Overconfidence and Team-Performance:
An Analysis of NBA-Players' Self-Perception

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Abstract

We analyse the effect of overconfidence in a model of team-production with effort complementarities. We show that overconfidence may not only enhance an overconfident agent's effort but also that of a rational one. Focusing the agents' payoffs we see that this increase in effort can be to the agents' benefit, regardless whether they are rational or overconfident. We take this notion to NBA-data which we have gained from the season 2009/10 and see that players who have been identified as overconfident have a significantly positive effect on their team's success.

JEL-Codes: D21, D62, L23.

Overconfidence und Team-Performance:
Eine Analyse der Selbsteinschätzung von NBA-Spielern

Zusammenfassung

Wir betrachten den Effekt von Overconfidence mit Hilfe eines intuitiven Modells einer Team-Produktion mit komplementären Arbeitseinsätzen. Es zeigt sich, dass Overconfidence nicht nur den Arbeitseinsatz des betroffenen Agenten erhöht, sondern gleichzeitig den eines rationalen Teammitglieds. Hieraus resultiert ein Nutzenvorteil für die Agenten, unabhängig davon, ob sie selbst rational oder overconfident sind. Daten der NBA-Saison von 2009/10 zeigen, dass Spieler, welche als overconfident identifiziert wurden, einen signifikant positiven Effekt auf den Erfolg ihres Teams haben.

1 Introduction

In this paper we analyse the effect of NBA-players' overconfidence on their teams' overall performance. First take a general model of team-production with effort-synergies from [1] into account and show how an agent's overconfidence may enhance his team's output as well as the individual payoffs of the rational and – more interestingly – the overconfident agents. This result may seem counterintuitive as a self-perception deviating from rationality should be eliminated by learning-mechanisms or market-forces.

In a second step we take this notion to NBA-data (which we have gained from the season 2009/10). In this context we derive a player's self-perception from his performance in crunch time (4th quarter or overtime, less than 5 minutes of playing time left, neither team ahead by more than 5 points). Using Plus-Minus-Stats as a measure of team-performance we are able to show that players who are identified as overconfident (their field-goal percentage drops by more than 10 percentage points during crunchtime) have a significantly positive impact on their team's success, even though their overconfidence should have a detrimental effect at first sight.

Research on the effects of overconfidence in sports is quite scarce. [2] analyse draft choices in the National Football League and show that the ability to pick the "right" player is systematically overestimated. Additionally, they find evidence for the winner's curse as the right to pick first is more a curse than a blessing. [3] conducted a shooting-experiment with basketball players which reveals that most players were overconfident and that those who were experienced less joy from their outcome. We might compare the expected effect of overconfident players on their teammates to the effect of trust in formal (coach or team captain) or informal (other teammates) leaders on performance. Several psychological studies analyse the effect of trust in small groups and different environments. [4] for example shows that a teams performance is positively affected by the trust in coaches as leaders.[1]

Our contribution is of various kinds: First, we are able to give a theoretical rationale for the persistent phenomenon of overconfidence (see e.g. [5]; [6]; or [7]; and more recently [8]; [9]; or [10]). Second, we show that even in situations where learning is very likely to occur (immediate feedback on one's own performance, which is repeated many times) overconfidence might be a persistent phenomenon as is leads to positive outcome. Finally, we want to emphasise the importance of a) the knowledge of a players self-perception and show how it could be measured and b) it's effect on a team's performance in a competitive situation.

2 Model

The framework we take into account is a basic model of team-production from [1] where a principal hires two agents for production. The production-technology requires the use of teams in order to benefit from effort-complementarities between the agents. We assume that all participation-constraints are binding[2] and that the principal as well as both agents are risk-neutral. In order to examine the effect of overconfidence on the agents' choices of effort and the resulting payoffs we take payments given and therefore need not to consider the principals problem of inducing effort.

