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An Analysis of Nations' Performance in International Multi-Sport Competitions

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An Analysis of Nations' Performance in International Multi-Sport Competitions

Darryl Wilson

Published works submitted in partial fulfilment of the requirements of Sheffield Hallam University for the degree of Doctor of Philosophy on the Basis of Published Work.

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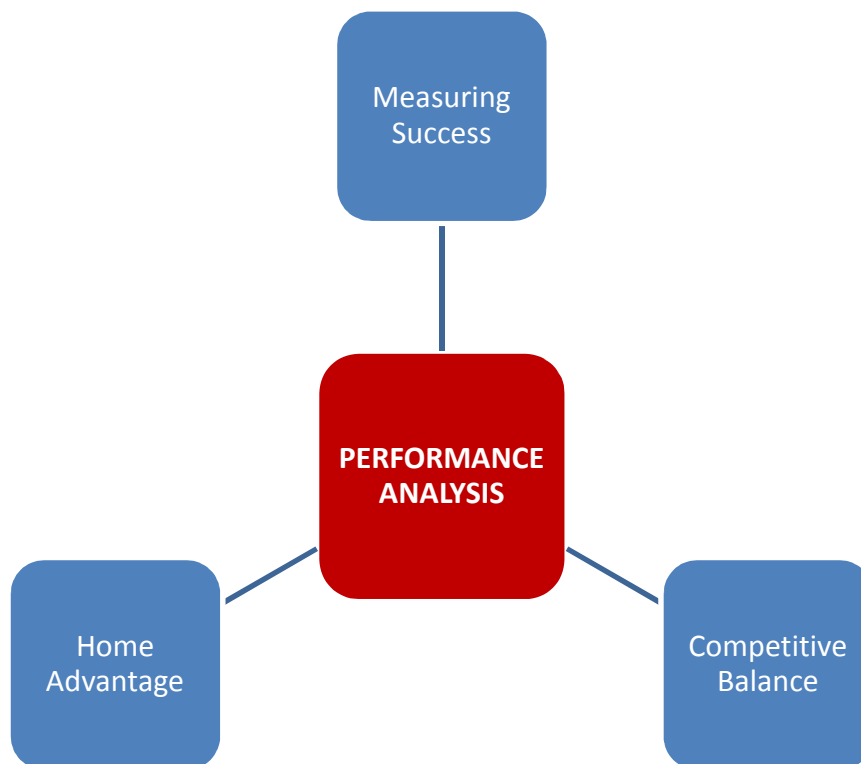
ABSTRACT

In recent years the competition between nations for success in elite sport has intensified, which has resulted in increasing sums of money being invested by some nations into elite sport development programmes. At the same time many governments around the world have adopted national sports policies that specify hosting major sports events as a major objective. A broad range of benefits have been suggested for both the country and the host city from staging these events. Set against this background of greater competition for hosting major sports events and achieving success in elite sport, the portfolio of publications contributes to knowledge in three ways. First, the research illustrates alternative ways by which nations' success in elite sport can be judged in major multi-sport events, including the Olympic and Paralympic Games and the Commonwealth Games. Second, the research provides new insights into the impacts of hosting these events from an elite performance perspective by investigating the prevalence of a home advantage effect and the factors that contribute to its occurrence. Third, the research also demonstrates how competitive balance has evolved in the specific context of the Commonwealth Games.

INTRODUCTION

This PhD consists of six original research articles published in peer reviewed academic journals and one published research report. The overall aim of the research programme was to examine the performance of nations in international multi-sport competitions. Figure 1 illustrates that there were three related themes to this analysis.

Figure 1: Research themes



First, the research involved conceiving, developing and applying different performance indicators for 'measuring success' in elite sport (REFS 1-7). Second, the research investigated the prevalence of a 'home advantage' effect in different competitions and explored the factors that contribute to its occurrence (REFS 2-3, 5-7). Third, the research contributed to the study of 'competitive balance' in a multi-sport event context (REF 4).

The following sporting competitions were featured in this research: Summer Olympic and Paralympic Games; Winter Olympic and Paralympic Games; and Commonwealth Games. While there is no universally agreed definition of sports events, the competitions featured in this research match the following criteria as per the event typology put forward by Gratton and Taylor (2000, p. 190):

Irregular, one-off, major international spectator events generating significant economic activity and media interest.

Another common feature between the events listed above is that they can all be termed 'unbalanced' competitions, in the sense that nations inevitably compete in them more often away from home than they do on home soil. This is unlike professional sports leagues where teams typically compete on a balanced home and away schedule.

RESEARCH OBJECTIVES

The broad objectives of the research programme are outlined below.

1. To develop and implement standardised measures for assessing the performance of nations in multi-sport competitions.
2. To investigate whether nations perform better at home than they do away from home in multi-sport competitions.
3. To explore the potential causes of the home advantage phenomenon by analysing its occurrence within different types of sports and events.
4. To investigate competitive balance in a multi-sport event context.

POSITIONING THE RESEARCH

Elite sport development and performance analysis in elite sport

In recent years the competition between nations' for success in elite sport has intensified, as is evidenced by the increasing sums of money being invested by some nations into elite sport development programmes. This development has been referred to as a 'global sporting arms race' (De Bosscher, De Knop, Van Bottomburg, & Shibli, 2006). To illustrate this point, Table 1 shows the amount of money invested by UK Sport (the nation's high performance sports agency investing in Olympic and Paralympic sport) through its World Class Performance Programme in recent years.

