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**Strategic analysis of medal markets at the Winter Olympics:
Introducing an index to analyse the market potential of sports disciplines**

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Abstract

Despite the evidence of nations investing strategically into their elite sport systems to produce Olympic success, there is a lack of knowledge on how national-level decision-makers can employ a strategy to analyse the competitive environment concerning sports contested in the Olympic Winter Games. In this paper, the concept of market potential analysis, which is commonly applied in economics, is proposed as a method to enable these investment decisions to be based on sound evidence. The markets for Olympic awards, i.e. medals (top 3 places) and diplomas (i.e. top 8 places) are compared in alpine skiing, biathlon, cross country, speed skating, freestyle skiing, short track and snowboarding from 1992 to 2018. The most notable changes are identified in cross country (2002), biathlon (2006), freestyle skiing (2014), snowboarding (2006 and 2014) and speed skating (2018). Drawing on strategic management literature analysing the changes in market potential in relation to the market-governing organisations, the strategic evidence of these findings is highlighted by discussing the role of the International Olympic Committee (IOC) and the respective International Federations. These organisations govern the competition in the Olympic awards' markets by introducing new events and altering qualification rules. With reference to principles of mainstream economics, decision-makers who understand the underpinning governing mechanisms of the competition at the Olympic Games can exploit this intelligence strategically to develop a sustainable competitive advantage over their rivals.

Keywords: Market potential analysis, Olympic Winter Games, International Olympic Committee, competitive advantage, market-based view

1. Introduction

The 1992 Albertville Games constitute a reference point in the development of the Olympic Winter Games. They mark the start of considerable market growth in terms of medal events and nations taking part, as well as being the last time the Winter Games were held in the same year as the Summer Games (Kempf et al. 2014). Between the 1992 Albertville and the 2018 PyeongChang Games, the International Olympic Committee (IOC) increased the number of medal events by 79%, from 57 to 102. In the same period, the number of competing nations increased by 37% from 68 to 93. Not all Olympic winter disciplines have benefitted equally from these overall growth rates. For example, the number of events in biathlon increased from six to 11 (+83%), whereas for alpine skiing the increase in the number of events was more modest, from 10 to 11 (+10%). While for the number of competing nations, 28 nations competed in biathlon at the 1992 and the 2018 Games. By contrast, the corresponding figure in alpine skiing increased from 47 in 1992 to 80 (+70%) in 2018. These discipline-specific differences characterise the competitive environment of nations at the Winter Games.

Despite the evidence of some nations driving themselves to invest more strategically in their elite sport systems to produce Olympic success (Green and Oakley 2001, Robinson and Minikin 2012, De Bosscher et al. 2015, Houlihan and Zheng 2013, De Bosscher et al. 2018, Weber et al. 2018), currently there is a lack of knowledge on how national-level decision-makers can employ a strategic approach to the analysis of their competitive environment at the Games. Such an external analysis to identify specific disciplines to be targeted is valid for policy makers and high performance managers to optimise the investment decisions they make. We make this assertion because the IOC has adapted the Olympic winter programme at every Games since 1992 by introducing new disciplines (e.g. short track 1992, snowboarding 1998, skeleton 2002), or new medal events (e.g. the mixed team relay in biathlon 2014, and big air for both men and women in snowboarding 2018).

This paper is concerned with analysing the market potential per discipline over time by quantifying the changes in the number of medals or diplomas (i.e. market size) and the number of nations competing for these Olympic awards (i.e. market competitors). The underlying premise is that a strategic management approach whereby firms or nations make an external analysis of their environment to target identified markets with a high potential for success, is transferable to the context of National Sport Agencies (NSAs) targeting sports in which to compete at the Winter Games (i.e. industry). The NSA is responsible for, amongst other things, investing (financial) resources in different Olympic disciplines to generate Olympic success (De Bosscher et al. 2015). NSAs are challenged to invest their limited financial resources efficiently either by improving competitiveness in their traditionally strong Olympic discipline(s), or by targeting new disciplines with high medal potential. The so-called *market potential analysis* (e.g., Meffert et al. 2015, Bea and Haas 2013) featured in this paper provides a method to base investment decisions on more evidence.