Both agents utility is additively separable into income and effort-cost. Finally we assume agent 1 to be rational and agent 2 to suffer from an overconfidence bias, which leads to the following utility functions:

$$U_1(e_1, e_2) = R(e_1, e_2) - C(e_1), \tag{1}$$

with $R(e_1, e_2)$ as the return-function of effort and $C(e_1)$ as the cost of effort. Accordingly the first order condition is given by:

$$R_{e_1}(e_1, e_2) = C'(e_1) \tag{2}$$

and the second order condition is satisfied if:

$$R_{e_1 e_1} - C''(e_1) < 0. \tag{3}$$

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[1] [4] gives an excellent review of recent studies on this matter.
[2] Both agents might be wealth-constrained.

Taking agent 2's biased self-perception into account, his utility is given by:

$$U_2(e_1, e_2) = R(e_1, e_2, b) - C(e_2). \tag{4}$$

The first order condition is given by:

$$R_{e_2}(e_1, e_2) = C'(e_2) \tag{5}$$

and the second order condition is satisfied if:

$$R_{e_2 e_2} - C''(e_2) < 0. \tag{6}$$

Overconfidence increases effort of agent 2, taken the effort of agent 1 given, if the marginal return to effort of agent 2 is increasing in overconfidence:

$$\frac{de_2}{db} = -\frac{R_{e_2 b}}{R_{e_2 e_2 - C''(e_2)}} > 0. \tag{7}$$

The Nash-equilibrium efforts are $e_1(b)$ and $e_2(b)$. Hence the reduced-form payoff of agent 1 is:

$$U_1(e_1(b), e_2(b)) = R(e_1(b), e_2(b)) - C(e_1(b)). \tag{8}$$

The effect of overconfidence on the payoff of agent 1 is given by:

$$\frac{dU_1}{db} = \frac{\partial U_1}{\partial e_1}\frac{de_1}{db} + \frac{\partial U_1}{\partial e_2}\frac{de_2}{db} = 0 + R_{e_2}(e_1, e_2)\frac{de_2}{db}. \tag{9}$$

The first term is the mistaken beliefs effect which is, naturally (and by the envelope theorem), zero for the rational agent. Therefore the effect of overconfidence on the payoff of agent 1 drives solely from the sign of the strategic effect through synergy which is positive. Hence the payoff of agent 1 increases in the overconfidence of agent 2.

The reduced form payoff of agent 2 is given by:

$$U_2(e_1(b), e_2(b)) = R(e_1(b), e_2(b)) - C(e_2(b)). \tag{10}$$

The effect of overconfidence on the payoff of agent 2 is given by:

$$\begin{aligned}
\frac{dU_2}{db} &= \frac{\partial U_2}{\partial e_1}\frac{de_1}{db} + \frac{\partial U_2}{\partial e_2}\frac{de_2}{db} \\
&= R_{e_1}(e_1(b), e_2(b))\frac{de_1}{db} + [R_{e_2}(e_1(b), e_2(b)) - C'(e_2(b))]\frac{de_2}{db}.
\end{aligned} \tag{11}$$

The first term is the strategic effect from synergy and we have:

$$\frac{de_1}{db} = \frac{de_1}{de_2}\frac{de_2}{db},$$

with the sign of $\frac{de_1}{de_2}$ as the sign of the slope of the best reply function, which is positive if efforts are strategic complements (which is equivalent to the assumption of effort synergies). Hence, the sign of the strategic effect is positive as long as efforts are complements and the marginal return to effort of agent 2 increases with his overconfidence. Taking the strategic effect into account, the overconfidence of agent 2 increases the effort of agent 1, which in is beneficial for agent 2.

The second term is the mistaken beliefs effect, which sign is negative since agent 2 is exerting too much effort regarding his true abilities, that is $e_2(b) > \arg\max_{e_2} R(e_1(b), e_2) - C(e_2)$, which implies that $R_{e_2}(e_1(b), e_2(b)) < C'(e_2(b))$. [1] show that, accordingly the trade off between the strategic effect and the mistaken beliefs effect is assertive for the impact of agent 2's overconfidence on his own payoff: If synergy is large the strategic effect dominates and agent 2 benefits from his own biased self-perception.