Table 1: Elite sport funding in the UK

Years	Summer Olympic Sports	Summer Paralympic Sports	Winter Olympic Sports	Winter Paralympic Sports
2005-2008	£235,103,000	£29,545,872		
2007-2010			£5,776,000	£650,000
2009-2012	£264,143,753	£49,254,386		
2011-2014			£13,444,638	£755,600
2013-2016	£274,465,541	£72,786,652		
2015-2018			£28,353,135	£3,909,223

Source: <http://www.uk sport.gov.uk/our-work/investing-in-sport/historical-funding-figures>

The amount of elite sport funding for Summer Olympic and Paralympic Sports combined increased from around £264m in the four years leading up to the Beijing 2008 Games to more than £347m in the four years leading up to the Rio 2016 Games. The data in Table 1 also illustrates that there has been considerable growth in the funding allocated to Winter Olympic and Paralympic sports in the UK. As a consequence of public investment in elite sport, there is increased scrutiny and accountability as to the efficiency and effectiveness of how those public funds are used. For example, the current Government Strategy for Sport in the UK

identifies the following key indicators against which to measure overall performance (Cabinet Office, 2015):

- Number of Olympic and Paralympic medals won at Summer and Winter Games
- Position in Olympic and Paralympic Summer and Winter medal tables
- UK/Home Nation performance in pinnacle World, European or Commonwealth competitions

Previous research on performance analysis in elite sport has questioned the appropriateness of medals' table rankings, which are based on the number of medals won, with gold medals taking priority over silver and bronze, as the primary measure of a nations' success. Medal-counting is often used by politicians and the media to compare international success. However, medals' tables are not formally recognised as an order of merit as illustrated by the excerpt below (UK Sport, 2003 p.35):

The International Olympic Committee (IOC) does not recognise global ranking per country; the medal tables are displayed for information only.

Several researchers have sought to investigate the determinants of success in elite sport based on macro-level factors such as population size, economic welfare, climate, geographical circumstances and political systems (e.g. Bernard and Busse, 2004). Research has shown that over 50% of international success by countries can be expressed by three variables, namely population, wealth and communism (De Bosscher, 2006). However, as nations have become strategic in their approach to elite sport development, they rely less on these passive macroeconomic variables and more on critical success factors that can be influenced by well-considered policies.

De Bosscher et al.'s (2015) SPLISS framework identifies nine pillars of policy components that can contribute to increased success in elite sport, namely: (1) financial support; (2) elite sport structures and policies; (3) sport participation; (4) talent identification and development system; (5) athletic and post-career support; (6) training facilities; (7) coaching and coach development; (8) national and international competition; and, (9) scientific research. These pillars are operationalised into a number of critical success factors. A co-ordinated approach to the staging of international events is considered to be a critical success factor within the eighth SPLISS pillar identified for successful elite sports policies.

An explicit and generic assumption here is that hosting international events inevitably has a positive effect on the success of athletes from the host country resulting from performing in a familiar environment and in front of a supportive home crowd. However, this assumption is not formally tested by SPLISS. The publications underpinning my PhD extend and develop the eighth pillar of the SPISS framework through a programme of home advantage research in international multi-sport competitions.

Impacts of hosting major events

Alongside the increase in elite sport funding, many governments around the world have adopted national sports policies that specify hosting major sports events as a major objective. The following excerpt from *Sporting Future* substantiates this point (Cabinet Office, 2015 p.79):

The UK has a strong track record of delivering world class major sporting events and this is something we want to continue, for the vital role many events play in preparing our athletes for the Olympic and Paralympic Games, for the economic

impact they can bring and the potential to inspire those that experience the events themselves.

The considerable public investment required to host major events such as the Olympic and Paralympic Games is often justified in terms of their potential to generate a wide range of benefits for host countries. In 2000, the Olympic Games Global Impact (OGGI) project was launched by the IOC to improve the evaluation of the overall impacts of the Olympic Games on the host city, its environment and its citizens, as well as to propose a consistent methodology to capture the overall effects of hosting the Games (Gratton & Preuss, 2008). The concept of 'legacy' has become an essential part of vocabulary of the IOC and the Organising Committee of the Olympic Games (Girginov & Hills, 2008).

