Reference dependent preference, but whose?

Evidence from MLB batters

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Abstract

- Specify the reference-dependent preference of the baseball players (Position players) by the econometric analysis
- Players regard the 0.300 *Batting average* as reference point and for many cases succesfully meet their goals.
- This tendency is observed only in .300 of Batting-Average, not in other round numbers (e.g. .200, .250) or other performance statistics, such as On-Base Percentage (: Rate statistics) or Homeruns (Cumulative statistics).
- There seems to be no monetary incentives for the players to do so.

Contents

Literature

- Pope & Simonsohn (2011) picked up MLB batters as an empirical evidence of "Round number reference dependence. " : They showed excess distribution above .300 of batting-average.
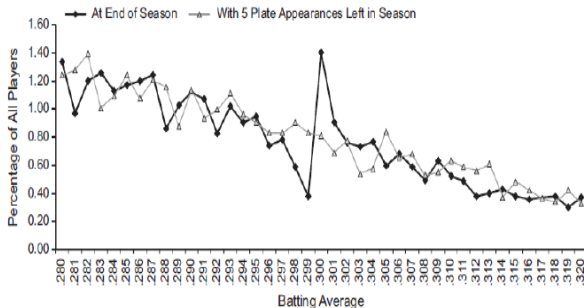

Fig. 1. Relative frequency of batting averages among Major League Baseball players between 1975 and 2008. Batting averages at the end of the baseball season and with five plate appearances left in the season are shown. The graph includes only player-seasons with at least 200 at bats.

Literature

- Allen et al. (2016) emphasized the existence of the round number reference point dependence of the marathon runners' finishing times.

Figure 2. Distribution of Marathon Finishing Times ($n = 9{,}789{,}093$)
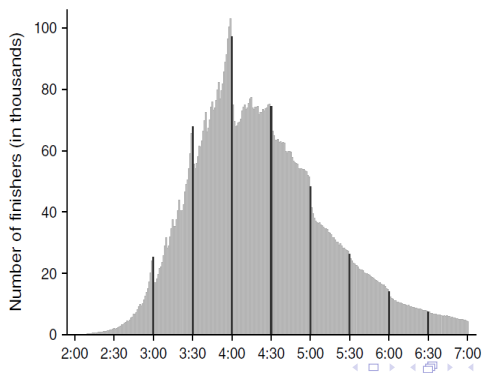
Research Question

- In this study, I conducted further research in three view points.

  1. Does round-number dependent preference occur in other statistics?

     : difference between "rate statistics" and "cumulative statistics"

  2. Is the reference dependent preference actually the player's?

     : If there is *monetary incentive* for the players to try to meet the goals, then it may be the team manager that has reference dependence.

  3. What about when the relative importance of batting-average diminishes?

     : The publication of '*Moneyball*' has been change the evaluation of the people about the importance of batting average.

Theoretical Framework

- Primary gain-loss function:Kahneman & Tversky(1979)

$$V(x|r) = \begin{cases} v(x-r) & \text{if } x \geq r \\ -\lambda v(x-r) & \text{if } x < r \end{cases}$$

- In this research, I follow utilize the specification of Allen et al. (2016), discontinuity at the reference point:

$$\lim_{\epsilon \to 0} v(r+\epsilon) \neq \lim_{\epsilon \to 0} v(r-\epsilon)$$

Theoretical Framework

- utility function with discontinuity at the reference point
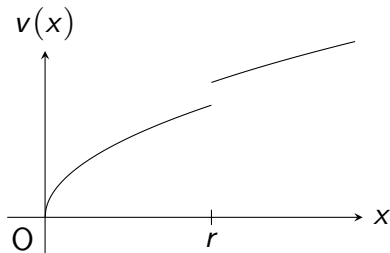
- This utility function makes
  - players try to meet their goals and excess distribution around the reference point observed
  - team managers overestimate whether he achieves to reach above the reference point.

Method: Monetary incentives

$$w_{it} = \beta_0 X_{it} + \beta_1 \text{ABOVE300}_{it}$$
$$+ \beta_2 X_{it} \times \text{ABOVE300}_{it} + \beta_3 Z_{it}$$

where

w_{it} :Log-salary of the player i in $t + 1$ season

X_{it} :Proxy for the performance of the player

ABOVE :indicator if the player achieves their inferred goals

Z_{it} :Player-specific charactaristics

Data Description

- Panel data of the player performance and salary.
  - Various performance statistics tagged by the player ID and year from "fangraphs" (1957 to 2017, $n = 53,090(61$ seasons))
  - Salary data from USA TODAY (1987 to 2017, $n = 8,928$ (31 seasons))
- Time-series data of team performance statistics (1987 to 2017, 31 seasons) from "Baseball reference."

