March Madness? Underreaction to hot and cold hands in NCAA basketball

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$^2$Naval Postgraduate School

WEAI/NAASE
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Background

1985-2010: “There is no hot hand”

≥ 2010: ‘Of course there’s a hot hand. And a cold one too’

But still a hot hand bias

(tendency to overestimate positive serial correlation)

Ironically HH is mostly a function of psychology that BE people typically say is so important.. including HH bias..)
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- Finance: Jegadeesh and Titman (2001)
New question: how prevalent is HH bias?

- Previous lit:
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  - Finance: Jegadeesh and Titman (2001)
  - Lab: Offerman and Sonnemans (2004); Massey and Wu (2005)
Our paper

Test for HH bias in novel context: NCAA tourney seeds

- Real-world committee with experience (10 ADs serving rolling 5 yr terms), soft incentives
- If HH bias: hot teams over-seeded
- So, conditional on seed, hot recent performance predicts worse outcomes in tourney
- No bias: recent performance doesn't predict tourney performance

HH underreaction: hot recent performance predicts better tourney
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- HH underreaction: hot recent performance predicts better tourney
Issues

▶ What are seeds supposed to be based on?
▶ NCAA (publicly released official) guidelines vaguely say “best”
▶ Media reports: starting in 2010, committee instructed to weight full “body of work” equally
▶ Prior to 2010: committee provided with separate stats on recent (last 10) games
▶ No documentation of change. And even post-2010, committee does account for injuries. And could still be biased
▶ We do analysis for pre/post regime change (2001-09; 2010-2016 samples)
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- Overreaction vs HH bias
  - Do recent signals make committee overestimate hotness or overestimate how good team is in general?

- HH bias ("HH over/underreaction"): signals of recent changes in team quality predict tourney performance

- Overreaction: signals of levels of team quality predict tourney performance

- Another issue: overreaction vs HH bias vs salience/inattention
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Variables

Recent signals of level of team quality:

- Score differences given priors for opponent ($SD_1$)
  - Team Y beats X by 20
  - $SD_1 = 20 - 15 = 5$

Signals of recent changes in quality:

1) Score differences given priors for own team and opponent ($SD_2$)
   - Team Y expected to beat team X by 20
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2) Changes in Sagarin ratings ($\Delta SR_T, T - 1$)
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- More salient info:
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Models

- Use game-level and team-tourney level data
  - Game-level: easier to control for characteristics of each team (in each game)
  - Team-tourney-level: easier to control for serial correlation within tournament and bigger picture outcomes
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- Game-level: regress binary $Y = \text{Win} = 1$ if higher seed wins on:
  - $X =$ higher seed recent performance ($\frac{SD_1}{SD_2} / \Delta SR$) - lower seed recent performance, ...
  - seed-round FEs, opponent seed-round FEs, seed diff FEs, home, earlier Sag ratings

- Team-tourney-level: regress $Y =$ # team's tourney wins on
  - $X =$ team's recent performance vars, seed FEs, earlier Sag ratings
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2001-09 Game-level results (LHS = higher seed win)

**Table:** All vars diffs (higher seed - lower seed). $T =$ pre-tourney ratings.

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<td></td>
<td></td>
<td>(0.018)</td>
<td></td>
</tr>
<tr>
<td>$SR_{T-1}$</td>
<td>0.017**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$SR_{T-2}$</td>
<td></td>
<td>0.017**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.007)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$SR_{T-3}$</td>
<td></td>
<td></td>
<td>0.018**</td>
<td>0.020**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
</tbody>
</table>
Robustness etc

Rd 1 only: slightly smaller pt estimates, insig

Seeds 5-12: larger pt estimates, insig

Evidence of effects declining in latter part of 2001-09 time-frame

Effects driven by higher-seeded team overrated when cold in 01-09; by lower-seeded team underrated when hot in 2010-16
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2001-09 Conf tourney effects (LHS = higher seed win; switch to percentage points)
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<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT Champ</td>
<td>-4.558</td>
<td>-4.237</td>
<td>-5.817</td>
<td>-4.774</td>
<td>-5.619</td>
<td>-3.140</td>
</tr>
<tr>
<td></td>
<td>(3.952)</td>
<td>(3.661)</td>
<td>(4.872)</td>
<td>(5.072)</td>
<td>(4.855)</td>
<td>(12.415)</td>
</tr>
<tr>
<td>CT SD₁</td>
<td>0.080</td>
<td></td>
<td>0.076</td>
<td></td>
<td>0.130</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.056)</td>
<td></td>
<td>(0.082)</td>
<td></td>
<td>(0.089)</td>
<td></td>
</tr>
<tr>
<td>CT SD₂</td>
<td>0.144*</td>
<td></td>
<td></td>
<td>0.130</td>
<td>0.023</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.084)</td>
<td></td>
<td></td>
<td>(0.089)</td>
<td>(0.229)</td>
<td></td>
</tr>
<tr>
<td>CT # W’s</td>
<td>1.898</td>
<td>0.172</td>
<td>0.783</td>
<td>1.893</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.733)</td>
<td>(2.528)</td>
<td>(1.843)</td>
<td>(5.258)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed 5-12</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2001-09 CT and reg. season effects (LHS = higher seed win)
2001-09 CT and reg. season effects (LHS = higher seed win)

