

## European Economics Analyst

Euro 2020—Modelling the Beautiful Game  
(Schnittker/Stehn)

*This version has been corrected for an error in the quarter-final progression of the tournament – the teams in the semi-finals and the winner prediction remain unchanged.*

- Following a year of delay, the Euro 2020 will finally go ahead on June 11. As the excitement for the tournament builds, we construct a statistical model to simulate the European Cup, which we intend to update as the tournament progresses.
- We start by modelling the number of goals scored by each team using a large dataset of international football matches since 1980. We find that the number of goals scored by each team can be explained by (1) the strength of the squad (measured with the World Football Elo Rating), (2) goals scored and conceded in recent games (capturing the side's momentum), (3) home advantage (which is worth 0.4 goals per game) and (4) a tournament effect (which shows that some countries tend to outperform at tournaments compared to their rating).
- We then simulate the tournament using our estimated scoring model. Our framework predicts that Belgium will win the Euros for the first time in history, narrowly beating Portugal on July 11. The reason the model gives Belgium the edge is primarily its high Elo score, where it is ranked first amongst European nations. That said, we see a close race between Belgium, Italy, Portugal and Spain, which make it to the semi-finals.
- Our simulations provide a number of interesting predictions beyond this. First, we forecast that Germany will make it out of its difficult group ahead of France, but then lose to England at Wembley during the round of 16, as Germany's low Elo ranking more than outweighs its positive tournament effect. Second, Denmark is projected to do well in this tournament, winning its group and losing only to Italy in the quarterfinals. Third, while France—as world champion—has a high Elo score, *Les Bleus* are penalised in our model by a difficult group, lack of home advantage and negative momentum in recent games.
- It is difficult to assess how much faith one should have in these predictions. While we capture the stochastic nature of the tournament carefully, we also see that the forecasts are highly uncertain, even with sophisticated statistical techniques, simply because football is quite an unpredictable game. This is, of course, precisely why football is so exciting to watch.

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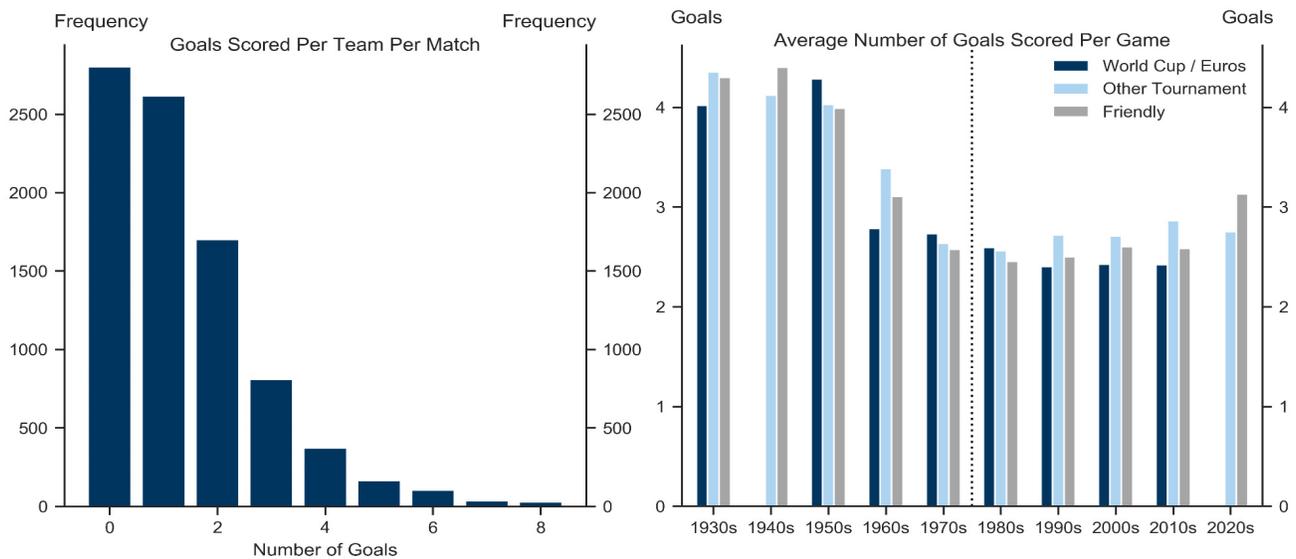
# Euro 2020—Modelling the Beautiful Game

The Euro 2020 will finally go ahead on June 11, a year behind schedule. As the excitement for the tournament builds, we construct a statistical model to simulate the European Cup, which we intend to update as the tournament progresses.