The aim of this paper is to introduce an index as a proxy for comparing the market potential for Olympic awards (i.e. medals or diplomas) between disciplines over time, and to discuss the evidence this economic measure provides to inform decision-makers from an improved market analysis.

Researchers emphasise the need to define the market and the relevant competitors first, before economic indices can be applied, in order to rationalise competition and identify market changes (e.g., Porter 2008b, Scherer and Ross 1990). In this paper, economic indices are introduced as a proxy to quantify market potential in the context of the Olympic Games. They are applied to the seven diploma-rich disciplines of the Olympic Winter Games over the period 1992 (Albertville) to 2018 (PyeongChang), to examine the discipline's market potential for Olympic medals (i.e. top 3 places) and diplomas (i.e. top 8 places).

Given a nation's core capabilities and distinct resources to produce athletes in these disciplines under investigation, this study provides decision-makers with a market-orientated

measure to analyse the development of the disciplines' market potential. Furthermore, this paper highlights some mechanisms used in the governance of international sport that can influence market structure in the disciplines of the Winter Olympics. The market intelligence that NSAs can derive from understanding these mechanisms is discussed in order to contribute to knowledge concerning the development of competitive advantage in high performance sports management.

2. Literature review

2.1 A strategic analysis of markets within an industry

The *market potential analysis* method applied in this study draws on mainstream strategic management and the market-based view (MBV) (e.g., Wheelen and Hunger 2010, Porter 2008b, Hooley et al. 2017), alternatively known as the market positioning view, where firms or nations analyse the (external) market conditions to develop a strategy to create competitive advantage. This approach complements with the resource-based view (RBV) (e.g., Barney and Hesterly 2010, Grant 2008, Peteraf 1993, Barney 2001, Wernerfelt 1984), which focuses on the firm's specific (internal) resources and capabilities to develop competitive advantage. According to McGee (2015), there has been an active debate on the relative merits of these two approaches, in particular, the conditions under which one might be preferred over the other. Leading scholars have observed that the MBV is particularly valid for firms competing in a dynamic competitive environment, to shape strategic decisions (Ketchen et al. 2007, Kumar et al. 2011, Vining 2011, Hooley et al. 2017). Since an industry usually consists of several markets (Chen 1996), strategists have quantified competition in these markets by assessing market size and growth as well as the number and performance of competing firms (i.e. market domination) (e.g., Sutton 2001, Scherer and Ross 1990, Makhija 2003, Hoskisson et al. 1999). To conduct an analysis from a MBV, these economic measures provide basic information on the characteristics of the competition and allow managers to identify specific markets to be targeted

strategically (e.g., Hooley et al. 2008, Sakarya et al. 2007). An important variant when examining these measures is to evaluate the potential of new markets to be targeted, i.e. market potential (Meffert et al. 2015, Bea and Haas 2013). Following Porter's argument (2008b), strategic positioning by targeting specific market(s) within an industry is at the heart of a firm's strategy to develop competitive advantage. However, there is an academic void concerning 'how' the market potential of an Olympic discipline could be rationalised over time and analysed strategically by an NSA.

Leading scholar in economics and business strategy Michael E. Porter (1998) described a common pitfall when applying economic indices to analyse markets: managers use the evidence to identify a more attractive business proposition (e.g. low domination) rather than identifying changes in market structure. Porter (2008b) emphasised that market changes in market size, number of competitors, or market barriers need to be analysed in greater depth to guide subsequent strategic investment choices and thereby create competitive advantage from an MBV. According to leading academics in strategic management (e.g., Vining 2011, Barney and Hesterly 2010, Hooley et al. 2001, Wheelen and Hunger 2010, Grant 2008), the Five Competitive Forces model developed by Porter (1998, 2008a) provides the most advanced tool to conduct this more comprehensive analysis of the underlying forces that influence competition in a market or an industry.