\[
\begin{array}{ll}
\text{CT Champion} & -5.405 \\
& (4.929) \\
\text{CT } SD_2 & 0.173* \\
& (0.087) \\
\text{CT } \# \text{ Wins} & 0.388 \\
& (1.928) \\
\end{array}
\]

\[
\begin{array}{ll}
SD_2 \text{ in last } X \text{ (pre-CT) regular season games} \\
X=1 & -0.103 \\
& (0.140) \\
\end{array}
\]

\[
\begin{array}{ll}
\# \text{ Wins in last } X \text{ (pre-CT) regular season games} \\
X=1 & 5.959 \\
& (4.205) \\
\end{array}
\]
### 2001-09 CT and reg. season effects (LHS = higher seed win)

<table>
<thead>
<tr>
<th></th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT Champion</td>
<td>-5.771</td>
</tr>
<tr>
<td></td>
<td>(4.919)</td>
</tr>
<tr>
<td>CT (SD_2)</td>
<td>0.192**</td>
</tr>
<tr>
<td></td>
<td>(0.084)</td>
</tr>
<tr>
<td>CT # Wins</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>(1.886)</td>
</tr>
<tr>
<td>(SD_2) in last X (pre-CT) regular season games</td>
<td></td>
</tr>
<tr>
<td>X=2</td>
<td>-0.128</td>
</tr>
<tr>
<td></td>
<td>(0.086)</td>
</tr>
<tr>
<td># Wins in last X (pre-CT) regular season games</td>
<td></td>
</tr>
<tr>
<td>X=2</td>
<td>7.565***</td>
</tr>
<tr>
<td></td>
<td>(2.416)</td>
</tr>
</tbody>
</table>
## 2001-09 CT and reg. season effects (LHS = higher seed win)

<table>
<thead>
<tr>
<th>Effect</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT Champion</td>
<td>-5.931</td>
<td>(4.710)</td>
<td></td>
</tr>
<tr>
<td>CT $SD_2$</td>
<td>0.191**</td>
<td>(0.085)</td>
<td></td>
</tr>
<tr>
<td>CT # Wins</td>
<td>0.854</td>
<td>(1.870)</td>
<td></td>
</tr>
<tr>
<td>$SD_2$ in last X (pre-CT) regular season games</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X=3$</td>
<td>-0.035</td>
<td>(0.079)</td>
<td></td>
</tr>
<tr>
<td># Wins in last X (pre-CT) regular season games</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X=3$</td>
<td>6.138***</td>
<td>(1.744)</td>
<td></td>
</tr>
</tbody>
</table>
2001-09 CT and reg. season effects (LHS = higher seed win)

<table>
<thead>
<tr>
<th></th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT Champion</td>
<td>-6.297</td>
</tr>
<tr>
<td></td>
<td>(5.301)</td>
</tr>
<tr>
<td>CT $SD_2$</td>
<td>0.207**</td>
</tr>
<tr>
<td></td>
<td>(0.088)</td>
</tr>
<tr>
<td>CT # Wins</td>
<td>0.994</td>
</tr>
<tr>
<td></td>
<td>(2.099)</td>
</tr>
</tbody>
</table>

$SD_2$ in last $X$ (pre-CT) regular season games

| $X$=4 | -0.04 |
|       | (0.073) |

# Wins in last $X$ (pre-CT) regular season games

| $X$=4 | 4.341** |
|       | (2.015) |
2001-09 CT and reg. season effects (LHS = higher seed win)