## Scoring Goals

We start by modelling the number of goals scored by each team using a large dataset of international football matches. To do so, we estimate a distribution for the number of goals scored, which captures how the number of goals scored tends to fall off quite quickly (Exhibit 1). We estimate this distribution using around 6,000 games since 1980 in which Euro 2020 contenders participated, taking into account the downward trend in the number of goals scored over the last century. We exclude friendly matches, given evidence that they usually lead to more goals than games at world or European cup tournaments.

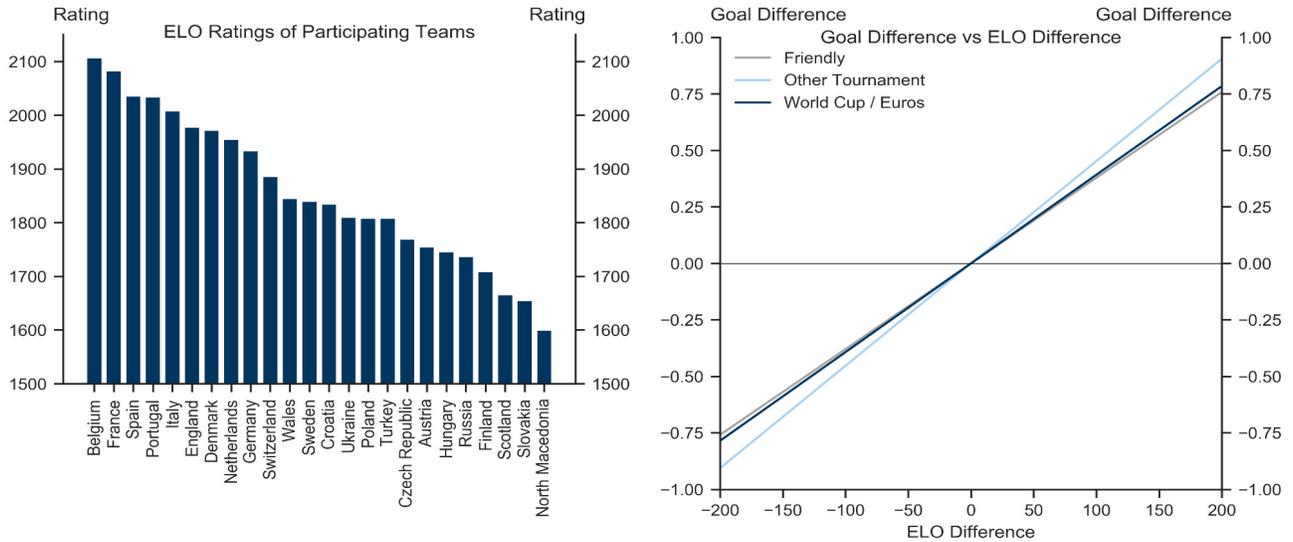
**Exhibit 1: Goals Scored**



Source: Goldman Sachs Global Investment Research

We find that four factors help explain the number of goals scored by each team. First, the relative strength of the two teams clearly matters. In particular, we use the World Football Elo Rating, which rates countries according to their recent performance. The Elo ranking does not incorporate individual player information, but correlates highly with other metrics, such as the FIFA rankings and teams' estimated transfer values.