This paper focuses on 'market entry' and its respective barriers, which is one of the main forces discussed by Porter (2008b). Key market entry barriers are based on the costs to a firm for entering a market, for example: the investment in expert personnel and technology, or the limited availability and high price of government controlled licences to enter a market (e.g., Johnson et al. 2011, Wheelen and Hunger 2010, Bea and Haas 2013). Entry barriers protect those firms already competing in the market and thereby shield these established firms from more intense competition. Hence, there are incentives for such companies to exploit their dominant market position and to increase these barriers by, for example, formulating exclusive

distributor and supplier agreements, building cartels with competitors, or lobbying for the implementation of tariffs on foreign competitors (Mankiw and Taylor 2012). In this regard, strategists need to be aware that market entry barriers can be particularly influenced by the respective market's governing organisation for example: the national government, the European Union or the World Trade Organisation. The most common governing instruments used by these organisations are the legal basis of competition such as quotas, taxation, safety rules or anti-cartel commissions (Scherer and Ross 1990, Sutton 2001). Porter (2008b, 2008c) emphasised that market-governing organisations are not a sixth force, but should be analysed from the perspective of how they influence market entry. Thereby, market-dominant competitors may be able to influence market governance in such a way that they can shape the regulations to their own advantage (Porter 2008b). Therefore, understanding how a market's governing instruments work is strategically useful intelligence for competitive firms to exploit.

2.2 Market governing at the Olympic Games

Similar market governing processes appear in the Olympic Games, where the IOC, in collaboration with the respective International Federation (IF), governs the competition between nations in every Olympic discipline. The IF's responsibilities towards the Olympic Games are formalised in Rule 46 of the Olympic Charter (IOC 2017a). The IF proposes the legal basis to be approved by the IOC by formulating 'rules of qualification' and 'rules of competition'. These documents of every IF are approved by the IOC prior to the qualification period for every edition of the Games no later than two years before the relevant Games (e.g., FIS 2012, ISU 2012).

Comparable to mainstream economics, the IOC and the IFs apply quota rules that limit the maximum number of athletes from each nation that can contest the Olympic disciplines. In this way, these governing organisations control the market size and the number of competitors at every Games, whilst inhibiting strong nations in every discipline by limiting their number of athletes eligible to compete. After every Winter Games since 2002, the IOC (e.g., 2011, 2002)

has provided an evaluation report to the IOC programme commission that reviews the composition of the Olympic programme to propose new medal events to be included (or existing events replaced) for the forthcoming Games in the popular disciplines. Popularity is measured by factors such as spectators, media coverage, appeal to young people, likes in digital media, and sponsors, which are characterized by a global excellence such as the number of active member National Governing Bodies (NGBs)¹, or the number of medal winning nations per continent.

The legal basis of such adaptations in the Olympic events' programme is formalised in Rule 45 of the Olympic Charter (IOC 2017a): Adaptations are to be made by the IOC board, on the proposal of the IOC programme commission, and in accordance with the respective IF and the local Organising Committee of the respective edition of the Olympic Games (OCOG). Finally, the events programme for each Olympic Games must be published at least three years prior to the Games. Hence, there is a strong argument to suggest that the IFs play an important role in governing a discipline's market structure in advance of the competition actually taking place.

In practice, some nations have identified the importance of the IFs governing the qualification criteria for the Olympic Games. For example, the Austrian and Swiss NGBs in alpine skiing publicly complained about the change in the qualification rules for the 2014 Sochi Games, because they believed the Fédération Internationale de Ski (FIS) seemed to favour weaker skiing nations to qualify athletes (Sport24 2013). Probably the most advanced strategic approach is implemented by UK Sport, which has identified a potential of market-governing mechanisms to protect or even increase the nation's interests in international sport. Subsequent to setting up a programme in 2006 to support the candidature of British officials on the boards of IFs, UK Sport strategically invests in its national elite sport system not only to develop athletes but also officials (UKSport 2013). The then Director of Major Events and International Relations of UK Sport explicitly emphasised the link between the board members of IFs and

¹ NGBs are alternatively called National Federations.

the opportunity to advocate national interests in governing international sports by explaining that having a strong voice *'is not just about advocating national interests. It is also about helping to make those International Federations as strong and credible as possible'* (Morton 2013, October).