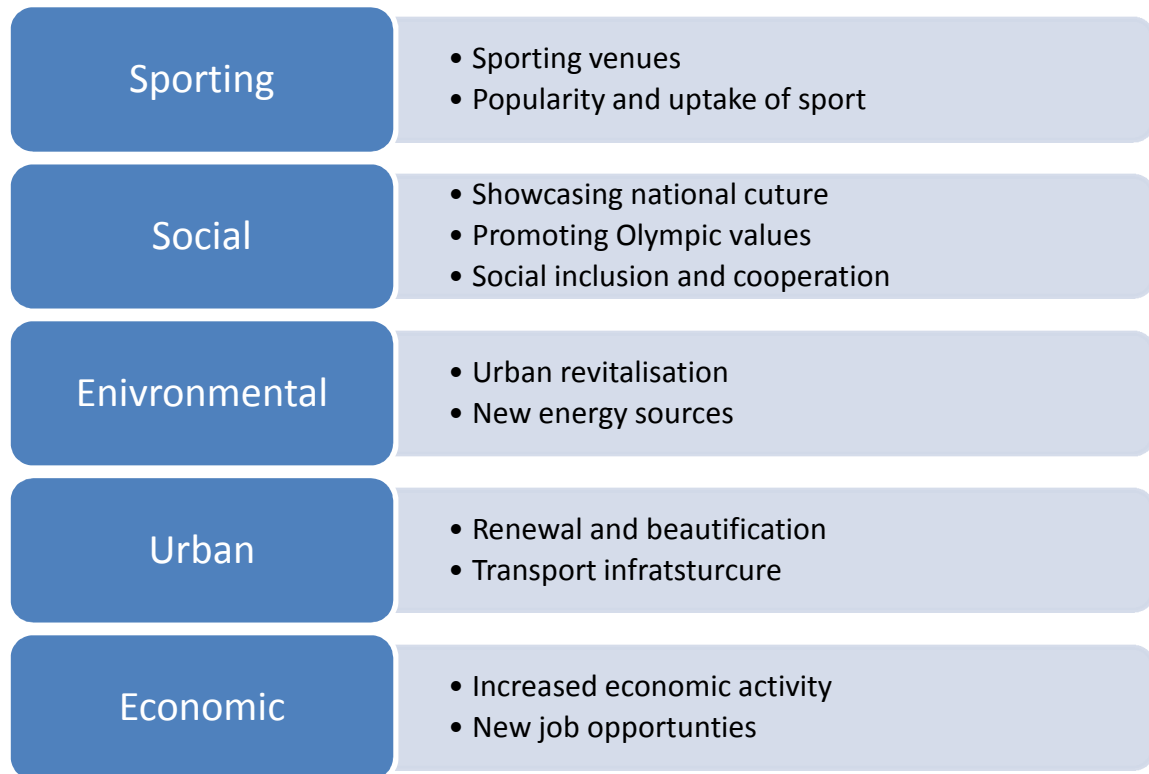
Despite the lack of a clearly defined concept, authors generally tend to agree that legacies of major sports events such as the Olympic and Paralympic Games could be positive or negative, tangible or intangible, intended or unintended (Cashman 2003; Gratton & Preuss, 2008; Mangan, 2008; Masterman, 2009), and authors have proposed different perspectives on possible event legacies.

The IOC categorises the proposed benefits associated with hosting the Olympic Games under five broad legacy dimensions. These five dimensions and their respective sub-dimensions are shown in Figure 2. These are equally applicable to other major sporting events including but not necessarily limited to the Paralympic Games and the Commonwealth Games.

The sporting legacy dimension in Figure 2 consists of two sub-dimensions. First, the sporting venues that are specifically built or refurbished for the Games, which can be used for sport following the conclusion of the Games. For example, permanent venues constructed in connection with the London 2012 Olympic and Paralympic Games such as the Aquatics Centre and the VeloPark have hosted several other major sports events subsequently and are

also open for public use. Second, the public interest generated by hosting a major sporting event provides an opportunity to enhance the profile of sport and boost grassroots participation, in order to improve the health and wellbeing of the population.

Figure 2: Olympic legacy dimensions



Source: Adapted from IOC (2012)

The evidence to support such legacy claims is, however, mixed. Indeed, a systematic review of literature found no conclusive evidence of positive health or socio-economic impacts on host populations resulting from major multi-sport events held between 1978 and 2008 (McCartney et al. 2010).

Another type of potential sporting legacy from hosting the major sporting events (seldom cited as such in academic literature) relates to success in elite sport, particularly the extent to which nations that are awarded the right to host certain major sporting events benefit from improved performance when competing at home through a quantifiable home advantage

effect. The majority of the publications that underpin this PhD (REF 2, 3, 5-7) are concerned with an investigation of home advantage in international multi-sport competitions.

Home advantage in elite sport

The most comprehensive and well-researched conceptual model that attempts to explain the home advantage phenomenon was developed by Carron and colleagues. Their model had two iterations. The original framework proposed by Courneya and Carron (1992) incorporated five major components: (1) game location; (2) game location factors; (3) critical psychological states; (4) critical behavioural states; and, (5) performance outcomes. 'Game location' is either home or away depending on where the competition takes place. There are four 'game location factors' that differentially impact on athletes and teams competing at home or away from home, namely: (1) the support of the home crowd; (2) familiarity with the home venue; (3) travel fatigue of the away team; and, (4) competition rules in certain sports that may favour the home team. Courneya and Carron (1992) theorised that these four factors contribute to the 'psychological states' of competitors, coaches and officials that in turn contribute to the 'behavioural states' (responses) of these individuals, which ultimately tend to favour home athletes and teams.

Courneya and Carron's (1992) model was subsequently refined by Carron, Loughhead and Bray (2005). A comparison of the original framework and its revised iteration is shown in Table 2. There are two key differences between the original and revised models. First, 'officials' were excluded from the latter, not because they do not potentially contribute to home advantage but as, unlike competitors and coaches, they do not have a designated home or visitor status. Second, the revised model incorporated the 'critical physiological states' of competitors and coaches that are associated with game location. The rationale for the inclusion of physiological states in Carron et al.'s (2005) revised home advantage model was

informed by the work of Neave and Wolfson (2003) who proposed that the competitive context of organised sport invokes the natural protective response to territorial intrusion in human beings, combined with the evidence provided by other researchers on the adverse effect of jet lag on athletic performance (Jehue, Street, & Huizenga, 1993; Recht, Lew, & Schwartz, 1995).

Table 2: Home advantage conceptual framework comparison

Component		Original model^a	Revised model^b
Game location	Home	✓	✓
	Away	✓	✓
Game location factors	Crowd	✓	✓
	Learning/Familiarity	✓	✓
	Travel	✓	✓
	Rules	✓	✓
Critical psychological states	Competitors	✓	✓
	Coaches	✓	✓
	Officials	✓	✗
Critical physiological states	Competitors	✗	✓
	Coaches	✗	✓
Critical behavioural states	Competitors	✓	✓
	Coaches	✓	✓
	Officials	✓	✗
Performance outcomes	Primary	✓	✓
	Secondary	✓	✓
	Tertiary	✓	✓

^a Courneya and Carron (1992)^b Carron et al. (2005)

Studies of territoriality in some team sports have shown that testosterone concentrations of players were considerably higher before home games compared with before away games (Neave & Wolfson, 2003; Carré, Muir, Belanger, & Putnam, 2006). Rises in testosterone are thought to benefit athletic performance because they coincide with greater physical aggression and motivation to compete (Wood & Stanton, 2012).