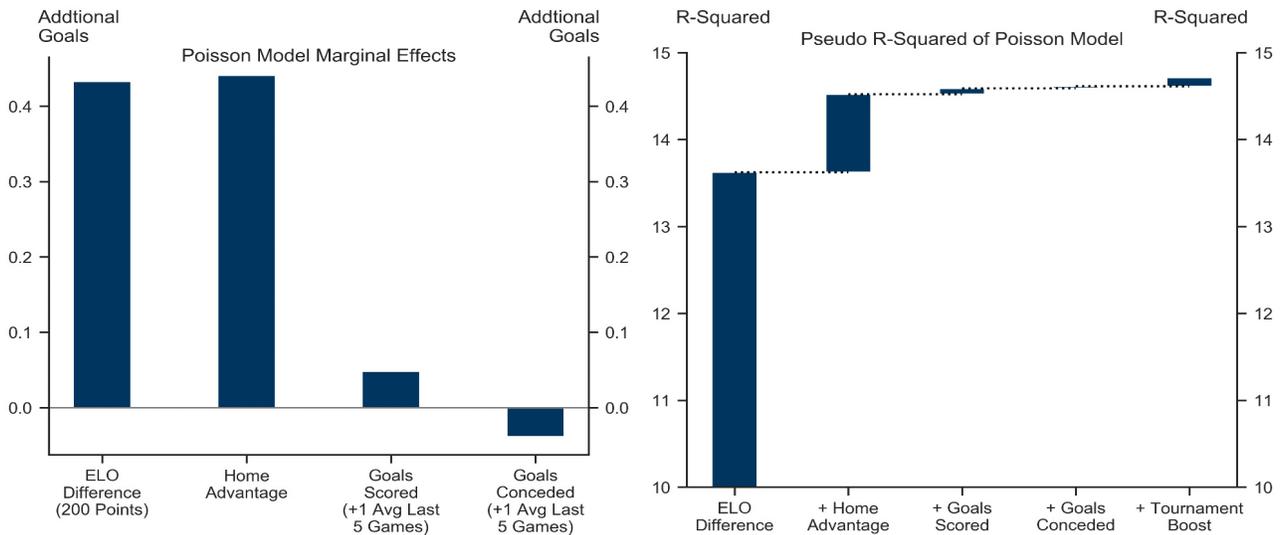
**Exhibit 2: The Strength of a Team**



Source: Goldman Sachs Global Investment Research, World Football Elo Ratings

Team strength—not surprisingly—is the single best predictor of goals scored. The right-hand side in Exhibit 2 shows how the Elo score correlates with the number of goals scored. Exhibit 3 summarises the results from our estimated model, by reporting the marginal effect of changing team strength on the predicted number of goals scored. In particular, in our full simulation our model suggests that Belgium (the highest Elo-rated team) is likely to score 1.1 goals more per game than North Macedonia (the lowest Elo-rated team in the Euro 2020).

**Exhibit 3: A Football Model**

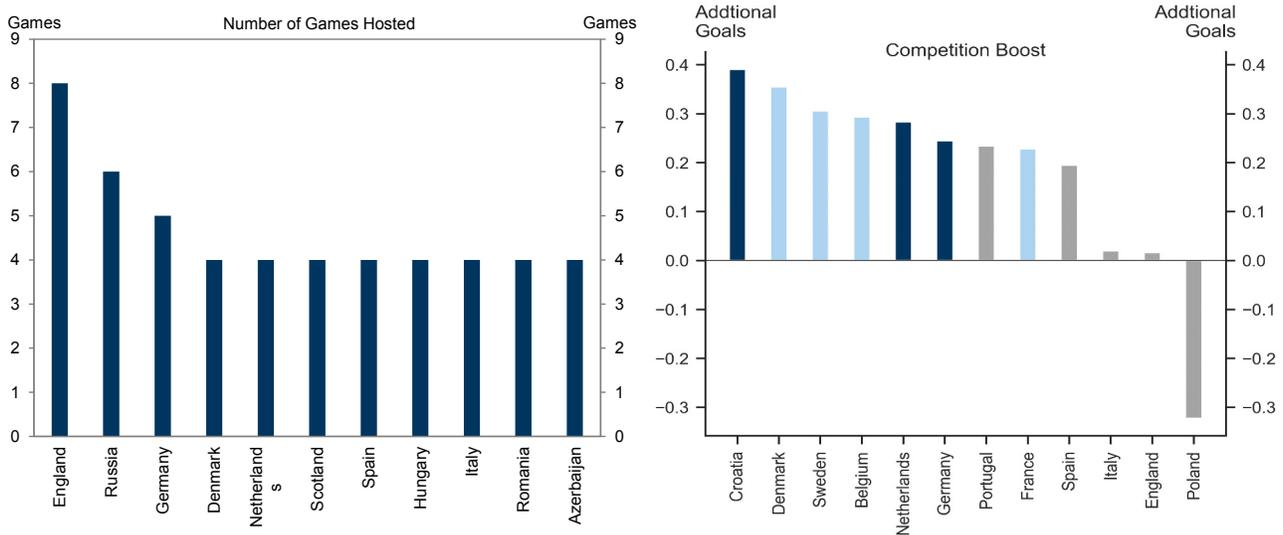


Source: Goldman Sachs Global Investment Research

Second, the recent performance of the two teams—games scored and conceded over the last 5 matches—helps to forecast the number of goals scored. Intuitively, these variables help capture the momentum of a team in the run-up—or during—the European Cup, which is often so important for the performance during a tournament.

