History Repeating: Spain Beats Germany in the EURO 2012 Final

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EURO 2012 tournament forecast based on bookmakers odds.

Main results: Spain and Germany are the top favorites with winning probabilities of 25.8% and 22.2%, respectively.

Most likely final: Spain vs. Germany (8.9%) with odds slightly in favor of Spain (52.9% winning probability).
Overview

- Bookmakers odds
- Modeling consensus and agreement
- Abilities and paired comparisons
- Performance throughout the tournament
- Discussion
Bookmakers odds: Motivation

Forecasts of sports events:
- Increasing interest in forecasting of competitive sports events due to growing popularity of online sports betting.
- Forecasts often based on ratings or rankings of competitors’ ability/strength. In football: Elo rating, FIFA rating.
- Alternatively, bookmakers odds for winning a competition.

Advantages of bookmakers odds:
- Bookmakers can be regarded as expert judges with monetary incentives to rate competitors correctly. If they set their odds too high or low, they will lose profits.
- Prospective in nature: Bookmakers factor not only the competitors abilities into their odds but also tournament draws/seedings, home advantages, recent events such as injuries, etc.
- Winning probabilities can be derived relatively easily.
Bookmakers odds: Overround adjustment

**Quoted odds:** Not an honest judgment of winning chances due to inclusion of a profit margin known as “overround”.

\[ quoted \text{ odds}_i = \text{odds}_i \cdot \delta + 1, \]

- where \( \text{odds}_i \) is the bookmaker’s “true” judgment of the odds for competitor \( i \),
- \( \delta \) is the bookmaker’s payout proportion (overround: \( 1 - \delta \)),
- and \(+1\) is the stake.

**Winning probabilities:** The adjusted \( \text{odds}_i \) then corresponding to the odds of competitor \( i \) for losing the tournament. They can be easily transformed to the corresponding winning probability

\[ p_i = 1 - \frac{\text{odds}_i}{1 + \text{odds}_i}. \]
Determining the overround: Assuming that a bookmaker’s overround is constant across competitors, it can be determined by requiring that the winning probabilities of all competitors (here: all 16 teams) sum to 1: $\sum_i p_i = 1$.

Illustration: EURO 2012 rating for Spain by bookmaker bwin.

- Bookmaker bwin pays 3.75 for a stake of 1 set on a victory of Spain, i.e., a profit of 2.75.
- The overround implied by bwin’s quoted odds for all 16 teams in the tournament is 14.8%.
- Thus, bwin’s implied odds for Spain are: $3.227 = (3.75 - 1)/(1 - 0.148)$, i.e., it is more than three times more likely that Spain loses vs. wins.
- The corresponding winning probability for Spain is 23.7%.
Bookmakers odds: EURO 2012

Data processing:

- Quoted odds from 23 online bookmakers.
- Computed overrounds $1 - \delta_b$ individually for each bookmaker $b = 1, \ldots, 23$ by unity sum restriction across teams $i = 1, \ldots, 16$.
- Median overround is 14.3%.
- Yields overround-adjusted and transformed winning probabilities $p_{i,b}$ for each team $i$ and bookmaker $b$. 
Modeling consensus and agreement

**Goal:** Get consensus probabilities by aggregation across bookmakers.

**Strategy:**
- Employ statistical model assuming some latent consensus probability $p_i$ for team $i$ along deviations $\epsilon_{i,b}$.
- Additive model is plausible on suitable scale, e.g., logit or probit.
- Logit is more natural here, as it corresponds to log-odds.
- Methodology can also be used for consensus ratings of default probability in credit risk rating of bank $b$ for firm $i$.

