

RULES OF THE GAME



As the World Cup kicks off in Brazil, **Ignacio Palacios-Huerta** explains how the beautiful game provides the perfect test bed for economic theories.

Just as Newton studied an apple falling from a tree because he was interested in physics rather than fruit, so data from football can be used to study important theories in economics that have not been tested before.

In fact, sports provide the perfect laboratory to do this for a number of reasons. There is an abundance of readily available data, the aims of the participants are often uncomplicated (score, win, enforce the rules) and the outcomes are extremely clear.

For example, I used football data to test, for the first time, a subset of theories by John F Nash Jr – recipient of the 1994 Nobel Prize in Economics and subject of the film *A Beautiful Mind*. These deal with how people should behave in “mixed” strategic situations or “games” where no one strategy is always optimal – like in rock, paper, scissors, where choosing scissors every time is unlikely to win you the game.

According to the Nash Equilibrium in a zero-sum game – where a gain for one player entails an identical loss for the other – the optimal strategy for a player is to choose his strategies in just the right proportions to make the probability of winning identical across strategies or plays, and to make a *random* choice between all plays available to him. This principle applies to any type of agent (firms, banks, countries,

public institutions) interested in varying their strategies so as to be unpredictable to their competitors.

But could this theory be proved in real life? The answer is yes – with data from penalty kicks. In fact, the clarity of the rules and structure of a penalty kick captures the theoretical setting of a zero-sum game extremely well. In a typical kick, the ball takes a mere 0.3 seconds to travel from the penalty mark to the goal line, which means that the kicker and goalkeeper must move simultaneously. Also, the players’ actions and the outcome are easily observable, contrary to other real-life settings.

I collected data on 9,017 penalty kicks between 1995 and 2012 from professional games in Spain, Italy and England. I found that, as the Nash Equilibrium suggests, professional football players typically choose the right proportions (roughly 55 per cent of kicks are made to the right of the net, 5 per cent to the centre, and 40 per cent to the left) to make the probability of winning statistically identical across each choice of shot, and that their shots are completely random. Incidentally, in previous tests of randomness in experimental research people switch strategy too often to be consistent with random play. Thus, for the first time, real-life data has shown that human behaviour is as Nash predicted in mixed strategy settings.

Data from penalty shoot-outs can also show how psychological pressure affects performance in competitive environments such as the labour market. In penalty shoot-outs the order of competition is randomly determined, and so one team (the one shooting first) is randomly given the chance to be leading in the competition. It turns out that the first kicking team wins not 50 but 60 per cent of the time. So, a penalty shoot-out is not a 50-50 lottery but rather a 60-40 lottery. In other words, the team that shoots first has an unfair psychological advantage that is caused by the leading/lagging asymmetry in the competition.

I also wanted to know if players were aware of this effect and would therefore, if rational, always choose to go first. In every case that was observed, the winner of the toss chose to kick first, with just two exceptions.

Notably, one was the Italy-Spain match in the quarter-finals of the European Championship in June 2008. Gianluigi Buffon, Italy’s goalkeeper, won the toss against Iker Casillas, the goalkeeper from Spain, and chose Spain to kick first. Spain won 4-2. Interestingly, the second comes five years later from the Spain-Italy match in the Confederations Cup in June 2013, again with Buffon and Casillas. This time

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Casillas won the coin toss and returned the favour: he chose Italy to kick first. Fortuitously Spain won the penalty shoot-out but, perhaps, as the saying goes, while you don't have to be crazy to be a goalkeeper, it certainly helps.

Data from football can also help us with the most prominent theories of the stockmarket – the efficient markets hypothesis – which was the focus of the last Nobel Prize in Economics. This posits that the market incorporates information so completely and quickly that any relevant news is fully incorporated into the stock's price before anyone has the chance to act on it. This means that, unless you have special information, no stock would be a better buy than any other.

If the theory is correct, then the price of an asset should jump up or down discretely when news breaks and then remain perfectly flat until there is more news. To test this we would need to freeze time for news but let the time for trading continue – which seems impossible. Except Karen Croxson and James Reade managed just that by using data from live football betting markets. They specifically looked at betting around goals scored just seconds before half-time and then during half-time.