Third, we confirm that home advantage has been an important determinant of the goals scored historically. In particular, we find that (all else equal) the home team has scored 0.4 goals more, on average. The home advantage, however, is less clear cut this time, as the Euro 2020 are hosted by eleven countries (with a rotating host nation) and covid-related restrictions will likely restrict fan travel (Exhibit 4, left). That said, England has a possible in-built edge here, hosting both semi-finals and the final at Wembley.

**Exhibit 4: Home Advantage and Tournament Teams**



In the right-hand chart, the dark blue and light blue bars denote statistical significance at the 5% and 10% level, respectively, while grey bars are statistically insignificant.

Source: Goldman Sachs Global Investment Research

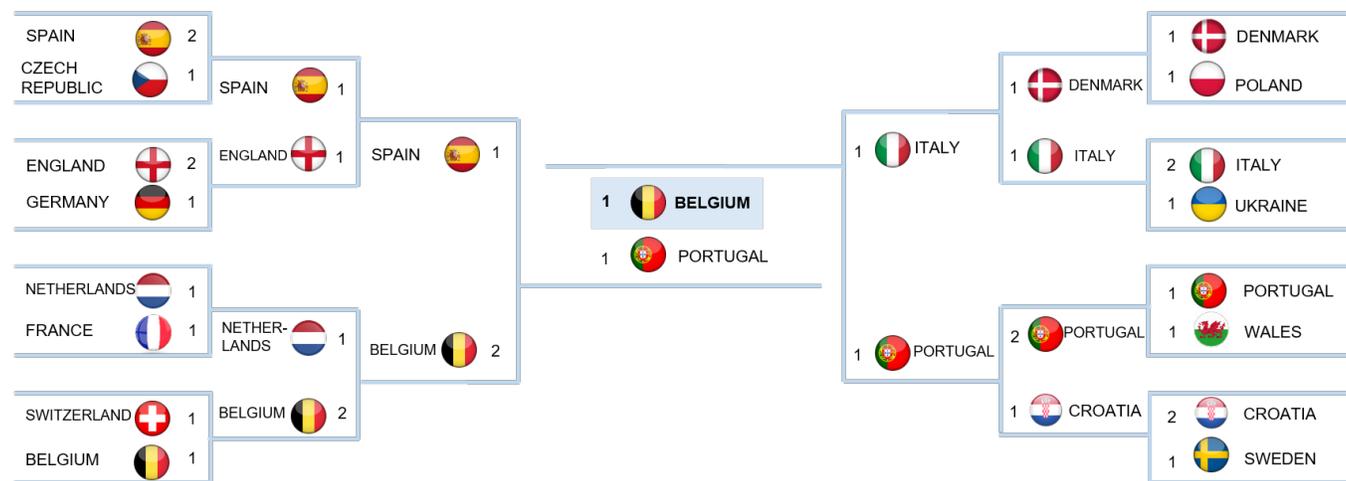
Fourth, we find that it matters whether nations typically tend to do well in competitions. We indeed find evidence that some countries—the “tournament teams”—systematically outperform relative to their Elo ranking. Teams where this effect is statistically significant include Croatia, the Netherlands and Germany (Exhibit 4, right).

**Picking a Winner**

We then simulate the tournament using our estimated scoring model (Exhibit 5 and 6). Our key predictions are:

First, Belgium will win the Euros for the first time in history, narrowly beating Portugal in extra time on July 11. The reason the model gives Belgium the edge is primarily its high Elo score, where it is ranked first amongst European nations, just behind Brazil. That said, we see a close race between Belgium, Italy, Portugal and Spain, which all make it to the semi-finals.

