid injury, and to allow less prominent players to gain minutes on the court.

The bottom line is that the literature has not reached a consensus yet about the question "momentum – real or illusionary?" (e.g., Avugos, Bar-Eli, Ritov, & Sher, 2013; Fry & Shukairy, 2012; Gilovich, Vallone, & Tversky 1985; Koehler & Conley, 2003; Merritt & Clauset, 2014; Stanimirovic & Hanrahan, 2004; for review, see Avugos, Köppen, Czienskowski, Raab, & Bar-Eli, 2013). We decided to contribute to this debate by looking for psychological momentum in basketball games that go to overtime due to a tie at the end of regulation time. Because no draw result is allowed in basketball, teams that end up the regulation time with a tie go to a 2-minute break and continue the game in a 5-minute overtime. If the score is still tied after the overtime, the procedure is repeated, and so on. The team that scores last in regulation time, ties the game and escapes a loss, whereas the other team fails to secure its lead and is stripped of a win. Thus, the psychological state of the teams (e.g., cohesion, confidence, and efficacy) may differ and affect their performance in overtime. In particular, the team that scored last and escaped a loss presumably experiences a positive psychological momentum, whereas the other team experiences a negative one.

We collected data from 11 NBA seasons (2003/4 - 2013/4), identified all the games that went to overtime and examined whether the team that tied the game indeed won more often in overtime. We found similar winning chances for both teams regardless of who tied the score, suggesting that coming from behind at the end of regulation time does not provide a meaningful psychological momentum. This conclusion is supported by some additional analysis as well.

2. Method

Approximately 1300 games are played each season in the NBA (including playoffs), and 5% to 6% of those games end up in overtime. Scanning through 11 NBA seasons (about 14,000 games), we built a comprehensive dataset that consists of 881 games that were tied by the end of fourth quarter; 742 of those games ended after a single overtime. For this sample the following variables were coded: (1) Home team; (2) Away team; (3) Regular season or Playoffs; (4) Which team tied the game; (5) How the game was tied: free-throw, two-pointer, three-pointer, etc.; (6) Seconds remaining to the end of regulation time when the game was tied; (7) Which team won the game; (8) Total number of wins in a given season for both teams; and (9) The biggest difference in points by which the tying team trailed behind during the second half of fourth quarter (i.e., last 6 minutes of regulation), a variable that reflects the magnitude of the recovery (coming back from behind) executed by the tying team.

The dependent variable in the current study is the performance level of the teams in the first overtime; which is derived from the identity of the team that won in the first overtime. Consequently, if over our large sample the tying team is found to win more than the opponent team (with the difference being statistically significant), this will suggest that success experienced in the last minutes of regulation time had a positive effect on performance in overtime. It is worth mentioning that first ball possession in overtime is independent of any prior event, since the overtime starts with a jump ball.

For each game, the team with more annual wins was defined as the favorite team, and the opposite team was defined as the underdog team. We used a Logit model to estimate the probability of the favorite team to win. We distinguished between different score dynamics (i.e., whether one team closed only a small score gap or a significant one), and analyzed performance in overtime as a function of score dynamics in the fourth quarter. Moreover, collecting many additional variables as mentioned above allowed us to control for many other factors (e.g., whether the home team is the tying team or its rival).

3. Results

Our sample consisted of 881 games that went into overtime; in 412 cases the game was tied by the home team (46.8%), in the other 469 cases (53.2%) the away team was the one to score last. A binomial test performed showed that this difference was near significant, p = .059. This makes sense when taking into account that, in general, the home teams had around a 60% win ratio and as a result home teams tended to lead rather than trail behind, and therefore had fewer chances to tie the game.

Home teams found to be more likely to win in overtime: 404 games (45.9%) were won in the first overtime by the home team compared to 338 games (38.4%) that were won by the guest team. A binomial test performed (after excluding from the sample 139 games that went to additional overtime) showed that this difference in the favor of the home teams is statistically significant, p = .017. This is an interesting finding. In general, home advantage is common and is not surprising. But here we only consider games that were tied, i.e., that with the home advantage taking effect, resulted in very similar performance of the two teams during the regulation time. If after taking into account the home advantage the teams perform similarly, it is not clear why the home advantage should suddenly become stronger in overtime and lead to more wins of the home team. However, the data show an advantage for the home team even conditional on a tied game.

