

Improving the odds of winning in professional football

Research by Professor Ignacio Palacios-Huerta has illustrated how penalty kicks in football can prove key concepts in game theory.



What was the problem?

The study of mathematical models relating to conflict and cooperation – collectively known as game theory – has become a standard tool in economics and the social sciences. Of particular value is a branch of game theory known as mixed strategy play, where two or more competing players employ different strategies in a competitive situation, and which is useful for illuminating how individuals and organisations operate in a global political, social and financial context.

Mixed strategy play is underpinned by the notion of Nash equilibrium, first posited by the late Nobel Prize-winning economist John Forbes Nash (portrayed by Russell Crowe in the film 'A Beautiful Mind'). According to Nash's theory, in a zero-sum game – where a win for one player means a loss for the other – the best approach is to vary moves unpredictably. This has potentially huge implications for markets and politics. Yet because of its complexity, economists have found it difficult to empirically verify the Nash equilibrium in a real-world context.

What did we do?

LSE Professor of Managerial Economics and Strategy **Ignacio Palacios-Huerta** believed that the football penalty shoot-out was an ideal context for empirically testing the theory of mixed strategy play: a two-player, zero-sum game with a precisely defined set of rules, with all outcomes easily observable.

Palacios-Huerta conducted two studies of penalty shoot-outs, the **first** involving more than 1,000 penalty kicks in major national and international competitions. A **second study**, conducted with Jose Apesteguia, associate professor at Pompeu Fabra University in Barcelona, used an even larger sample of 2,820 penalty kicks from games held between 1970 and 2008.

Both studies reinforced the theory of mixed strategy play and Nash's underpinning notion equilibrium with remarkable consistency. Shooters invariably mixed up their shots, with about 60 percent aimed at the right of the net and 40 percent at the left (the difference due to more kickers being right-footed.) But the success rate was found to be the same: a goal about 80 percent of the time.

With Apesteguia, Palacios-Huerta also **analysed the implications of the coin toss on the outcome of penalty shoot-outs**. Most teams winning the toss elect to shoot first. Palacios-Huerta and Apesteguia discovered that the team shooting first wins 60 per cent of the time. According to interviews with more than 200 coaches, the advantage of shooting first is that it places additional pressure on the following team, leading to errors and a generally lower success rate.



What happened?

Palacios-Huerta published the findings of the first penalty shoot-out study in the *Review of Economic Studies* in 2003, and the study with Apesteguia in 2010 in the *American Economic Review*. Both publications drew immediate and widespread media coverage and were the subject of feature articles and interviews in the *Telegraph* and

Financial Times. An updated analysis by Palacios-Huerta – in which he reviewed more than 9,000 penalty kicks between 1995 and 2008 – resulted in a feature article in the *New York Times* published during the 2014 World Cup in Brazil.

The penalty shoot-out analysis was also quoted or referenced in three books, including *The Football Men: Up Close with the Giants of the Modern Game* by Simon Kuper and the best-selling *Soccernomics* by Kuper and Stefan Szymanski.

In 2014, Palacios-Huerta himself authored a popular book, *Beautiful Game Theory: How Soccer Can Help Economics*, which described the research and its broader implications for football and economics. In a review of the book, Nobel Laureate in Economics Gary S. Becker wrote that 'this stimulating book shows that an understanding of economic ideas gives deep insights into soccer play, and that soccer provides important evidence to test various theories of economic behaviour, such as efficient markets and social influences on behaviour'.

The data-set and methodology of Palacios-Huerta's research were also used to provide advice and recommendations for professional football clubs including Chelsea, Portsmouth and Barcelona and for national teams including England and Holland, both of which consulted Palacios-Huerta's work in the midst of the 2010 World Cup in South Africa. According to Ruud Hesp, the Goalkeeping Coach for the Holland National Team, 'The report gave us valuable additional information and analysis on each player. We were highly impressed by the amount of detail in the report, and would recommend his penalty reports to other teams.'

Palacios-Huerta also authored several academic and popular media articles suggesting ways to mitigate against the outsized impact of the coin toss on penalty shoot-outs.

Notes:

- This article was initially published as an *Impact Case Study* and re-published on our blog with the authors' permission.



Ignacio Palacios-Huerta has been a Professor of Management since 2007. Professor Palacios-Huerta's research mainly focuses on identifying and studying novel questions concerning individual and aggregate human behaviour, including strategic behaviour in competitive settings, human preferences, incentives and human capital, among others. Prior to joining

LSE, he was Assistant Professor and Full Professor of Economics at Brown University, Assistant Professor at the Tuck School of Business at Dartmouth College, Visiting Professor at the University of Chicago, and National Fellow at the Hoover Institution of Stanford University.



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Afroditi was the editor of the Management with Impact blog between February - June 2017. In September, Afroditi is starting her PhD at LSE to investigate the mediation of migration.

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