Another hormone that changes in response to game location is cortisol (Allen & Jones, 2014) and there is research showing that cortisol levels are elevated prior to competing at home venues (Carré et al. 2006; Fothergill, Wolfson, & Neave, 2017), which is indicative of a higher level of stress before home games. Feeling stressed or under pressure to perform in front of home fans could in turn have a detrimental effect on athletic performance such that home advantage is diluted or even reversed. This is the premise for another conceptual model, according to which the pressure of performing in front of a supportive audience can in certain situations trigger a 'choking' response among home athletes and teams, resulting in a home disadvantage. This notion was introduced by Baumeister and Steinhilber (1984). Butler and Baumeister (1998) found that participants in laboratory experiments performed less well when performing for supportive versus unsupportive audiences.

Competitive balance

Another concept that is highly relevant to both elite and professional sport is that of competitive balance. In business terminology, competitive balance is normally used to describe a market situation where no business is too big or has an unfair advantage (FT Lexicon, 2013). In the context of sport, competitive balance is the extent to which competitors are evenly matched (Fort & Quirk, 1995). Competitive balance is important because it enhances outcome uncertainty and therefore it promotes spectator interest, and encourages government investment in a sport (Zheng, Oh, Kim, Dickson & De Bosscher 2018). Studies on competitive balance in sport can be categorised along two broad lines: first, analysis of competitive balance (ACB) literature, which focuses on what has happened to competitive balance over time due to changes in business practices of sports organisations; and second, literature on competitive balance that tests the uncertainty of outcome hypothesis (UOH) i.e. the effect of competitive balance on fan attendance. It is the first of these

approaches (i.e. ACB) that one of the publications underpinning my PhD (REF 4) is concerned with.

METHODS

Philosophical stance

This section attempts to place the techniques employed within my research into a wider philosophical context which demonstrates the ontological and epistemological assumptions underpinning my research. Gratton and Jones (2010) identify research as a systematic process of discovery and advancement of human knowledge, a systematic investigation to answer a question. They go further stating that research can be placed on a continuum between pure research and applied research depending on its context and methods employed. These methods each fall into a different paradigm, which in turn is made up of different philosophical components.

Research methods text books typically identify two broad theoretical perspectives in the social sciences, positivism and interpretivism. These paradigms have very different ontological and epistemological assumptions. Ontology is defined as a way of looking at the world and epistemology as the relationship between the researcher and the subject of research. Ontology deals with a set of philosophical questions which arise when we consider the nature of reality whereas epistemology is concerned with the question of what is (or should be) regarded as acceptable knowledge in a discipline (Crotty (1998); Veal (2017)). The ontological and epistemological positions that researchers take have important implications for the way that research is approached, notably in the type of data that is collected, how such data is collected, the way that such data can be interpreted and the conclusions that can be drawn.

It is my view that the techniques employed within my research programme are most closely aligned with the ontological stance of 'realism' whereby it is possible to observe and record events in the real world objectively. In epistemological terms, my approach is one of objectivism, according to which the methods of the natural sciences can be used to develop 'laws' in order to explain or predict future behaviour. However, there are aspects of my research that can be regarded as having an interpretivist design. An example of this is the approach I have taken to define how nations' performance can be measured or what constitutes success in elite sport. There are alternative approaches to performance measurement in international sport and different performance measurement systems can give conflicting diagnosis of a nation's performance (De Bosscher, et al. 2006; De Bosscher, De Knop, Van Bortomburg, Shibli & Bingham 2009). Consequently, I consider my philosophical stance to be that of post-positivism rather than purely positivist.

Post-positivism softens the stance of pure positivism by acknowledging that a reality exists, but qualifies this by suggesting that we can only know this reality in part and on the basis of probability rather than certainty. Furthermore, as Howell (2016) suggests, positivists accept that the influence of researchers through their knowledge, values and theories can influence what is observed or reported. The scientific paradigm that post-positivism falls under encourages the use of research methods that generate quantitative data (Pring, 2004).

Research design

The overall design of my research involved:

- a critical review of relevant academic literature to identify the gaps in knowledge and formulate the relevant research questions;
- a thorough analysis of results' databases of different sporting competitions;

- developing suitable performance indicators to measure the success of nations in these competitions;
- defining/refining what is meant by 'home advantage' and 'competitive balance'; and
- examining these concepts through descriptive and statistical analysis of the data.

Relative measures of performance were used to analyse the success of nations at home and away from home in order to control for changes in the number of events contested over time. This approach facilitated performance of nations to be measured on a standardised basis, which is important when examining home advantage and competitive balance.

Home advantage is commonly defined as the consistent finding that home teams in sport competitions win over half of the games played under a balanced home and away schedule (Courneya & Carron, 1992). However, this definition of home advantage is not directly applicable to 'unbalanced' competitions such as major multi-sport competitions. A more appropriate definition for such competitions is suggested by Koning (2005, p.19):

...the performance advantage of an athlete, team or country when they compete at a home ground compared to their performance under similar conditions at an away ground.

In order to ensure that less successful countries were not unfairly compared with more successful countries, the derivation of home advantage involved a comparison of the performance of a nation when an event was held in its own country with its own performance when competing in other countries. An average home advantage effect was then calculated across all host nations. Countries that had not hosted an event were excluded from the analysis. However, in order to measure competitive balance the performance of all competing nations needed to be considered. Home advantage and competitive balance calculations were undertaken at an overall nation level as well as for different types of sports and events. A summary of the programme of research undertaken is presented in Table 3.