Definitions of Statistics

- Batting-Average (AVG)

$$AVG = Base\text{-}Hit/At\text{-}Bat$$

- On-Base Percentage (OBP)

$$OBP = \frac{Base\text{-}Hit + Walk + Hit\text{-}by\text{-}Pitch}{Prate\text{-}Appearance - Sacrifice\text{-}Hit - Catcher\text{-}Interferance}$$

- Slugging Average (SLG)

$$SLG = \frac{Single + 2 \times Double + 3 \times Triple + 4 \times HR}{At\text{-}Bat}$$

AVG for at least 200 PA

*difference between the number of batters with .299 (0.37%) and .300 (1.13%) is significant at 0.1% ($\chi^2 = 69.03$)
**Also, the difference between those with .299, .298 (0.87%) and with .300 and .301 (1.91%) is significant at 0.1% ($\chi^2 = 70.26$)

Other statistics: Rate statistics

OBP for at least 200 PA
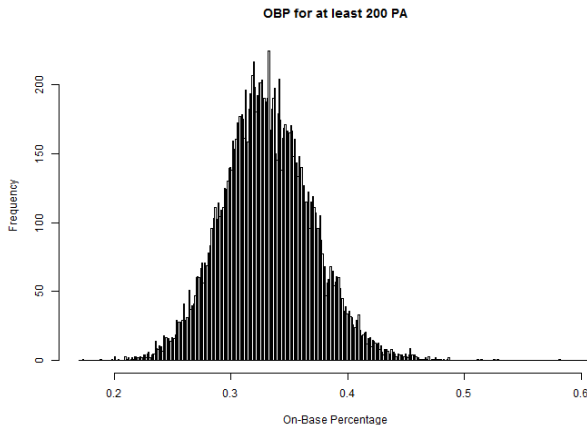
There was no observation of round number dependence.
OPS (OBP + SLG) either does not show such tendency.

Other statistics: Cumulative statistics
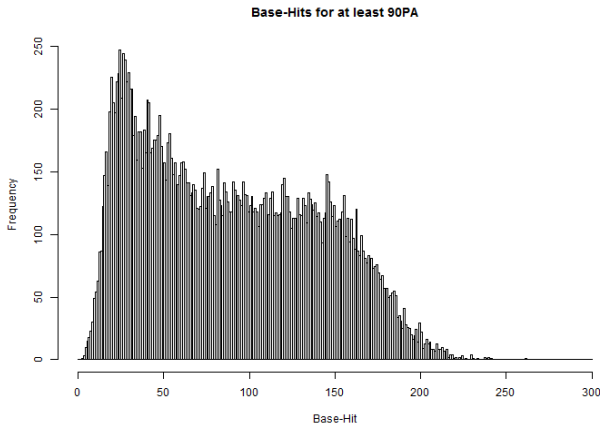
Also, round number reference dependence is not observed.

SB for at least 90PA
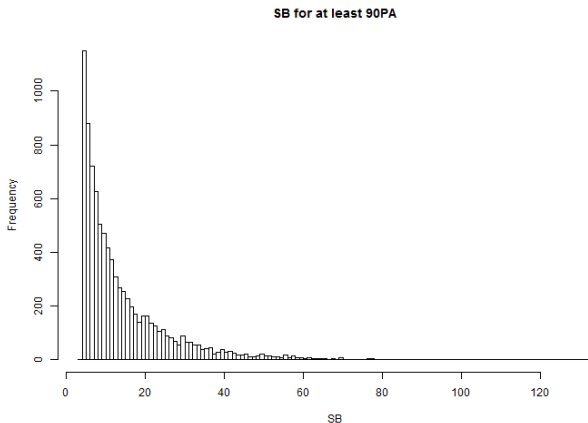
Stolen-Bases may be more easily controled, but no reference-dependence observed.

Observed Choice of the player

- .300 of AVG seems to act as a reference point, but it may not be "round number" dependence, as is mentioned in Pope & Simonsohn (2011)

- Such a behavior is observed only in AVG, not in either rate statistics or cumulative ones.

- Then, we next have to see whether there is some monetary incentives for the player, which reveals that the observed behavior is certainly the player's preference.

Measuring Performance

- In the regression analysis, I utilize the statistics below as proxies for performance:
    - Weighted On-base Percentage (wOBA)
      : Value of runs the batter produce per plate-appearance ($+$ adjustment)
    - BATTING, FIELDING and BaseRun
      : Runs created by the batter by batting, fielding and baserunning, respectively.
    - (fangraphs) Win-above-Replacement (fWAR)
      : Wins created by the player, relative to the "replacement level" player, who has value as a player that achieves .298 of win-average.
    - (negative) Win-Probability Added (WPA (nWPA))
      : Sum of how much their action increased (decreased) their team's odds of winning
      In this research, I devide this with the number of games he attended.