In Table 1 we present the winning distribution in the first overtime grouped by favorite and underdog teams.

Table 1

Teams that Won in Overtime

		Frequency	Percent
Favorite team tied	Favorite team won	213	52.1
	Underdog team won	132	32.3
	Another overtime	64	15.6
	Total	409	100.0
Underdog team tied	Underdog team won	159	33.7
	Favorite team won	238	50.4
	Another overtime	75	15.9
	Total	472	100.0

Table 1 demonstrates that favorite teams are more likely to win in overtime: 451 (213+238) games (51.2%) were won in the first overtime by the favorite team compared to 291 (132+159) games (33.0%) that were won by the underdog team. A binomial test performed (after excluding from the sample 139 games that went to additional overtime) showed that this difference in the favor of the favorite teams is statistically significant, $p < .001$. Similar to the case with home advantage, we can see that favorite teams possess significant advantage in the 5-minute overtime even after the 48-minute regulation time ended up tied (which imply that the game was balanced).

The data presented in Table 1, however, show no evidence for momentum, i.e., the team that tied the game is not more likely to win in overtime. In 372 (213+159) games (42.2%) the team that tied the game also won it in the overtime. In 370 (132+238) games (42.0%) the opponent team won the game. Of the 742 games that ended after the first overtime, we thus have 50.1% (372/742) winning chances for the team that tied versus 49.9% (370/742) for the opponent team.[1]

[1] To understand the statistical power of the result that we do not observe momentum when analyzing who won the first overtime, suppose we define momentum as having at least 60% chances to win in the first overtime (conditional on the first overtime not ending tied again) for a team that tied the game. With a success probability of 0.6, the chances according to the binomial distribution to get 372 (as in the empirical data) or fewer successes out of 742 trials are essentially zero (3.42646E-08), meaning that we have $\beta=0$ and the power is $1-\beta = 1$. With a more conservative definition of momentum as having at least 55% chances to win in overtime, the chances to get 372 or fewer successes out of 742 trials (with p=0.55) are $\beta = 0.0044$, with power of $1-\beta = 0.9956$.

In the face of the complete absence of the "tying the game" effect as presented so far, we conjectured that besides the last basket scored, the whole game dynamics during the last phase of regulation time is an important factor. That is, if we want to trace momentum, we should better look at games where the team that tied the game did so after erasing a sufficient score deficit. With this in mind, we solicited games where the comeback team trailed by 8 points or more.

Table 2

Teams that Won in Overtime after Significant Comeback

		Frequency	Percent
Favorite Team Tied	Favorite team won	32	42.1
	Underdog team won	33	43.4
	Another overtime	11	14.5
	Total	76	100.0
Underdog Team Tied	Underdog team won	34	36.6
	Favorite team won	49	52.7
	Another overtime	10	10.7
	Total	93	100.0

The data presented in Table 2 demonstrate no trend of the comeback teams to win more in overtime. The team that tied the game after a sufficient comeback won in 66 (32 + 34) cases, whereas the opponent team won in 82 (33+49) cases. A binomial test performed showed this difference to be non-significant, $p = .109$.

We proceed to conduct a binary logistic regression analysis (Logit) in order to assess the explanatory power of various variables on the favorite team's chances to win in overtime. In Table 3 we present a description of the variables that appear in the models below.