Table 3: Scope of the research programme

REF	Competition	Concepts Examined	Analysis Period	Scope of analysis	Key Performance Indicators
1	Commonwealth Games	MS	1950 - 2002	Overall host nation, event and sport level analysis	Absolute: gold medals, total medals, medal points Relative: medal points share
2	Commonwealth Games	MS, HA	1950 - 2006	Overall host nation level analysis	Relative: medal points share
3	Commonwealth Games	MS, HA	1950 - 2010	Overall host nation, event and sport level analysis	Relative: gold medal share, total medal share, medal points share
4	Commonwealth Games	MS, CB	1930 - 2010	Overall nation, event and sport level analysis	Relative: medal points share
5	Winter Paralympic Games	MS, HA	1976 - 2014	Overall host nation and sport level analysis	Relative: medal points share
6	Summer Paralympic Games	MS, HA	1960 - 2016	Overall host nation and sport level analysis	Relative: medal points share
7	Summer Olympic Games	MS, HA	1988 - 2018	Overall host nation and sport level analysis	Relative: medal points share
	Winter Olympic Games				
	Summer Paralympic Games				
	Winter Paralympic Games				

MS = measuring success; HA = home advantage; CB = competitive balance

CONTRIBUTION TO KNOWLEDGE

Measuring success

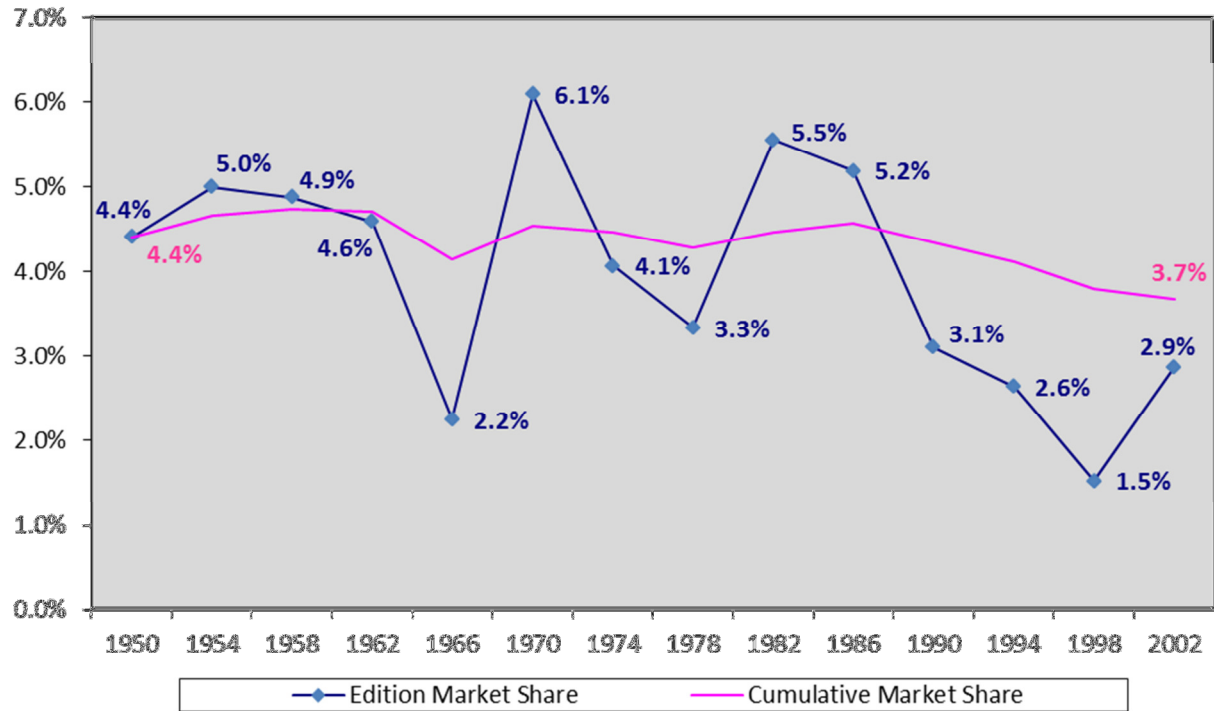
The success of nations at major sports events is typically judged in terms of the number and type of medals that they win and their overall position in the medal table. In multi-sport competitions like the Olympic Games and the Commonwealth Games, nations are ranked according to the number of gold medals, then silver and then bronze medals. One shortcoming of this approach to measuring success is that it does not consider the relative weight of medals won by nations. In other words, a nation that wins (say) three gold medals is placed higher in the medal table compared to a nation that wins (say) two golds, two silvers and one bronze. It is therefore important to assign a value to the type of medals won so that the totality of achievement can be measured.

Furthermore, when comparing a nation's performance in a competition over time, considering absolute performance is of limited value because the number of events contested can vary considerably. As illustrated in REF 1 and REF 2, the number of events contested at the Commonwealth Games increased from 88 in 1950 to 281 in 2002. To account for such challenges associated with consistent measurement over time, in my research I have utilised a standardised measure of performance - market share - whereby the number of medals won by nations were converted into points and then expressed as a proportion of the total number of points won by all nations.

The figure below is taken from REF 1 and shows how Scotland performed in the Commonwealth Games between 1950 and 2002 using this measure (where a gold medal equals three points, a silver equals two and a bronze equals one). My approach to the measurement of success is given credence by the fact that market share has been adopted as being the most robust measure of controllable performance by an international network of

research cooperation on elite sport policies – SPLISS (Sports Policy factors Leading to International Sporting Success).