Comparision among various statistics

	(1)	(2)	(3)	(4)	(5)	(6)
			Dependent variable:			
			Log-salary next season			
AVG	9.849*** (0.616)					
OBP		10.439*** (0.453)				
OPS			4.999*** (0.162)			
wOBA				11.610*** (0.423)		
BATTING					0.031*** (0.001)	
fWAR						0.272*** (0.009)
ABOVE_300	−0.842 (0.767)	−0.481 (0.438)	−0.207 (0.336)	−0.565 (0.409)	−0.070 (0.055)	0.043 (0.071)
FIELDING	0.003* (0.002)	0.005*** (0.002)	0.007*** (0.002)	0.006*** (0.002)	0.007*** (0.002)	
BaseRun	−0.023*** (0.005)	−0.022*** (0.005)	−0.014*** (0.005)	−0.017*** (0.005)	−0.017*** (0.005)	
AVG:ABOVE_300	3.058 (2.456)					
OBP:ABOVE_300		1.515 (1.164)				
OPS:ABOVE_300			0.165 (0.389)			
wOBA:ABOVE_300				1.483 (1.092)		
BATTING:ABOVE_300					0.001 (0.002)	
fWAR:ABOVE_300						−0.012 (0.018)
Constant	11.618*** (0.160)	10.750*** (0.149)	10.485*** (0.121)	10.417*** (0.137)	14.187*** (0.014)	13.778*** (0.019)
Observations	8,883	8,883	8,883	8,883	8,883	8,928
R^2	0.065	0.101	0.146	0.125	0.140	0.153
Adjusted R^2	0.064	0.100	0.146	0.125	0.140	0.153
Residual Std. Error	1.295 (df = 8877)	1.270 (df = 8877)	1.238 (df = 8877)	1.253 (df = 8877)	1.242 (df = 8877)	1.231 (df = 8924)
F Statistic	122.451*** (df = 5; 8877)	199.008*** (df = 5; 8877)	304.053*** (df = 5; 8877)	254.613*** (df = 5; 8877)	290.119*** (df = 5; 8877)	539.388*** (df = 3; 8924)

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

performance = fWAR

	Dependent variable:					
	Log-salary next season					
	OLS				felm	
	(1)	(2)	(3)	(4)	(5)	(6)
fWAR	0.272***	0.281***	0.279***	0.102***	0.022*	0.083***
	(0.009)	(0.008)	(0.008)	(0.010)	(0.012)	(0.008)
ABOVE_300	0.043	−0.089	−0.102*	−0.038	−0.156**	−0.077*
	(0.071)	(0.062)	(0.062)	(0.072)	(0.070)	(0.045)
AGE		0.928***	0.932***			1.619***
		(0.034)	(0.034)			(0.027)
AGE_sq		−0.013***	−0.013***			−0.024***
		(0.001)	(0.001)			(0.0005)
WPA					15.549***	7.584***
					(1.530)	(0.988)
nWPA					24.902***	20.865***
					(1.571)	(1.018)
fWAR:ABOVE_300	−0.012	0.004	0.006	0.0003	0.031*	0.001
	(0.018)	(0.015)	(0.015)	(0.017)	(0.017)	(0.011)
Constant	13.778***	−1.664***				
	(0.019)	(0.498)				
Fixed effect	-	-	Team	Individual	Individual, Team	Team
Observations	8,928	8,928	8,928	8,928	8,928	8,928
R^2	0.153	0.358	0.366	0.484	0.521	0.802
Adjusted R^2	0.153	0.357	0.363	0.364	0.407	0.755
Residual Std. Error	1.231 (df = 8924)	1.073 (df = 8922)	1.068 (df = 8893)	1.067 (df = 7239)	1.030 (df = 7208)	0.663 (df = 7206)
F Statistic	539.388*** (df = 3; 8924)	993.022*** (df = 5; 8922)				

Note:

*p<0.1; **p<0.05; ***p<0.01

performance = BATTING

			Dependent variable:			
			Log-salary next season			
		OLS			felm	
	(1)	(2)	(3)	(4)	(5)	(6)
BATTING	0.031***	0.030***	0.030***	0.030***	0.013***	0.015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
ABOVE_300	−0.070	−0.112**	−0.099**	−0.108**	−0.187***	−0.177***
	(0.055)	(0.049)	(0.049)	(0.049)	(0.054)	(0.044)
FIELDING	0.007***	0.008***	0.008***	0.008***	−0.004**	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
BaseRun	−0.017***	0.007*	0.001	0.002	−0.048***	−0.003
	(0.005)	(0.004)	(0.005)	(0.005)	(0.006)	(0.004)
AGE		0.947***	0.971***	0.976***		1.008***
		(0.035)	(0.035)	(0.035)		(0.032)
AGE_sq		−0.014***	−0.014***	−0.014***		−0.015***
		(0.001)	(0.001)	(0.001)		(0.001)
WPA					10.820***	16.259***
					(1.629)	(1.373)
nWPA					25.727***	44.336***
					(1.492)	(0.982)
BATTING:ABOVE_300	0.001	0.002	0.002	0.001	0.003	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	14.187***	−1.393***				
	(0.014)	(0.519)				
Fixed effect	-	-	Position	Position, Team	Individual, Position, Team	Position, Team
Observations	8,883	8,883	8,883	8,883	8,883	8,883
R²	0.140	0.324	0.344	0.354	0.548	0.476
Adjusted R²	0.140	0.324	0.343	0.350	0.439	0.473
Residual Std. Error	1.242 (df = 8877)	1.101 (df = 8875)	1.086 (df = 8863)	1.080 (df = 8834)	1.003 (df = 7151)	0.972 (df = 8832)
F Statistic	290.119*** (df = 5; 8877)	608.849*** (df = 7; 8875)				

Note: *p<0.1; **p<0.05; ***p<0.01

'Moneyball' Publication

- 'Moneyball' (Michael Lewis, 2003) claims that when it comes to measuring the performance from the viewpoint of how to score more runs and more wins, AVG is relatively less important statistics than On-base percentage or OPS ($=$ OBP $+$ SLG).