Referring back to the strategic analysis from an MBV (e.g., Porter 2008b, Wheelen and Hunger 2010, Hooley et al. 2017), understanding how the IOC and the IFs apply the governing measures outlined above is strategically relevant information. This market intelligence enables a nation to compete effectively in the dynamic environment of the Winter Games, which is tightly controlled and rigorously reviewed by the market governing organisations, namely the IOC and the relevant IFs.

2.3 Market size and market competitors at the Olympic Winter Games

When analysing the market size of Olympic disciplines, researchers have emphasised the differences between the number of awards distributed by the IOC and the number that are actually contestable by a nation (e.g., Weber et al. 2017, Houlihan and Zheng 2013). Due to the IOC quota system, the number of Olympic awards that a given nation can contest is smaller than the number distributed by the IOC. Depending on the discipline, a maximum of two to four athletes can compete in individual events, whereas in team (e.g. ice hockey) and mixed team events (e.g. relay biathlon), only one team per nation can compete. Hence, the actual number of contestable diplomas per nation and discipline is less than the number of diplomas distributed by the IOC. In contrast, most earlier studies that have analysed nations' performance over time do not apply this distinction nor include the governing role of the IOC (e.g., De Bosscher et al. 2015, Storm et al. 2016, De Bosscher et al. 2008b, Otamendi and Doncel 2014, Johnson and Ali 2004).

Following the previous section on 'contestable' diplomas per nation as controlled by the IOC and the respective IF (i.e. market size), the market competitors are the participating nations as represented by their NOCs. The number of competing nations is based on the results of their

athletes in the respective qualification competitions recognised by the IOC and organised by IFs. Depending on the performance of their athletes in each discipline during the qualification phase, nations are able to secure starting places in the various disciplines. The rules of qualification also define the minimum performance standard an athlete must achieve to earn a starting place. While there are solidarity places offered by the IOC to enable every nation competing in the qualification competitions to take part in the Games, not every nation uses all of its quota places. These are then reallocated to the nations' interested in and capable of qualifying more athletes to take part. This stepwise quota allocation process, as well as the nomination deadlines for the respective athletes to compete, are managed by the IF and approved by the IOC prior to every edition of the Games (e.g., ISU 2012, FIS 2012).

In reality, there are considerable differences between the number of nations that qualify to take part and the number of nations that are sufficiently competitive to win Olympic awards at the Winter Games. The latter seem to be limited to a small number of approximately 26 nations per Games that actually win medals or diplomas (Andreff and Andreff 2011, Weber et al. 2017). The competitiveness of nations at the Games is determined primarily by macro-economic factors, such as gross domestic product (GDP) per capita, population, and having a cold climate (e.g., Andreff and Andreff 2011, Johnson and Ali 2004, Otamendi and Doncel 2014), as well as to a lesser extent the effectiveness and efficiency of national elite sport development systems (e.g., De Bosscher et al. 2008b, Otamendi and Doncel 2014, Renaud et al. 2018). Hence, despite the growth of the Winter Games as governed by the IOC and the FIS in both the number of events and nations taking part, the actual number of award-winning nations is limited.