Figure 3: Scotland's market share in the Commonwealth Games 1950-2002



When analysing the performance of Scotland in the Commonwealth Games (REF 1), it was noticed that Scotland achieved its greatest market share in 1970 when it was the host nation (6.1%). This finding was the basis for my subsequent research into home advantage in the Commonwealth Games (REF 2 and 3), which I then extended to the Olympic and Paralympic Games (REF 5-7).

Home advantage

Commonwealth Games

My first paper on home advantage (REF 2) showed that seven of the eight nations that had hosted the Commonwealth Games between 1950 and 2006 achieved a better average market share at home compared to their average away market share. This analysis was developed further in REF 3 in two ways. First, by comparing how host nations performed at home

compared to the editions that immediately preceded (pre-host) and followed (post-host) their home edition. In the context, REF 3 corroborated the findings from REF 2 and confirmed that hosting the Commonwealth Games coincided with a significant improvement in performance over the pre-host edition, which was not sustained in the post-host edition. Second, by examining differences in home advantage based on different sport groups. For example, it was confirmed that home advantage was more prevalent in sports that involved subjective decision making by officials such as boxing, gymnastics and wrestling compared to sports that were more objectively judged such as badminton, shooting and squash. This finding supports the notion that for sports involving subjective scoring or judgement, it is possible for referees to make decisions in favour of the home team (Nevill, Balmer, & Williams, 2002; Balmer, Nevill, & Lane, 2005).

Another potential factor influencing home advantage in the Commonwealth Games is strategic in nature. A relatively recent development in the Commonwealth Games (since the 1998 event held in Kuala Lumpur, Malaysia) has been that a host nation is allowed the flexibility by the Commonwealth Games Federation (CGF) to influence the sports (and disciplines within each sport) included on the programme. Thus, host nations may opt to put forward sports and events that provide them with the best medal winning opportunity. Concurrently, organising committees may consciously minimize or omit disciplines in which competitor nations have a proven track record of success.

There is some evidence that recent hosts have sought to manipulate the programme of the Commonwealth Games to their advantage; for example, Malaysia introducing ten pin bowling in Kuala Lumpur 1998, the inclusion of judo by England in Manchester 2002, basketball by Australia in Melbourne 2006 and wrestling by India in Delhi 2010. The analysis conducted in REF 3 verified that home advantage was more prevalent in 'optional'

sports that are held at the discretion of host nations compared to 'core' sports that are a mandatory part of the competition programme.

Olympic and Paralympic Games

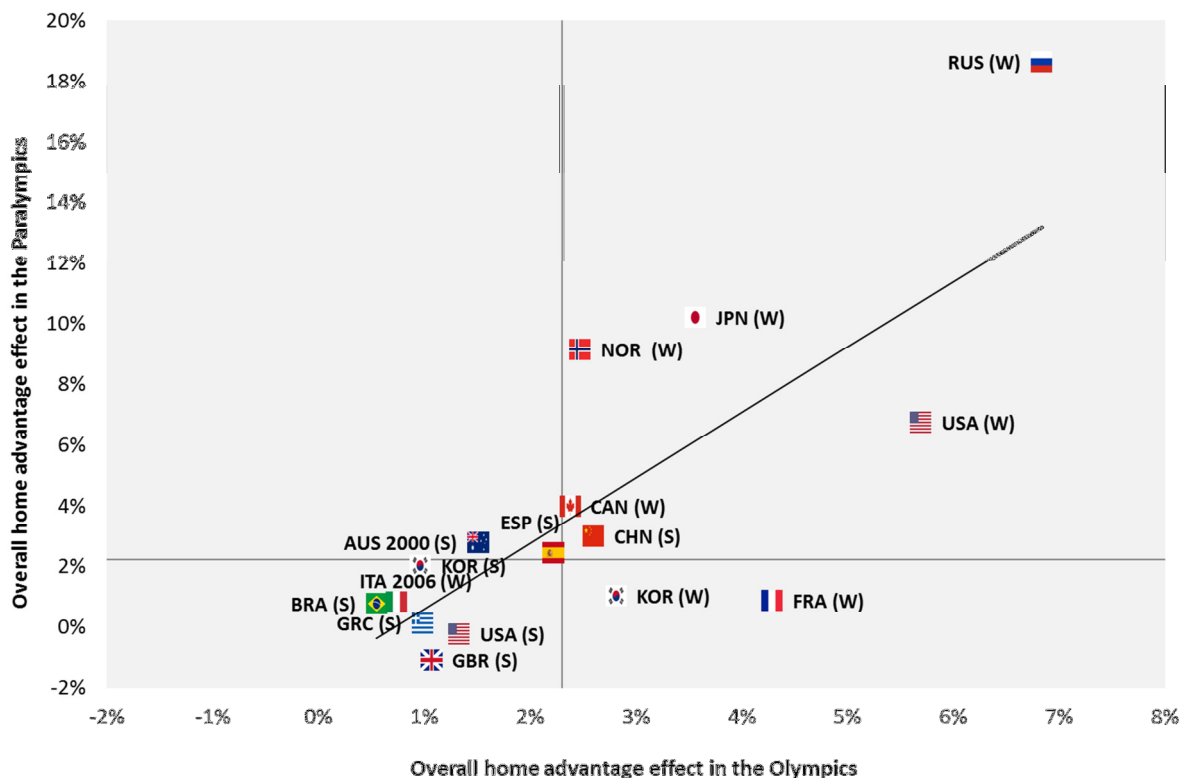
There is a paucity of research regarding the impacts associated with hosting the Paralympic Games, which feature elite athletes with a disability. Few studies have evaluated the comparative outcomes, legacies and event leverage that the Paralympic Games have generated (Misener, Darcu, Legg, & Gilbert, 2013). The Paralympic Games underline the change from sport as therapeutic competition to that of elite events that carry intrinsic prestige, with growing rivalry over medal tables (Gold & Gold, 2007). On the premise that home advantage can be considered to be a short-term legacy of hosting major sporting events, my research on the Olympic and Paralympic Games makes a novel contribution to knowledge in several ways. Using a similar approach to that I used for the Commonwealth Games, my research is the first to investigate and report clear evidence of a home advantage effect at an overall nation level separately in the Winter Paralympic Games (REF 5) and the Summer Paralympic Games (REF 6).