Table 3

Variables used in the regression models below

Name	Explanation	Mean/Freq	SD
Favorite tied	Favorite team tied=1; Opponent team tied=0	0=397 1=345	
Number of wins in a given season favorite team	Total number of games won by the favorite team in the regular season	46.89	9.81
Number of wins in a given season opponent team	Total number of games won by the opponent team in the regular season	34.51	10.46
Annual wins difference	The difference in annual number of wins between the favorite team (team with more annual wins) and the opponent team	12.37	9.17
Favorite tied × Gap closed	Interaction variable: Favorite tied × Score deficit erased by tying team during last 6 minutes of regulation	4.98	3.14
Favorite tied × Seconds remained	Interaction variable: Favorite tied × Seconds remained to the end of regulation time when the game was tied	19.31	23.27
Favorite tied × Playoff	Interaction variable: Favorite tied × Regular season game (equals 0) or Playoff game (equals 1)	0=323 1=22	
Favorite tied × Three points	Interaction variable: Favorite tied × Game was tied by three-point play (equals 1) or Otherwise (equals 0)	0=213 1=132	

In Table 4 we present binary logistic regression (Logit) that assesses the explanatory power of four variables on the favorite team's chances to win in overtime.

Table 4

Logit Model: Favorite Team's Chances to Win in Overtime

	B	S.E.	p-value	Exp(B)
Favorite Tied	.319	.238	.181	1.375
Favorite Home	.603	.159	.000	1.828
Annual Wins Difference	.041	.009	.000	1.042
Favorite Tied × Gap closed	.028	.036	.437	1.028
Constant	-.386	.173	.026	.680

Table 4 shows that tying the game has no statistically significant effect on the favorite team's chance to win in overtime, controlling for several relevant variables. This reinforces the finding that despite the common belief that coming from behind provides positive momentum, we see no evidence for it in our data. Further support of this conclusion can be seen when considering the interaction of Favorite tied × Gap closed. The gap closed is a measure of how large was the comeback of the tying team, and its interaction with Tied is therefore a measure of the momentum of the tying team, assuming that closing a larger gap creates a stronger psychological feeling of momentum. The result that this interaction is also far from being statistically significant therefore also suggests that we see no evidence for an impact of momentum on the game's result.

Table 4 also suggests that the general strength of the teams, represented by the difference in the number of wins during the regular season, is a statistically significant factor ($p < .001$) in explaining a team's chances to win in overtime. This is not as trivial as it may seem since we are considering here not all season games or a random sample of them, but rather only games whose regulation time ended with a tie. This could suggest that on the game's date, the two teams were roughly equal in their abilities; if one had been much stronger, it should have won at the end of regulation time. Nevertheless, it turns out that the general strength of the teams as reflected by the difference in their aggregate number of wins during the season is statistically significant, and even in a tied game, the bigger the difference, the higher are the chances of the favorite team to win in overtime.

We conducted additional binomial regressions with various variables and interactions that were added to and removed from the model. However, we did not identify additional variables that are statistically significant beyond the ones discussed above. In Table 5 we present one of those models.

Table 5

Logit Model: Favorite Team's Chances to Win in Overtime

	B	S.E.	p-value	Exp(B)
Favorite Tied	.168	.282	.551	1.183
Favorite Home	.600	.159	.000	1.822
Annual Wins Difference	.041	.009	.000	1.042
Favorite Tied × Gap closed	.050	.050	.317	1.051
Favorite Tied × Seconds Remained	.004	.005	.390	1.004
Favorite Tied × Playoff	.045	.464	.923	1.046
Favorite Tied × Three points	.288	.238	.227	1.334
Gap closed by Favorite team	-.021	.035	.550	.980
Constant	-.422	.183	.021	.656

In Table 5 we can see that tying the game closer to the end of regulation did not facilitate momentum as may be expected, similar is the case for tying the game with three-point play. Additionally, we did not evidence any difference between tying the game during regular season and tying the game during the playoffs. The "Gap closed" variable aimed to capture momentum in cases where the favorite team did not tied the game but still erased a sufficient score deficit during the last 6 minutes of regulation, i.e., performed comeback but was not the last to score. This variable also showed to be non-significant.