- Hakes & Sauyer (2006) points out that MLB teams got to pay more to the players with high on-base percentage rather than batting average after the publication of *Moneyball*.

- Reference dependence of the players may diminish after the model case of the *Moneyball*, Oakland Athletics's World champion.

- Also, events that affects the procedure of the contraction may change the preference about the statistics.

Classfying the Time series

I devide the sample into four eras:

1. Before "Free Agent" system was introduced: -1975 ($n = 4292$)
2. Before "Strike" of the players occurred: 1976-1994 ($n = 5331$)
3. Before '*Moneyball*' was published: 1995-2001 ($n = 2028$)
4. After '*Moneyball*': 2002- ($n = 5555$)

|				*Dependent variable:*		
				Team Runs		
	(1)	(2)	(3)	(4)	(5)	(6)
AVG	36.162***			14.844***		
	(0.870)			(0.856)		
OBP		32.515***			18.494***	
		(0.548)			(0.547)	
SLG			16.578***	12.015***	9.506***	
			(0.277)	(0.356)	(0.278)	
OPS						12.360***
						(0.138)
Constant	−4.874***	−6.123***	−2.236***	−4.241***	−5.416***	−4.570***
	(0.228)	(0.181)	(0.114)	(0.152)	(0.121)	(0.103)
Observations	896	896	896	896	896	896
R²	0.659	0.798	0.800	0.850	0.912	0.899
Adjusted R²	0.659	0.797	0.799	0.850	0.912	0.899
Residual Std. Error	0.311 (df = 894)	0.240 (df = 894)	0.239 (df = 894)	0.207 (df = 893)	0.158 (df = 893)	0.169 (df = 894)
F Statistic	1,729.301*** (df = 1; 894)	3,521.401*** (df = 1; 894)	3,568.839*** (df = 1; 894)	2,533.648*** (df = 2; 893)	4,638.196*** (df = 2; 893)	7,976.722*** (df = 1; 894)

Note: *p<0.1; **p<0.05; ***p<0.01

				Dependent variable:		
				Winning-Average		
	(1)	(2)	(3)	(4)	(5)	(6)
AVG	3.460***			1.366***		
	(0.115)			(0.130)		
OBP		3.157***			1.815***	
		(0.078)			(0.097)	
SLG			1.656***	1.247***	0.962***	
			(0.041)	(0.055)	(0.051)	
OPS						1.238***
						(0.025)
Runs Allowed	−0.093***	−0.092***	−0.100***	−0.101***	−0.100***	−0.101***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.022	−0.117***	0.277***	0.095***	−0.035	0.046***
	(0.029)	(0.025)	(0.016)	(0.023)	(0.022)	(0.017)
Observations	896	896	896	896	896	896
R²	0.675	0.767	0.769	0.794	0.834	0.827
Adjusted R²	0.674	0.766	0.768	0.793	0.833	0.827
Residual Std. Error	0.039 (df = 893)	0.033 (df = 893)	0.033 (df = 893)	0.031 (df = 892)	0.028 (df = 892)	0.029 (df = 893)
F Statistic	925.821*** (df = 2; 893)	1,469.533*** (df = 2; 893)	1,482.702*** (df = 2; 893)	1,147.337*** (df = 3; 892)	1,492.012*** (df = 3; 892)	2,136.514*** (df = 2; 893)

Note:

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Restricted sample for Before Strike

AVG before FA
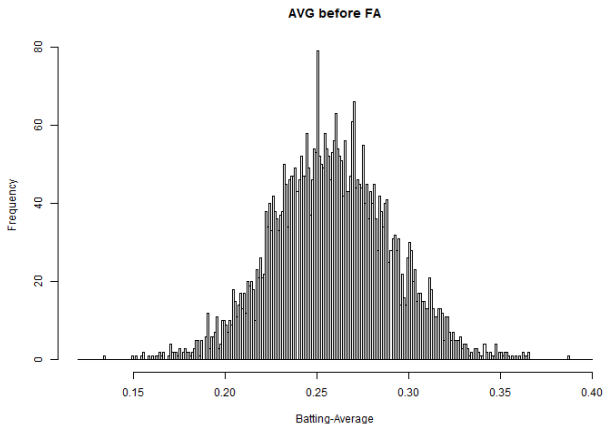
.299 to .300: significant at 5% ($\chi^2 = 3.04$, $p = 0.0406$)
.298, .299 to .300, .301: significant at 1% ($\chi^2 = 7.34$, $p = 0.0034$)