Furthermore, REF 5 and REF 6 demonstrate that home advantage is not homogenous between para-sport events. For example, in the Winter Paralympic Games, home advantage was found to be prevalent in alpine skiing and cross country skiing but not in biathlon, ice sledge speed skating, ice sledge hockey or wheelchair curling. Similarly, in the Summer Paralympic Games, athletics, table tennis and wheelchair fencing exhibited a significant home advantage effect; however, in archery, swimming and wheelchair basketball the effect was either weak or inconclusive.

REF 7 adds another layer to the research undertaken in REF 5 and REF 6, by illustrating that the size of the overall home advantage effect in the Paralympic Games is of a comparable

magnitude to the Olympic Games i.e. it does not differ significantly between able-bodied and para-sport events. REF 7 also reveals that nations that experience a large home advantage effect in the Olympic Games also have a large home advantage in the Paralympic Games. To illustrate this last point, Figure 4 plots the home advantage effect for each host nation in the Olympic Games since 1988 (on the horizontal axis) against their respective home advantage effect in the Paralympic Games (on the vertical axis). The axes intersect at the median home advantage values across all host nations in each competition, i.e. 2.30 percentage points in the Olympic Games and 2.24 percentage points in the Paralympic Games, resulting in four quadrants.

Figure 4: Relationship between home advantage in the Summer (S) and Winter (W) Olympic and Paralympic Games



The six nations positioned in the top right quadrant of Figure 4 have a relatively large home advantage in both the Olympic and Paralympic Games (above the median), whereas the six nations in the bottom left quadrant exhibit a relatively small or no host nation effect in both

competitions (below the median). The top left quadrant contains two nations with a relatively large home advantage in the Paralympic Games (but not in the Olympic Games). Finally, two nations with a relatively large home advantage in the Olympic Games (but not in the Paralympic Games) feature in the bottom right quadrant. The upward slope of the trend line in Figure 4 is indicative of a strong association between the size of the overall home advantage effect in the two competitions.

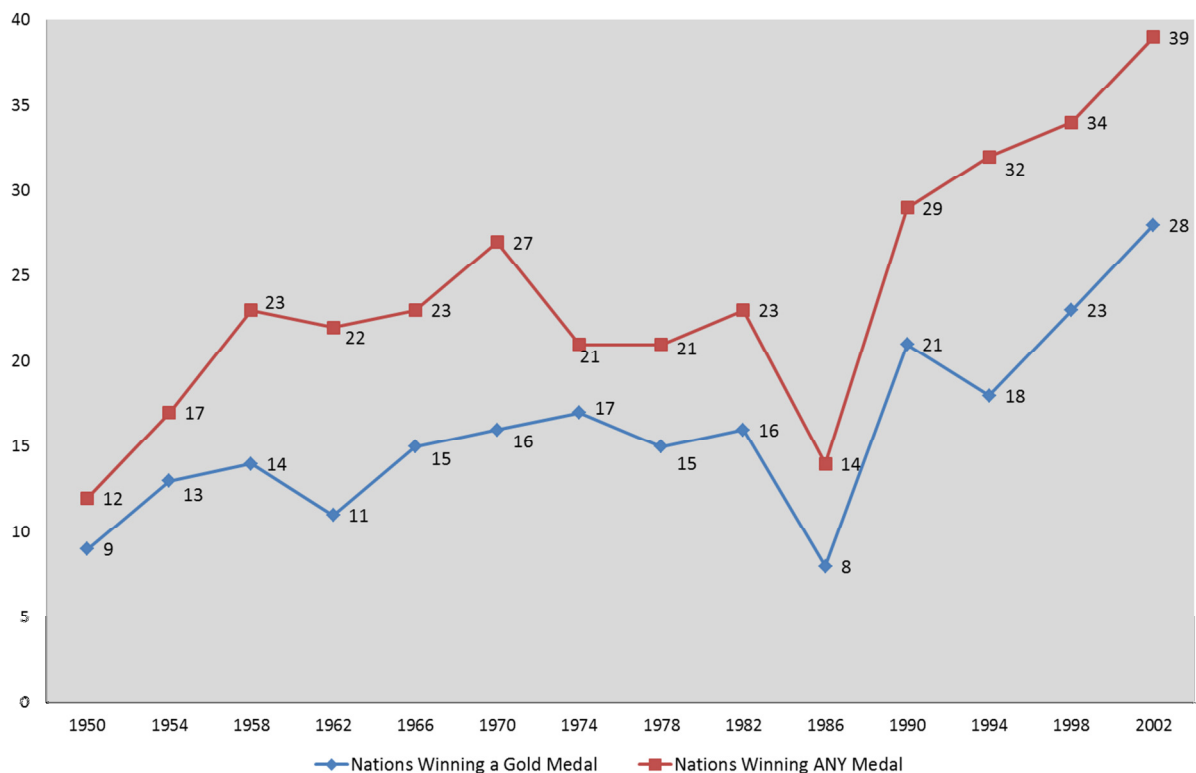
Beyond the influence of game-location factors normally associated with the occurrence of home advantage in elite sport, including the influence of the home crowd on officials in certain sports, home athletes' familiarity with local venues and facilities and the detrimental effects of jet lag associated with travelling across time zones on athletes from non-host countries, there is also evidence that host nations tend to increase their level of investment in elite sport prior to hosting the Olympic and Paralympic Games. For example, in the four years leading up to the Beijing 2008 Games, UK Sport spent £235.1 million to support 27 Summer Olympic sports and this figure increased by 12% to £264.1 million in the four years leading up to the London 2012 Games, when Great Britain was the host nation. The proportionate increase in funding for Summer Paralympic sports in the UK between 2005-8 (£29.5 million) and 2009-12 (£49.3 million) was even higher at 67% (UK Sport, 2018).