3 Empirical Evidence

Prior to analysing the effect of overconfident NBA-players on their teammates we need to think of a measure for overconfidence of basketball-players. In the following we identify overconfident players by analysing their performance in crunchtime.[3] A player is identified as overconfident if his field goal percentage decreases by at least 10 percentage points during crunchtime compared to his average overall field goal percentage. If more than one player of a team fulfills this criterion the player with the highest decrease in field goal percentage is taken into account in our analysis.

The preliminary data set[4] contains of the first 531 games of the 2009/2010 NBA-season. According to our measure of overconfidence, in this season only three teams (Chicago Bulls, Denver Nuggets and Orlando Magic) have no overconfident player. Table 1 shows the (most) overconfident players of the remaining teams and shows how many of the games they played ended in crunchtime and how long they played in these periods. Additionally, the average overall field goal percentages and those in crunchtime of the 2009/2010 seasons are shown as well as their differences.

The overconfident players of the 27 teams show an averaged 18 percentage point decrease in their field goal percentage during crunchtime compared to the overall field goal percentage (see Table 1).

After identifying the relevant overconfident players for every game and both teams in every game two types of Plus-Minus-Stats[5] are derived for all teammembers: On the one hand the performance (Plus-Minus-Stats) of each player while the overconfident player is on court is derived and on the other hand the performance (Plus-Minus-Stats) of each player while the overconfident player is off court.[6] Deleting those cases in which a team is without an overconfident player according to our measure or in which the overconfident player did not play, 800 cases remain.

In those 800 cases the overconfident players score an average of 11.17 points within a playing time of 28.84 minutes and their average Plus-Minus-Stats is 0.56.

For our analysis the performance of the non-overconfident teammembers is important: Comparing the Plus-Minus-Stats of the teammates while the overconfident player is on and off court shows that teams perform significantly[7] better if the overconfident player is on court. The average Plus-Minus-Stats without the overconfident player on court total -0.2184 whereas they aggregate to 0.3231 with the overconfident player on court.

A closer look at the performance of the overconfident player reveals his importance for the teams. Table 2 shows the performance of the other players depending on whether the overconfident players performs good (Plus-Minus-Stats greater than zero) or bad (Plus-Minus-Stats below or equal to zero) and whether he is on court or not.

Not surprisingly, the corresponding χ^2-test reveals that the four average Plus-Minus-Stats differ highly significant (χ^2-Value is 285.903). It shows that a well performing overconfident player on court leads to the highest Plus-Minus-Stats of his teammates; while bad performing overconfident players have the worst Plus-Minus-Stats. Additionally, the results show, that the team is better off with a bad performing overconfident player off court. Hence for further research the interesting question arises whether this fact holds for all players or whether the performance of an overconfident player has a higher effect on the stats of his teammates than a non-overconfident player. If the overconfident player is able to carry away his team, the negative effects of his overconfidence can be compensated by the positive effect he has on his teammates.

Like the effect on the stats of the teammates the performance of the overconfident player also has an effect on the result of the game. A correlation test shows, that the correlation between the performance of the overconfident player (measured as his Plus-Minus-Stats) has a highly significant positive effect on the difference between the achieved points of his own team and the achieved points of the opponent.

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[3] According to 82games.com crunchtime starts in the fourth quarter or overtime, with less than 5 minutes left to play and neither team ahead by more than 5 points.

[4] The final data set will include all games from the 2005/2006 to the 2009/2010 season.

[5] The Plus-Minus-Stat shows a team's net points while the player is on court.

[6] We do this by using the gameflows of www.popcornmachine.net.

[7] The effect is significant at the 10%-Level (Significance: 0.053).

The Correlation Coefficient is .678 (significant at the 1% level). Again, the question arises, whether this positive effect is higher for an overconfident player than for his non-overconfident teammates.