**Model:** Bookmaker consensus model

$$\text{logit}(p_{i,b}) = \text{logit}(p_i) + \epsilon_{i,b},$$

where further effects could be included, e.g., group effects in consensus logits or bookmaker-specific bias and variance in $\epsilon_{i,b}$. 
Modeling consensus and agreement

Here:

- Simple fixed-effects model with zero-mean deviations.
- Consensus logits are simply team-specific means across bookmakers:
  \[
  \hat{\logit}(p_i) = \frac{1}{23} \sum_{b=1}^{23} \logit(p_{i,b}).
  \]

- Consensus winning probabilities are obtained by transforming back to the probability scale:
  \[
  \hat{p}_i = \logit^{-1}\left(\hat{\logit}(p_i)\right).
  \]

- Model captures 99.0% of the variance in \(p_{i,b}\) and the associated estimated standard error is 0.1155.
## Modeling consensus and agreement

<table>
<thead>
<tr>
<th>Team</th>
<th>FIFA code</th>
<th>Probability</th>
<th>Log-odds</th>
<th>Log-ability</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>ESP</td>
<td>25.8</td>
<td>−1.055</td>
<td>−2.025</td>
<td>C</td>
</tr>
<tr>
<td>Germany</td>
<td>GER</td>
<td>22.2</td>
<td>−1.256</td>
<td>−2.140</td>
<td>B</td>
</tr>
<tr>
<td>Netherlands</td>
<td>NED</td>
<td>11.3</td>
<td>−2.063</td>
<td>−2.464</td>
<td>B</td>
</tr>
<tr>
<td>England</td>
<td>ENG</td>
<td>8.0</td>
<td>−2.441</td>
<td>−2.654</td>
<td>D</td>
</tr>
<tr>
<td>France</td>
<td>FRA</td>
<td>6.9</td>
<td>−2.602</td>
<td>−2.700</td>
<td>D</td>
</tr>
<tr>
<td>Italy</td>
<td>ITA</td>
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<td>−2.773</td>
<td>−2.776</td>
<td>C</td>
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<tr>
<td>Portugal</td>
<td>POR</td>
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<td>−3.107</td>
<td>−2.857</td>
<td>B</td>
</tr>
<tr>
<td>Russia</td>
<td>RUS</td>
<td>4.0</td>
<td>−3.172</td>
<td>−2.993</td>
<td>A</td>
</tr>
<tr>
<td>Ukraine</td>
<td>UKR</td>
<td>2.1</td>
<td>−3.863</td>
<td>−3.158</td>
<td>D</td>
</tr>
<tr>
<td>Croatia</td>
<td>CRO</td>
<td>1.8</td>
<td>−4.009</td>
<td>−3.178</td>
<td>C</td>
</tr>
<tr>
<td>Poland</td>
<td>POL</td>
<td>1.6</td>
<td>−4.111</td>
<td>−3.332</td>
<td>A</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>CZE</td>
<td>1.4</td>
<td>−4.263</td>
<td>−3.351</td>
<td>A</td>
</tr>
<tr>
<td>Sweden</td>
<td>SWE</td>
<td>1.3</td>
<td>−4.313</td>
<td>−3.266</td>
<td>D</td>
</tr>
<tr>
<td>Greece</td>
<td>GRE</td>
<td>1.3</td>
<td>−4.356</td>
<td>−3.375</td>
<td>A</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>IRL</td>
<td>1.0</td>
<td>−4.582</td>
<td>−3.348</td>
<td>C</td>
</tr>
<tr>
<td>Denmark</td>
<td>DEN</td>
<td>1.0</td>
<td>−4.614</td>
<td>−3.325</td>
<td>B</td>
</tr>
</tbody>
</table>
Abilities and paired comparisons

**Question:** Is Spain really the strongest team in the tournament?

**Motivation:**
- Germany was apparently drawn in a stronger group than Spain.
- Tournament schedule was known to bookmakers and hence factored into their quoted odds.
- Can abilities (or strengths) of the teams be obtained, adjusting for such tournament effects?