**Exhibit 5: The Knockout Stage**



Source: Goldman Sachs Global Investment Research

Second, we predict that Germany will make it out of its difficult group ahead of France, but then lose to England at Wembley during the round of 16, as Germany’s low Elo ranking more than outweighs its positive tournament effect. (Speaking as Germans, we checked this prediction a number of times.)

**Exhibit 6: The Chance of Success**

	R16	QF	SF	F	W
Belgium	91.7	65.4	52.2	33.6	21.7
Portugal	85.1	51.7	35.4	21.4	11.6
England	97.0	66.0	31.5	19.0	10.9
France	72.9	41.0	27.8	17.1	10.5
Spain	97.7	77.2	45.2	22.8	10.2
Denmark	97.7	62.2	36.3	16.1	8.2
Italy	92.3	61.4	31.6	15.6	6.8
Netherlands	98.2	65.1	29.2	14.6	5.6
Germany	77.2	35.8	20.9	10.1	5.2
Switzerland	63.9	28.0	13.0	5.6	1.8
Croatia	74.6	35.6	9.4	3.7	1.6
Wales	61.7	23.8	10.4	3.3	1.2
Poland	60.1	26.0	8.5	2.6	1.2
Sweden	69.4	27.8	8.8	2.8	0.9
Turkey	54.1	20.6	7.0	2.2	0.7
Hungary	39.2	11.3	4.5	1.6	0.5
Ukraine	67.8	23.2	7.2	2.4	0.4
Czech Republic	54.3	19.7	4.4	1.1	0.3
Finland	32.0	8.8	2.6	0.8	0.2
Russia	41.8	11.1	4.6	0.8	0.2
Austria	60.9	14.7	4.3	1.5	0.2
Slovakia	34.3	8.5	2.0	0.6	0.1
Scotland	42.7	10.7	2.1	0.5	0.0
North Macedonia	33.4	4.4	1.1	0.2	0.0

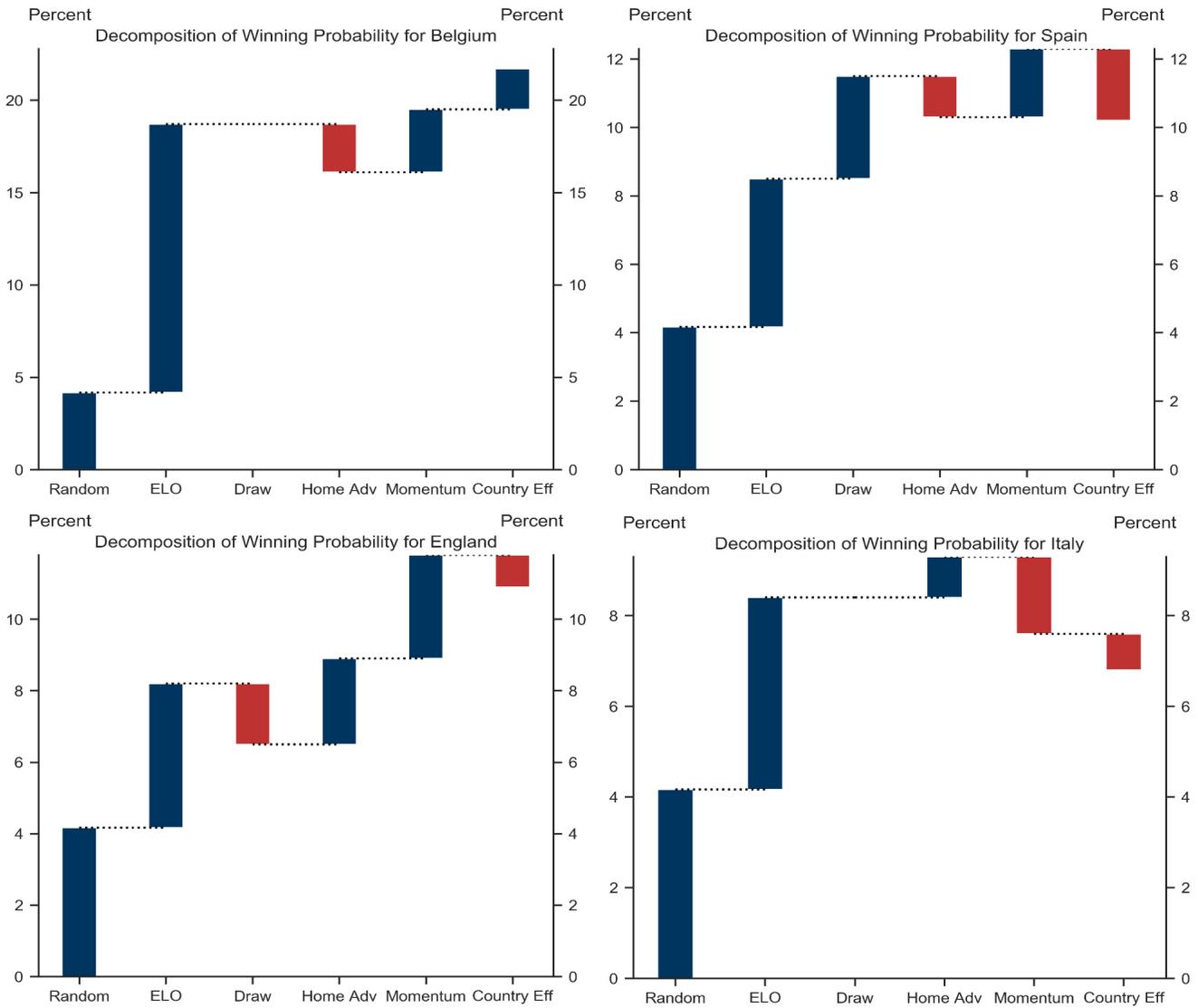
Source: Goldman Sachs Global Investment Research