In addition to the described points, in a next step a logistic regression should reveal further effects of overconfidence. A logistic regression goes along the lines of the comparison of Plus-Minus-Stats of a team with and without the overconfident player on court and by that shows the effects of any individual player. In this context we will additionally control for the performance of the teams and players in general. Estimating the logistic regression with the dummy-variable "overconfident player on or off court" as the dependent variable we will be able to show whether good or bad teams react more to overconfident players as well as whether overconfident players affect bad teammates more than good teammates or vice versa.

4   Conclusion

Using a theoretical framework from [1] we show how overconfidence might have a positive effect on the output of a team, if effort-complementarities are high, rational as well as overconfident agents might benefit from the mistaken self-perception of one agent. This situation is highly applicable to the game of basketball, since a team's performance is greatly determined by synergies between the players on court. So, the production technology described in our model is comparable to the production of an NBA-team.

We isolate a player's self-perception by analysing his performance during crunchtime and show that an overconfident player's performance, even though detrimental at first sight (since he scores with less efficiency), has a positive impact on this teammates' performance. Our analysis of a preliminary data-set of 800 cases reveals significantly higher Plus-Minus-Stats of the remaining players if the overconfident player is on court. Additionally, the performance of the overconfident player significantly favours his team to win the game.

Appendix

team	oc player	ct-games	ct-minutes	FG%	ct-FG%	diff.
Atlanta Hawks	J. Crawford	36	143	0.45	0.25	-0.20
Boston Celtics	K. Perkins	38	127	0.60	0.44	-0.17
Charlotte Bobcats	G. Wallace	43	190	0.48	0.32	-0.16
Cleveland Cavaliers	A. Varejao	41	115	0.57	0.44	-0.13
Dallas Mavericks	J. J. Barea	18	56	0.44	0.33	-0.11
Detroit Pistons	W. Bynum	23	67	0.44	0.21	-0.24
Golden State Warriors	C.J. Watson	28	73	0.47	0.27	-0.20
Houston Rockets	S. Battier	35	151	0.40	0.19	-0.21
Indiana Pacers	M. Dunleavy	23	53	0.41	0.08	-0.33
Los Angeles Clippers	E. Gordon	25	85	0.45	0.33	-0.12
Los Angeles Lakers	R. Artest	26	109	0.41	0.23	-0.19
Memphis Grizzlies	O. J. Mayo	44	195	0.46	0.27	-0.19
Miami Heat	C. Arroyo	13	59	0.48	0.25	-0.23
Milwaukee Bucks	C. Bell	27	71	0.38	0.23	-0.15
Minnesota Timberwolves	C. Brewer	32	108	0.43	0.29	-0.14
New Jersey Nets	J. Yi	17	52	0.40	0.21	-0.19
New Orleans Hornets	M. Thornton	30	91	0.45	0.34	-0.11
New York Knicks	W. Chandler	32	140	0.48	0.33	-0.15
Oklahoma City Thunder	T. Sefolosha	40	138	0.44	0.25	-0.19
Philadelphia 76ers	W. Green	28	94	0.46	0.24	-0.22
Phoenix Suns	J. Dudley	33	79	0.46	0.36	-0.10
Portland Trail Blazers	N. Batum	20	61	0.52	0.33	-0.19
Sacramento Kings	B. Udrih	45	167	0.49	0.40	-0.10
San Antonio Spurs	G. Hill	35	108	0.48	0.27	-0.21
Toronto Raptors	J. Jack	33	109	0.48	0.27	-0.21
Uta Jazz	P. Millsap	24	66	0.54	0.31	-0.23
Washington Wizards	M. Miller	22	73	0.50	0.39	-0.11
Average		30.04	102.96	0.47	0.29	-0.18

Table 1: Field goal percentages (FG%) of overconfident (oc) players in the 2009/2010 season overall and during crunchtime (ct).

	Plus-Minus-Stats of oc player > 0	Plus-Minus-Stats of oc player ≤ 0
oc player on court	4.7328	-3.9136
oc player off court	-1.2454	.7683

Table 2: Plus-Minus-Stats of the overconfident player's teammates.

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