4. Discussion

The general question behind the current investigation is whether recent success creates a psychological momentum that positively affects subsequent individual and collective performance. To address this question we analyzed the effect of comeback by the end of the fourth quarter in NBA games on performance in overtime, which has never been analyzed before. The previous literature showed that comebacks are commonly perceived as momentum facilitators. Yet, Gauriot and Page (2018) did not found any evidence of the effect of tying just before half-time in association football (soccer).

To address this discordance in the literature, we collected a comprehensive dataset of all the games that went to overtime in the 11 NBA seasons 2003/4-2013/4. Surprisingly, and in contradiction to common beliefs, the data showed no momentum effects between the end of the fourth quarter and overtime. We found that the probability of winning in overtime was equal between the comeback teams (that tied the game and escaped a loss) by the end of regulation time (372 games, 42.2%) and teams that were stripped from a win during the final stages of regulation time (370 games, 42.0%) (the remaining games were again tied and went to a second overtime).

In order to distinguish between small comebacks and more significant ones, we analyzed the case of comeback of 8 points or more separately. However, even in this situation, which presumably should prompt intense momentum, we see no evidence for momentum, as the chance of the comeback team to win in overtime is in fact a little lower than that of its opponent (though this difference is not statistically significant). Regressions explaining the chances of winning show that not only the comeback team identity is insignificant, but also its interaction with the score gap that was closed. This suggests once again that the data do not show evidence for momentum, regardless of the size of the score gap that was closed.

The game being tied after regulation time suggests that the teams' ability on that date is similar, and this ability is already affected by home advantage, the general teams' strength, and other factors that affect performance. Therefore, there is no obvious reason to expect that these factors that affect performance in general will affect the result in overtime, conditional on the game being tied after regulation time. Surprisingly, however, we found several such factors that do have a significant effect on winning in overtime. Home advantage improved the chances to win and was statistically significant regardless of who tied the game. The balance of power between the teams (measured by the difference in number of annual wins accumulated by the favorite team and the opponent) also proved to be a statistically significant factor. Bigger difference in number of wins increases the chances of the favorite team to win.

The current results are in line with Gauriot and Page (2018) who did not find any evidence of scoring "before half-time" effect, and concluded that the layman perception of a path dependent momentum in soccer appears to be an illusion. Such findings raise some interesting questions that may provide ideas for future research. One question is why in a situation where experienced success should lead to psychological and physiological gains we still do not observe momentum. This while taking into account, that Cohen-Zada, Krumer and Shtudiner (2017) recently affirmed that male athletes who experienced success, increased their performance. Is this discordance a result of the setting of fierce competition between high-caliber teams rather than individuals? Could it be that the momentum of the comeback team is offset by higher aggressiveness, focus and motivation of the team that led the game but was 'robbed' from winning by the end of regulation time? More generally, are there differences in momentum between competitive situations (where the gain of one player comes at the expense of another) and individualistic situations (e.g., someone taking exams and every good grade leads him to excel also in the next exam)?

Potential explanation for the absence of momentum in our study is the excessive amount of mental and physical effort required to perform a significant comeback. Possibly the comeback team is so exhausted that this acts to reduce the possible momentum. In addition, the existence of a break before overtime, even if very short (two minutes), can result in a tension relief and false feeling that the target was achieved (not to lose) and thus act to reduce potential momentum of the comeback team.

An additional interesting question is why comeback commonly interpreted as psychological momentum, whereas in the data we do not see any evidence for it. A possible reason may be that it seems intuitive to expect momentum for the comeback team and therefore people believe that it exists. Furthermore, when one watches a game and its regulation time ends with a tie, if his intuition is that the comeback team will win and he turns out to be correct, maybe being correct in his belief causes him to remember this case more than the other cases when his intuition proved wrong (the comeback team losing in overtime). Such a process can over time reinforce the belief in a momentum of the comeback team.

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Does a "Comeback" Create Momentum in Overtime?

Analysis of NBA Tied Games

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Highlights

When a basketball team ties a game in its allotted time, the game goes to overtime.

Momentum implies that a comeback team should have higher chances to win in overtime.

Data from 11 NBA seasons showed no evidence for such momentum.