AVG FA to Strike
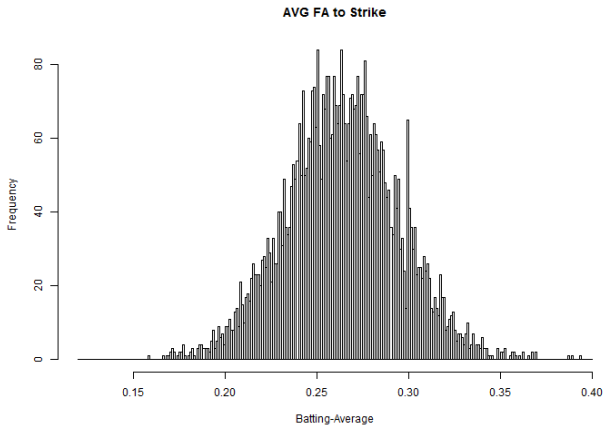
.299 to .300: significant at 0.1% ($\chi^2 = 31.88$)
.298, .299 to .300, .301: significant at 0.1% ($\chi^2 = 31.60$)

AVG Strike to MB

.299 to .300: significant at 0.1% ($\chi^2 = 19.32$)
.298, .299 to .300, .301: significant at 1% ($\chi^2 = 7.28, p = 0.0034$)

AVG after MB

.299 to .300: significant at 0.1% ($\chi^2 = 16.67$)
.298, .299 to .300, .301: significant at 0.1% ($\chi^2 = 23.10$)

OBP for after Moneyball

Restricted sample for Before Strike
performance = fWAR

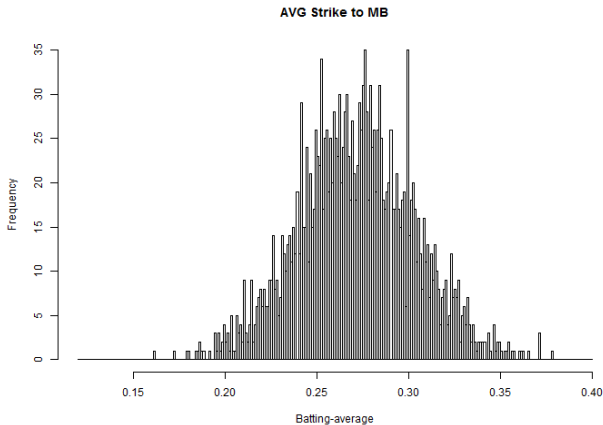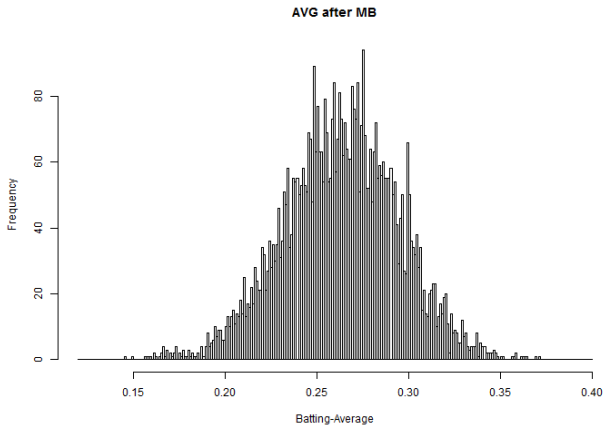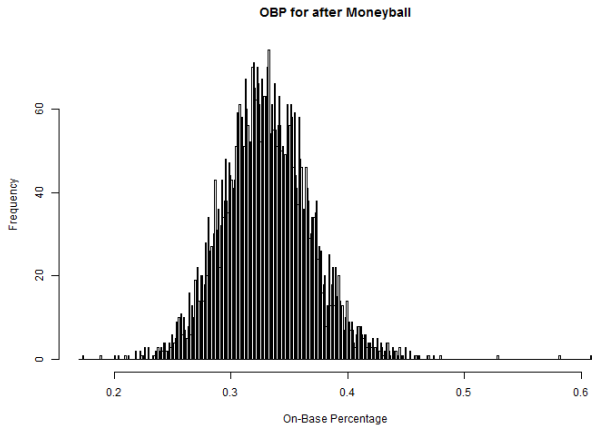|	Dependent variable:					
	Log-salary next season					
	OLS				felm	
	(1)	(2)	(3)	(4)	(5)	(6)
fWAR	0.234***	0.234***	0.236***	0.080***	0.034*	0.096***
	(0.014)	(0.012)	(0.012)	(0.017)	(0.019)	(0.012)
ABOVE_300	0.154	0.013	−0.003	0.142	0.010	0.064
	(0.120)	(0.104)	(0.104)	(0.131)	(0.129)	(0.077)
AGE		0.812***	0.811***			1.829***
		(0.054)	(0.054)			(0.061)
AGE_sq		−0.012***	−0.012***			−0.027***
		(0.001)	(0.001)			(0.001)
WPA					9.692***	4.835***
					(2.588)	(1.551)
nWPA					25.105***	13.612***
					(2.723)	(1.644)
fWAR:ABOVE_300	−0.007	0.015	0.017	0.024	0.048	−0.018
	(0.030)	(0.026)	(0.026)	(0.032)	(0.031)	(0.018)
Constant	13.047***	−0.294				
	(0.030)	(0.790)				
Fixed effect	-	-	Team	Individual	Individual, Team	Team
Observations	2,122	2,122	2,122	2,122	2,122	2,122
R²	0.189	0.401	0.416	0.533	0.583	0.851
Adjusted R²	0.188	0.399	0.407	0.365	0.422	0.793
Residual Std. Error	0.959 (df = 2118)	0.825 (df = 2116)	0.820 (df = 2089)	0.849 (df = 1558)	0.810 (df = 1529)	0.485 (df = 1527)
F Statistic	165.009*** (df = 3; 2118)	282.841*** (df = 5; 2116)				