Third, our analysis offers a few unexpected insights. One is that Denmark is projected to do well in this tournament, winning its group and losing only to Italy in the quarterfinals. Although France—as world champion—has a high Elo score, *Les Bleus* are penalised in our model by a difficult group stage, lack of home advantage and negative momentum in

recent games.

We see the intuition for our predictions in Exhibit 7, which decomposes the winning probability for selected teams. We see that Belgium’s high ELO score is the main component in the expected winning probability. But we also see that the “Home Advantage” favours countries in unexpected ways: while England clearly benefits from hosting both the semi-finals and the final in London, Italy has an easier path to victory because other countries’ home advantages help eliminate stronger competitors.

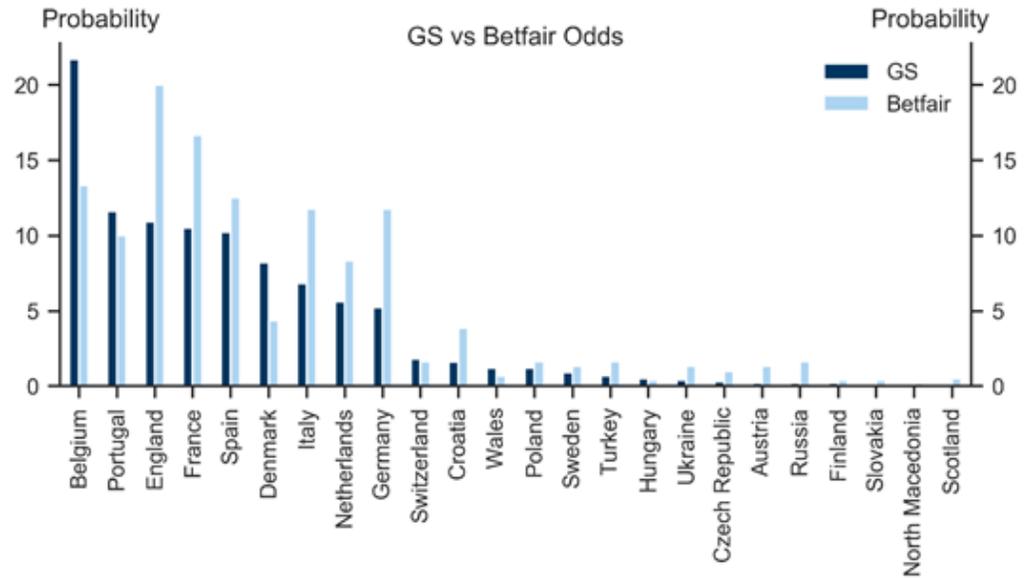
**Exhibit 7: The Path to Glory**



Source: Goldman Sachs Global Investment Research

Compared to betting odds, our model favours Belgium and predicts a lower probability of success for England. Another big gap arises for Germany, for which we predict that the draw will mean Germany faces England in the round of 16 in London, a difficult task. Our model does not, however, feature strategic play so Germany could tilt the odds in its favour by placing it third in the group with a favourable points/goal difference balance to still proceed to the knockout round.