The break in play provides a golden opportunity to study market efficiency because the playing clock stops but the betting clock continues. Any drift in half-time prices can be interpreted unambiguously as evidence for market inefficiency, since efficient prices should not drift when there is no news (goals in this case).

At the start of a recent Premier League match between Tottenham Hotspur and Manchester United, Manchester was the favourite to win, as implied by the best back price offered by Betfair – the online bookmakers – with a 56 per cent probability. This probability drifted downwards as the first half progressed without a goal. By the 44th minute it had fallen to under 50 per cent. Then, just before half-time began, Manchester scored to go ahead and the probability for a Manchester victory increased to 77 per cent. During half-time this probability remained perfectly constant at 77 per cent while the market traded actively.

Croxson and Reade found that this was the case for all 160 goals they looked at that arrived within five minutes of the end of the first half. Betting continued throughout half-time but the price remained constant – thus proving that these markets are indeed efficient.

Football can also shed light on how decision-making can be affected by social pressure, in particular on whether social pressure can cause corruption. Professional soccer games are attended by huge crowds of up to 100,000 people in the top European and South American leagues, often overwhelmingly and loudly rooting for the home team. Does the home referee internalise the social preferences in the stadium? Do these forces corrupt him and push him to rule in favour of one team over the other?

There is one specific, easily quantifiable decision that a football referee makes that allows for a clean testing of this: the amount of injury time added to a match. This amount should depend on observable factors and be independent of the identity of the team (home or visiting) that is leading in the score. Yet, it is not. Referees on average add more injury time when the home team is behind in a close game (35 per cent above average) than when it is ahead in an equally close game (29 per cent below average).

Fellow football fan LSE provost Stuart Corbridge referenced my research in the run-up to the last World Cup (*LSE Connect*, summer 2010) to make the case that England was not going to win – unfortunately by that logic England does not stand much of a chance in 2014 either!

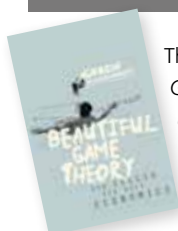
Other areas where football data can shed important light include the economics of discrimination, the economics of fear, the dark side of incentives in organisations, and even the neuroeconomics of mixed strategies.

So aspects of the game that are less than “beautiful” from a fan's perspective can be extremely illuminating for economists. I hope this will not ruin how football fans appreciate the game! As for me, I'm looking forward to watching the World Cup as both an enthusiastic fan and an economist. ■



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This article is based on *Beautiful Game Theory: how soccer can help economics* by Ignacio Palacios-Huerta, published by Princeton University Press (2014).

ALUMNI VIEWPOINT



The football pitch may provide a perfect laboratory for some economic theories, but the game itself and sport generally can transform economies. This is the case in China, where I am working to introduce American football and the American Football League of China (AFLC).

Though still in its infancy, signs that the sport has grown in recent years are apparent. The National Football League (NFL) China, opened in 2007, has witnessed a 240 per cent climb in its fan base, with more than 22 broadcasting platforms bringing games and league news to potential fans. Domestic viewership of the Super Bowl last year surpassed 15.7 million people, a seventh of 111.5 million people who watched it in the US.

As the sport's popularity has taken off, so has the desire to experience the passion and excitement that comes with playing the game. Enthusiasts, both local and foreign, have worked hard to organise teams at the grassroots level. Between high schools, universities and amateur-level clubs, there have been more than 35 teams established in the last three years.

Larger trends happening across the country help explain why you now find the pigskin being tossed around the streets in China. The mix of an increasingly large number of native-born Chinese returning to China, a growing middle class who demand new forms of recreation and entertainment, and expanding influence of American and European sports culture are all factors that have led to the sport's emergence.

As an organizer of China's largest amateur American football league – AFLC – I work with teams in seven of China's top-tier cities to coordinate, promote and popularize American football for a national audience. Next year's season will feature an exciting seven-game season and championship featuring more teams, players, referees and fans.

More people following and playing American football in China, along with other popular sports from abroad, has the potential to transform economies in ways that can challenge conventional theory and expand on the economic test bed that Professor Palacios-Huerta elucidates in *Beautiful Game Theory*.

Chris McLaurin (MSc Social Policy and Planning 2011) is an organiser of the American Football League of China. His story was recently published by the *New Republic Magazine*.