Restricted sample for Before Strike
performance = BATTING

		OLS				felm	
				Dependent variable:			
				Log-salary next season			
	(1)	(2)	(3)	(4)	(5)	(6)
BATTING	0.027***	0.026***	0.027***	0.028***	0.007**	0.014***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
ABOVE_300	0.037	−0.102	−0.112	−0.114	0.010	−0.135*
	(0.102)	(0.089)	(0.089)	(0.089)	(0.107)	(0.078)
FIELDING	0.006**	0.005*	0.004*	0.005*	0.003	0.005**
	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
BaseRun	0.044***	0.049***	0.044***	0.044***	−0.019	0.013
	(0.013)	(0.011)	(0.012)	(0.012)	(0.017)	(0.011)
AGE		0.819***	0.825***	0.832***		0.915***
		(0.056)	(0.056)	(0.056)		(0.050)
AGE_sq		−0.012***	−0.012***	−0.012***		−0.014***
		(0.001)	(0.001)	(0.001)		(0.001)
WPA					8.579***	13.581***
					(2.801)	(2.109)
nWPA					26.270***	37.854***
					(2.687)	(1.519)
BATTING:ABOVE_300	0.001	0.006*	0.006	0.005	0.006	0.008***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Constant	13.388***	0.004				
	(0.023)	(0.820)				
Fixed effect	-	-	Position	Position, Team	Individual,Position, Team	Position, Team
Observations	2,108	2,108	2,108	2,108	2,108	2,108
R²	0.171	0.374	0.382	0.400	0.593	0.539
Adjusted R²	0.169	0.372	0.378	0.388	0.431	0.530
Residual Std. Error	0.972 (df = 2102)	0.845 (df = 2100)	0.841 (df = 2093)	0.834 (df = 2066)	0.804 (df = 1508)	0.731 (df = 2064)
F Statistic	86.931*** (df = 5; 2102)	179.240*** (df = 7; 2100)				

Restricted sample for Before Moneyball
performance = fWAR

	Dependent variable:					
	Log-salary next season					
	OLS				felm	
	(1)	(2)	(3)	(4)	(5)	(6)
fWAR	0.314***	0.292***	0.285***	0.147***	0.083***	0.073***
	(0.016)	(0.014)	(0.014)	(0.018)	(0.021)	(0.013)
ABOVE_300	0.159	0.026	0.006	0.016	−0.099	0.057
	(0.105)	(0.090)	(0.090)	(0.108)	(0.106)	(0.067)
AGE		0.964***	0.960***			2.060***
		(0.063)	(0.063)			(0.068)
AGE_sq		−0.014***	−0.014***			−0.030***
		(0.001)	(0.001)			(0.001)
WPA					10.767***	5.104***
					(2.590)	(1.659)
nWPA					25.245***	16.875***
					(2.711)	(1.760)
fWAR:ABOVE_300	−0.050*	−0.013	−0.010	−0.012	0.023	−0.025
	(0.027)	(0.023)	(0.023)	(0.026)	(0.025)	(0.016)
Constant	13.566***	−2.169**				
	(0.033)	(0.917)				
Fixed effect	-	-	Team	Individual	Individual, Team	Team
Observations	2,063	2,063	2,063	2,063	2,063	2,063
R^2	0.263	0.462	0.486	0.681	0.716	0.885
Adjusted R^2	0.262	0.461	0.477	0.555	0.594	0.835
Residual Std. Error	1.048 (df = 2059)	0.896 (df = 2057)	0.882 (df = 2028)	0.814 (df = 1476)	0.777 (df = 1445)	0.495 (df = 1443)
F Statistic	244.465*** (df = 3; 2059)	353.758*** (df = 5; 2057)				