The basic point here is that financial support for elite sport is one of the fundamental 'pillars', which can be influenced by policy, through which international sporting success can be produced (De Bosscher, et al. 2006). It is therefore entirely plausible that taking a strategic approach to elite sport development by host nations in the build up to the Olympic and Paralympic Games can contribute to some of the observed home advantage identified in my research.

Competitive balance

In addition to providing the spark for my research on home advantage in international multi-sport competitions, the analysis in REF 1 illustrated that there had been a step change in the number of countries winning a gold medal and a medal of any colour over time in the Commonwealth Games, implying an increase in competition for medals - see Figure 5.

Figure 5: Competition for medals in the Commonwealth Games



Part of the increase in competition can be explained by nations taking a state sponsored strategic approach towards the production of medal winners. Aside from sport policy factors, the sporting success of countries is also determined by the competitive environment of a sport. This has led to a more thorough analysis of competitive balance in the Commonwealth Games (REF 4). Prior to this paper, previous research on competitive balance had been set almost exclusively in the context of professional sports leagues (e.g. Butler, 1995; Booth, 2005; Maxcy & Mondello, 2006; Soebbing, 2008; Ramchandani, 2012; Williams, 2012).

REF 4 was the first of its kind to investigate this concept within an international multi-sport event and illustrates how competitive balance has evolved in the Commonwealth Games over 20 years at an overall level and in different sports and events. Specifically it was found that events contested by men were found to be the more balanced relative to both 'women only' and 'mixed / open' events. Boxing and athletics emerged as the most balanced sports compared with diving, cycling, swimming and, to a lesser extent, weightlifting.

Upon reflection, it can be argued that the concept of competitive balance is less relevant to multi-sport competitions compared to its relevance for professional sports leagues for two reasons. First, unlike home advantage, competitive balance is not an objective for nations bidding to host major events. Second, while bidding to secure major sports events can be regarded as a sports policy factor that can influence international sporting success, the same cannot be said for competitive balance. Nevertheless, this strand of my research has laid the foundation for subsequent studies on competitive balance of specific sports contested in the Commonwealth Games (Chaplin and Mendoza, 2017), the Summer Olympic Games (Forrest, Beaumont, Goddard, Simmons, 2005; Truyens, De Bosscher, & Heyndels, 2016; Zheng et al. 2018) as well as the Winter Olympic Games (Weber, Kempf, Shibli & De Bosscher, 2016), which suggests that it is still an area of interest to academics and researchers.

CONCLUDING COMMENTS

The overall aim of the research programme was to examine the performance of nations in international multi-sport competitions. In summary, my research has contributed to knowledge in the following ways:

1. Vindicated the use of standardised measures of performance in elite sport (i.e. market share) over traditional indicators of absolute success (REF 1-7).

2. Confirmed the existence of home advantage at an overall nation level in multi-sport competitions including the Commonwealth Games (REF 2 and 3), the Winter Paralympic Games (REF 5), the Summer Paralympic Games (REF 6), and the Summer and Winter Olympic Games (REF 7).
3. Verified that the size of the home advantage effect does not differ significantly between Olympic events contested by able-bodied athletes and Paralympic events contested by athletes with a disability (REF 7).
4. Highlighted that the prevalence of home advantage differs between sports and events and contributed to a better understanding of the potential causes of the home advantage phenomenon (REF 3, 5-7).
5. Applied competitive balance measures to a multi-sport event context and provided a platform for subsequent research (REF 4).

The study of home advantage in particular, which is the most substantive part of my PhD, has focused entirely on analysis of archival quantitative data. In other words, no contextual or qualitative information has been gathered from competitors or coaches to triangulate my conclusions. This is both a limitation of my research and an avenue for future consideration.

The evidence from my research on the Commonwealth Games and the Olympic and Paralympic Games has provided some mixed evidence about whether home advantage is prevalent in individual sports that did not involve subjective judgement or scoring. For example, evidence in favour of a statistically significant home advantage effect was found in Olympic archery, Paralympic athletics, table tennis and alpine skiing, but not in Olympic athletics, cycling, shooting, swimming, table tennis, weightlifting or in Paralympic archery, cycling, shooting and swimming (REF 5-7). A similar inconclusive picture was also evident in previous research concerning home advantage in objectively scored sports (e.g. Nevill, Holder, Bardsley, Calvert, & Jones, 1997; Balmer, Nevill, & Williams, 2003; Koning, 2005;

Bullock, Hopkins, Martin, & Marino, 2009; Koning, 2011). In light of this inconclusive evidence, it is my view that further research is required to investigate the reasons underpinning inconsistent patterns of home advantage in objectively judged sports and the conditions under which such an effect is observed.

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