**Exhibit 8: GS vs. Betting Odds**



Source: Goldman Sachs Global Investment Research

**Skill and Luck**

It is difficult to assess how much faith one should have in these predictions. We capture the stochastic nature of the tournament carefully using state-of-the-art statistical methods and we consider a lot of information in doing so. That said, we also see that the forecasts remain highly uncertain, even with the fanciest statistical techniques, simply because football is quite an unpredictable game. This is, of course, precisely why football is so exciting to watch.

**Christian Schnittker**

**Sven Jari Stehn**

## Appendix: Group Results

**Exhibit 9: Model Predictions for the Group Stage**

Group	Location	Date	Game		
A	Italy	11/06/2021	Turkey	1	2
A	Azerbaijan	12/06/2021	Wales	1	1
B	Denmark	12/06/2021	Denmark	3	1
B	Russia	12/06/2021	Belgium	2	1
C	Netherlands	13/06/2021	Netherlands	2	1
C	Romania	13/06/2021	Austria	1	1
D	England	13/06/2021	England	2	1
D	Scotland	14/06/2021	Scotland	1	1
E	Spain	14/06/2021	Spain	3	1
E	Russia	14/06/2021	Poland	1	1
F	Hungary	15/06/2021	Portugal	2	1
F	Germany	15/06/2021	Germany	2	1
A	Azerbaijan	16/06/2021	Turkey	1	1
A	Italy	16/06/2021	Italy	2	1
B	Denmark	17/06/2021	Denmark	2	1
B	Russia	16/06/2021	Finland	1	1
C	Netherlands	17/06/2021	Netherlands	3	1
C	Romania	17/06/2021	Ukraine	1	1
D	England	18/06/2021	England	2	1
D	Scotland	18/06/2021	Croatia	1	1
E	Spain	19/06/2021	Spain	2	1
E	Russia	18/06/2021	Sweden	2	1
F	Germany	19/06/2021	Portugal	2	1
F	Hungary	19/06/2021	Hungary	1	2
A	Azerbaijan	20/06/2021	Turkey	1	1
A	Italy	20/06/2021	Italy	2	1
B	Denmark	21/06/2021	Denmark	3	1
B	Russia	21/06/2021	Finland	1	2
C	Netherlands	21/06/2021	Netherlands	3	1
C	Romania	21/06/2021	Ukraine	1	1
D	England	22/06/2021	England	2	1
D	Scotland	22/06/2021	Croatia	2	1
E	Spain	23/06/2021	Spain	3	1
E	Russia	23/06/2021	Sweden	1	1
F	Hungary	23/06/2021	Portugal	1	1
F	Germany	23/06/2021	Hungary	1	2

Source: Goldman Sachs Global Investment Research

**Exhibit 10: Model Predictions for the Group Outcomes**

Country	Group	Points	Goal Difference	Goals Scored
Italy		9	3	6
Switzerland	A	2	-1	3
Wales		2	-1	3
Turkey		2	-1	3
Denmark		9	5	8
Belgium	B	6	1	5
Russia		1	-3	3
Finland		1	-3	3
Netherlands		9	5	8
Ukraine	C	2	-1	3
Austria		2	-2	3
North Macedonia		2	-2	3
England		9	3	6
Croatia	D	4	0	4
Czech Republic		2	-1	3
Scotland		1	-2	3
Spain		9	5	8
Sweden	E	4	-1	4
Poland		2	-1	3
Slovakia		1	-3	3
Portugal		7	2	5
Germany	F	6	1	5
France		4	0	4
Hungary		0	-3	3

We have changed the order in which third-placed teams progress from the group stages from a ranking based on points and unrounded goal difference, to points, rounded goal difference, followed by unrounded goal difference as the tie-breaker.

Source: Goldman Sachs Global Investment Research



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