Restricted sample for After Moneyball
performance = BATTING

			Dependent variable:			
			Log-salary next season			
	OLS				felm	
	(1)	(2)	(3)	(4)	(5)	(6)
BATTING	0.030***	0.026***	0.026***	0.026***	0.011***	0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
ABOVE_300	−0.029	−0.013	−0.020	−0.040	−0.105	−0.113*
	(0.084)	(0.073)	(0.073)	(0.073)	(0.083)	(0.061)
FIELDING	0.007**	0.009***	0.009***	0.007***	0.001	0.005**
	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
BaseRun	0.056***	0.069***	0.066***	0.063***	−0.005	0.024*
	(0.017)	(0.015)	(0.015)	(0.015)	(0.017)	(0.013)
AGE		1.031***	1.052***	1.053***		1.052***
		(0.067)	(0.068)	(0.067)		(0.057)
AGE_sq		−0.015***	−0.016***	−0.016***		−0.016***
		(0.001)	(0.001)	(0.001)		(0.001)
WPA					9.286***	17.676***
					(2.861)	(2.301)
nWPA					28.144***	46.543***
					(2.606)	(1.601)
BATTING:ABOVE_300	0.002	0.003	0.003	0.003	0.004	0.007***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Constant	14.027***	−2.606***				
	(0.027)	(0.983)				
Fixed effect	-	-	Position	Position, Team	Individual, Position, Team	Position, Team
Observations	2,051	2,051	2,051	2,051	2,051	2,051
R²	0.226	0.414	0.421	0.452	0.722	0.616
Adjusted R²	0.224	0.412	0.417	0.441	0.601	0.607
Residual Std. Error	1.076 (df = 2045)	0.937 (df = 2043)	0.933 (df = 2036)	0.914 (df = 2007)	0.772 (df = 1426)	0.766 (df = 2005)
F Statistic	119.371*** (df = 5; 2045)	206.223*** (df = 7; 2043)				

Restricted sample for After Moneyball
performance = fWAR

			Dependent variable:			
			Log-salary next season			
		OLS			felm	
	(1)	(2)	(3)	(4)	(5)	(6)
fWAR	0.251***	0.278***	0.273***	0.079***	0.021	0.076***
	(0.012)	(0.010)	(0.010)	(0.013)	(0.016)	(0.012)
ABOVE_300	−0.037	−0.135	−0.158*	−0.227**	−0.276***	−0.105
	(0.105)	(0.088)	(0.088)	(0.106)	(0.105)	(0.074)
AGE		1.008***	1.010***			1.779***
		(0.044)	(0.044)			(0.047)
AGE_sq		−0.015***	−0.015***			−0.026***
		(0.001)	(0.001)			(0.001)
WPA					11.917***	6.367***
					(2.206)	(1.553)
nWPA					19.545***	19.447***
					(2.326)	(1.644)
fWAR:ABOVE_300	0.013	0.018	0.020	0.021	0.042*	0.008
	(0.026)	(0.022)	(0.022)	(0.026)	(0.025)	(0.018)
Constant	14.224***	−2.553***				
	(0.027)	(0.646)				
Fixed effect	-	-	Team	Individual	Individual, Team	Team
Observations	4,743	4,743	4,743	4,743	4,743	4,743
R²	0.135	0.381	0.396	0.514	0.542	0.774
Adjusted R²	0.134	0.380	0.392	0.370	0.402	0.705
Residual Std. Error	1.230 (df = 4739)	1.040 (df = 4737)	1.030 (df = 4708)	1.048 (df = 3659)	1.022 (df = 3628)	0.718 (df = 3626)
F Statistic	245.749*** (df = 3; 4739)	583.306*** (df = 5; 4737)				

Note: *p<0.1; **p<0.05; ***p<0.01

Restricted sample for After Moneyball
performance = BATTING

	Dependent variable:					
	Log-salary next season					
	OLS				fdm	
	(1)	(2)	(3)	(4)	(5)	(6)
BATTING	0.032***	0.031***	0.031***	0.031***	0.011***	0.013***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
ABOVE_300	−0.126	−0.152**	−0.149**	−0.167**	−0.234***	−0.230***
	(0.080)	(0.069)	(0.069)	(0.068)	(0.079)	(0.062)
FIELDING	0.006**	0.008***	0.008***	0.008***	−0.003	0.008***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
BaseRun	−0.031***	−0.002	−0.007	−0.006	−0.044***	−0.007
	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.005)
AGE		1.027***	1.052***	1.058***		1.074***
		(0.046)	(0.045)	(0.045)		(0.041)
AGE_sq		−0.015***	−0.015***	−0.016***		−0.016***
		(0.001)	(0.001)	(0.001)		(0.001)
WPA					9.145***	18.814***
					(2.317)	(1.836)
nWPA					20.672***	44.162***
					(2.213)	(1.342)
BATTING:ABOVE_300	0.003	0.003	0.003	0.003	0.003	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Constant	14.607***	−2.230***				
	(0.019)	(0.670)				
Fixed effect	-	-	Position	Position, Team	Individual, Position, Team	Position, Team
Observations	4,724	4,724	4,724	4,724	4,724	4,724
R²	0.140	0.354	0.366	0.384	0.572	0.501
Adjusted R²	0.139	0.353	0.364	0.377	0.439	0.496
Residual Std. Error	1.226 (df = 4718)	1.063 (df = 4716)	1.054 (df = 4704)	1.043 (df = 4675)	0.990 (df = 3596)	0.938 (df = 4673)
F Statistic	153.663*** (df = 5; 4718)	368.576*** (df = 7; 4716)				