**Answer:** Yes, an approximate solution can be found by simulation when
- adopting a standard model for paired comparisons (i.e., matches),
- assuming that the abilities do not change over the tournament.
Abilities and paired comparisons

**Strategy:** Based on Bradley-Terry model.

- Standard model to derive pairwise winning probabilities \( \pi_{i,j} \) from a set of abilities:
  \[
  \Pr(\text{i beats j}) = \pi_{i,j} = \frac{\text{ability}_i}{\text{ability}_i + \text{ability}_j}.
  \]

- Given \( \pi_{i,j} \) the whole tournament can be simulated (assuming the abilities do not change over the course of the tournament).

- Using “many” simulations (here: 100,000) of the tournament, the empirical relative frequencies \( \tilde{p}_i \) of each team \( i \) winning the tournament can be determined.

- Choose \( \text{ability}_i \) for \( i = 1, \ldots, 16 \) such that the simulated winning probabilities \( \tilde{p}_i \) approximately match the consensus winning probabilities \( \hat{p}_i \).

- Found by simple iterative local search starting from log-odds.
Abilities and paired comparisons

Team j
IRL DEN GRE SWE CZE POL UKR CRO RUS POR ITA FRA ENG NED GER ESP

Team i
IRL DEN GRE SWE CZE POL UKR CRO RUS POR ITA FRA ENG NED GER ESP

0.15
0.25
0.40
0.60
0.75
0.85
Abilities and paired comparisons

Group effects:

- Germany has to play the much stronger group (B) than Spain (C).
- However, in the quarter-finals Germany plays against an opponent from the weakest group (A), provided they proceed to that stage.
- Hence, it is not much harder for Germany to proceed to the final than for Spain.
- However, more disadvantages for The Netherlands and Portugal to be drawn in the same group as Germany.
- A final of Spain vs. Germany can be expected to be very close. There is only a slight advantage for Spain with a winning probability of 52.9%.
### Abilities and paired comparisons

<table>
<thead>
<tr>
<th>Group</th>
<th>Average log-ability (compared to median team)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A w/o RUS</td>
<td>-0.2</td>
</tr>
<tr>
<td>B w/o GER</td>
<td>-0.1</td>
</tr>
<tr>
<td>C w/o ESP</td>
<td>0.0</td>
</tr>
<tr>
<td>D w/o ENG</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Graph showing the average log-ability (compared to median team) for different groups.
Performance throughout the tournament

Furthermore: Simulation approach does not only provide probabilities for winning the tournament but also for “surviving” each stage of the tournament (group phase, quarter- and semi-finals).

Results:

- Groups B, C, and D have more or less clear favorites.
- Group A has no clear favorite.
- Probability to proceed to semifinals is extremely low for teams from group A because they have to face teams from group B in the quarterfinals.
- Group D is particularly exciting because the group’s favorites (England and France) are extremely close and only one can avoid facing the expected group C winner Spain in the quarterfinals.
Performance throughout the tournament

Group A

<table>
<thead>
<tr>
<th>Probability (%)</th>
<th>Quarter</th>
<th>Semi</th>
<th>Final</th>
<th>Winner</th>
</tr>
</thead>
</table>

Group B

<table>
<thead>
<tr>
<th>Probability (%)</th>
<th>Quarter</th>
<th>Semi</th>
<th>Final</th>
<th>Winner</th>
</tr>
</thead>
</table>

- RUS
- POL
- CZE
- GRE

- GER
- NED
- POR
- DEN
Performance throughout the tournament

Group C

Group D

ESP
IT A
CRO
IRL
ENG
FRA
UKR
SWE
Discussion

- Winning probabilities for EURO 2012 are obtained from quoted odds of 23 online bookmakers.
- Basis is adjustment for overround and averaging on suitable log-odds scale.
- Furthermore, implied team abilities are inferred by classical pairwise-comparison model in combination with iterated tournament simulations.
- Approach outperformed Elo and FIFA ratings for EURO 2008 and correctly predicted the final (Germany vs. Spain).
- Also correctly predicted FIFA 2010 World Cup winner (Spain).
- Nevertheless, all forecasts are in terms of probabilities much lower than 100%. Other outcomes are not unlikely, hopefully making EURO 2012 the exciting event that football fans worldwide are looking forward to.