<table>
<thead>
<tr>
<th></th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT Champion</td>
<td>-4.158</td>
</tr>
<tr>
<td></td>
<td>(6.064)</td>
</tr>
<tr>
<td>CT SD&lt;sub&gt;2&lt;/sub&gt;</td>
<td>0.292**</td>
</tr>
<tr>
<td></td>
<td>(0.113)</td>
</tr>
<tr>
<td>CT # Wins</td>
<td>-0.103</td>
</tr>
<tr>
<td></td>
<td>(2.260)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SD&lt;sub&gt;2&lt;/sub&gt; in last X (pre-CT) regular season games</th>
</tr>
</thead>
<tbody>
<tr>
<td>X=5</td>
</tr>
<tr>
<td>0.008</td>
</tr>
<tr>
<td>(0.072)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># Wins in last X (pre-CT) regular season games</th>
</tr>
</thead>
<tbody>
<tr>
<td>X=5</td>
</tr>
<tr>
<td>2.024</td>
</tr>
<tr>
<td>(2.325)</td>
</tr>
</tbody>
</table>
2001-09 Tourney-level horse race/kitchen sink (LHS = # tourney wins)
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<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta SR_{T, T-2}$</td>
<td>0.152***</td>
<td>0.160**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.046)</td>
<td>(0.073)</td>
<td></td>
</tr>
<tr>
<td>CT Champion</td>
<td>-0.111</td>
<td>-0.117</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.171)</td>
<td>(0.170)</td>
<td></td>
</tr>
<tr>
<td>CT $SD_2$</td>
<td>0.007***</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.004)</td>
<td></td>
</tr>
<tr>
<td>CT # Wins</td>
<td>-0.004</td>
<td>-0.01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.058)</td>
<td>(0.058)</td>
<td></td>
</tr>
<tr>
<td>Last 2 RS: $SD_2$</td>
<td>-0.002</td>
<td>-0.006</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.004)</td>
<td></td>
</tr>
<tr>
<td>Last 2 RS # Wins</td>
<td>0.201**</td>
<td>0.205**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.076)</td>
<td>(0.076)</td>
<td></td>
</tr>
</tbody>
</table>
2001-09 Tourney-level horse race/kitchen sink by seed

Seeds: 1-8 5-12 9-16

\[ \Delta SR, T - 20.102 \pm 0.203^* \pm 0.093 \]

CT Champion -0.198 0.002 0.029

CT SD 0.012^* -0.001 -0.003

CT # Wins -0.07 -0.037 0.042

Last 2 RS:

SD -0.002 -0.006 -0.005^*

Last 2 RS # Wins 0.331** 0.136 0.072

Adj \[ R^2 0.42 0.161 \]

N 285 287 288
### 2001-09 Tourney-level horse race/kitchen sink by seed

<table>
<thead>
<tr>
<th>Seeds:</th>
<th>1-8</th>
<th>5-12</th>
<th>9-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta SR_{T,T-2}$</td>
<td>0.102</td>
<td>0.203*</td>
<td>0.093</td>
</tr>
<tr>
<td></td>
<td>(0.141)</td>
<td>(0.101)</td>
<td>(0.067)</td>
</tr>
<tr>
<td>CT Champion</td>
<td>-0.198</td>
<td>0.002</td>
<td>0.029</td>
</tr>
<tr>
<td></td>
<td>(0.224)</td>
<td>(0.191)</td>
<td>(0.199)</td>
</tr>
<tr>
<td>CT $SD_2$</td>
<td>0.012*</td>
<td>-0.001</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>CT # Wins</td>
<td>-0.07</td>
<td>-0.037</td>
<td>0.042</td>
</tr>
<tr>
<td></td>
<td>(0.085)</td>
<td>(0.088)</td>
<td>(0.064)</td>
</tr>
<tr>
<td>Last 2 RS: $SD_2$</td>
<td>-0.002</td>
<td>-0.006</td>
<td>-0.005*</td>
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<td>(0.007)</td>
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<td>(0.127)</td>
<td>(0.090)</td>
<td>(0.077)</td>
</tr>
<tr>
<td>Adj $R^2$</td>
<td>0.42</td>
<td>0.03</td>
<td>0.161</td>
</tr>
<tr>
<td>N</td>
<td>285</td>
<td>287</td>
<td>288</td>
</tr>
</tbody>
</table>
Overall magnitudes

What are overall effects of bias on accuracy of seeds?

Maybe effects nullify or are just 'within' seed or off by 1 seed.

Calculate 'optimal' seeds with and without incorporating recent performance.

Without: \[\sim 30\% \text{ of actual seeds off by } \geq 2 \text{ seed-lines}\]

With: \[\sim 35\% \text{ off by } \geq 2\]
Overall magnitudes

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Concluding remarks
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- College bball teams do get hot/cold heading into tourney
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- Opposite of standard hot hand bias
- Conf. tourney overall performance and last 2-3 regular season *wins* key predictors
  *(Wins indicates team-level confidence effect.)*
- Inattention is likely big factor - lots of info for busy people to process
- But attention is endogenous - so inattention suggests under-appreciation of importance of hot/cold factors
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Maybe not so surprising..

The madness is very profitable!
Concluding remarks

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