Note: *p<0.1; **p<0.05; ***p<0.01

Full Sample: Including Era Dummies for Before Strike, Before Moneyball, and After Moneyball

	Dependent variable
	Log-salary next season
BATTING	0.012**
	(0.006)
ABOVE_300	0.018
	(0.288)
After_MB	1.554***
	(0.084)
Before_Strike	−0.500***
	(0.078)
Erastmb	0.612***
	(0.077)
FIELDING	0.001
	(0.002)
BaseRun	−0.037***
	(0.006)
WPA	11.341***
	(1.598)
nWPA	27.454***
	(1.382)
BATTING.ABOVE_300	−0.0003
	(0.010)
BATTING.After_MB	0.001
	(0.006)
BATTING.Before_Strike	−0.004
	(0.006)
BATTING.ST_MB	0.0004
	(0.006)
ABOVE_300TRUEAfter_MB	−0.269
	(0.219)
ABOVE_300TRUEBefore-Strike	0.033
	(0.234)
ABOVE_300TRUEST_MB	−0.239
	(0.224)
BATTING.ABOVE_300TRUEAfter_MB	0.003
	(0.010)
BATTING.ABOVE_300TRUEBefore_Strike	0.004
	(0.010)
BATTING.ABOVE_300TRUEST_MB	0.005
	(0.010)
Fixed effect	Position, Teams, Individual
Observations	8,883
R^2	0.615
Adjusted R^2	0.521
Residual Std. Error	0.926 (df = 7139)
Note:	*p<0.1; **p<0.05; ***p<0.01

Conclusion

- Players regard .300 of batting-average as reference point:
  This preference is close to the evidence of Pope & Schweizer
  (2011,AER), " par " in the golf rather than "round number."
- There are no monetary incentive that discontinuously raise their
  salary of them.
- Deipite of the evolution the technique of measuring the players'
  performance, they yet take batting-average important than other
  statistics

Discussion

- Round number reference dependence may diminish as the season get close to the end:
  See other knot of the season, such as at the All-Star game.
- How about career (= Not a single season) performance?
- Other elements of the contract can be monetary incentive:
  Additional bonus based on their performance contract length, possession of the right of free agent and arbitration

Specific Contents of the Contracts

from: *Cot's Baseball Contracts*

- Adrian Beltre (Texas Rangers) 2011-2015, plus 2016
  - voidable option
  - Texas may void 2016 season if Beltre fails to reach 1,200 PAs in 2014-15 or 600 PAs 2015
  - if option vests and Beltre is on Disabled List at end of 2015 season and not healthy by spring 2016, club may defer $12M of 2016 salary at 1% interest
  - award bonuses, including $0.1M for each Gold Glove, All Star
  - limited no-trade protection

Specific Contents of the Contracts

- Ichiro Suzuki (Seattle Mariners) 2001-2003
  - $5M signing bonus
  - full no-trade clause
  - performance bonuses:
    - $0.4M each for 200, 250, 300, 350, 450 PAs in 2001
    - $0.6M each for 200, 250, 300, 350, 450 PAs in 2003
  - award bonuses: $0.15M for MVP ($0.2M for 2nd award, $0.25M for 3rd). $0.1M for WS MVP. $75,000 for Rookie of the Year. $50,000 each for LCS MVP. Gold Glove, Silver Slugger. $75,000 for most All-Star votes. $50,000 for most All-Star votes in AL. $50,000 for All-Star start. $25,000 for All-Star reserve
  - $10,000 moving allowance, plus use of car, trainer, interpreter
  - 2001-03 housing allowances: $25,000, $26,000, $27,000
  - four 1st-class air tickets between Japan Seattle, twice a year

References

- Pope & Simonsohn. 2011. Round Numbers as Goals: Evidence From Baseball, SAT Takers, and the Lab *Psychological Science 22(1) 7179*

- Hakes & Sauer. 2006. An Economic Evaluation of the *Moneyball* Hypothesis *Journal of Economic Perspectives—Volume 20, Number 3—Summer 2006—Pages 173185*

- Allen,Dechow, Pope & Wu. 2016. Reference-Dependent Preferences: Evidence from Marathon Runners *Management Science 63(6):1657-1672.*

- Pope & Schweizer. 2011. Is Tiger Woods Loss Averse? Persistent Bias in the Face of Experience, Competition, and High Stakes *American Economic Review 101 (February 2011): 129157*

- Kahneman & Tversky.1979. Prospect Theory: An Analysis of Decision under Risk. *Econometrica: Journal of the Econometric Society47 (2): 263291.*

Data References

- fangraphs Baseball
  https://www.fangraphs.com/
- Baseball Reference
  https://www.baseball-reference.com
- USA TODAY
  https://www.usatoday.com/sports/mlb/
- Baseball Prospectus
  https://www.baseballprospectus.com/