2.4 Measuring market potential of Olympic winter sports disciplines

Recently, Weber et al. (2017) introduced economic indices from industrial economics to quantify competition in Olympic winter sports disciplines between 1992 and 2014. The authors focused their analysis on six medal-rich winter sports disciplines to examine the relationship between the development of market domination and market governing measures applied by the

IOC and the IFs as discussed above. Weber et al.'s (2017) study draws on the extensive literature on sport economics examining the competitive balance between teams in leagues, relative governing measures applied by the league commission (e.g., Binder and Findlay 2012, Fort and Quirk 1995, Lee and Fort 2012, La Croix and Kawaura 1999). Compared with the article of Weber et al. (2017), the current study shifts from a sports economics focus on governing competition in Olympic disciplines; to a strategic, market-orientated view that can be applied by NSAs of competitive winter sports nations to create competitive advantage at the Winter Olympics. The competition analysis performed in this study identifies relevant changes of market potential and the underlying causes, which we argue is useful information that can be exploited strategically. This shift in the research perspective is comparable to the development identified in mainstream management literature (e.g., Porter 2008b, Hooley et al. 2017, Wheelen and Hunger 2010), in which strategists who apply a MBV to develop the competitive advantage of business firms have adopted an industrial economics perspective.

In the management literature, market size and market growth are the two most important measures for comparing the current and future potential of markets within the same industry (Meffert et al. 2015, Bea and Haas 2013). By applying this, managers can make trade-offs between investing the available resources and capabilities in targeting particular markets and thereby position their firm within the industry. According to Meffert et al. (2015), these targeting strategies are based on combining information on market potential and a firm's competitiveness within that market.

Mundy and Bullen (2015) introduced a universal formula to help companies estimate the market potential (MP) of a given market, by multiplying the total number of potential customers (N), the company's estimated market share (MS), the average selling price (P) and the average annual consumption (Q).

$$(1) \quad MP = N * MS * P * Q$$

Formula (1) models the market potential resulting in the expected sales volume of a firm. This analysis enables firms to compare their expected income relative to their expenses when evaluating new business proposals.

While formula (1) includes the price of a unit to estimate the total sales volumes (i.e. $P * Q$), this study draws on Bruhn and Homburg (2004), who described quantitative potential analysis as an alternative way to estimate market potential. Quantitative analysis focuses only on the maximum number of units sold in a given time period and thereby excludes the price setting mechanism. This method allows for the analysis of market domination, market size and market entry by using number of units sold instead of prices of goods to assess the respective market potential (e.g., Sutton 2001, Bruhn and Homburg 2004). The constraint to define the price of market goods (P) to be equal to 1 allows researchers to make a comparison between markets with different price levels, such as the market for sports cars and the market for small city cars within the car industry. The quantitative potential analysis excludes also the average annual consumption (Q) because it is not sensible to expected sales volumes.

In this research context, quantitative market potential analysis is adapted to examine the medal market potential of sports disciplines (i.e. markets) of the Winter Olympics (i.e. industry). On one hand, the quantitative approach is feasible, because every medal (i.e. market good) adds the same value to a nation's performance in the overall Olympic medal table. On the other hand, including an estimation of the value of an Olympic medal or diploma separately for every discipline as well as the respective production costs is not feasible in this study.

In summary, the market potential analysis performed in this study refers specifically to Hooley et al.'s (2017) market orientation research, which relied on Porter's (1998, 2008c, 2008b) concept of market analysis in order to collect the relevant evidence on the market changes to be targeted. This study introduces economic measures to identify changes in the market potential of sports disciplines by focusing on market size and market entry. The

governing measures applied by the IOC and the IFs that influence these market indices are discussed further from a MBV.

3. Method

In this paper, the Olympic Winter Games between Albertville 1992 and PyeongChang 2018 are analysed. The strategic approach illustrated, allows decision-makers within competitive nations to assess information on the underlying governing mechanisms that influence the market potential of Olympic winter disciplines.

3.1 Data

The medal and diploma data were retrieved from the online Podium Performance database managed by Gracenote² in November 2015 and from the IOC for the 2018 Games in March 2018. Every nation or delegation winning a diploma (respectively a medal) for the first time during the period was considered to be new, including the independent nations emerging after the fall of the Iron Curtain in 1989. This accounts also for the team of ‘Olympic Athletes from Russia’ (OAR) that competed at the 2018 Winter Olympics independently from the Russian NSA, because the IOC banned the Russian Olympic Committee after strong doping accusations by the World Anti-Doping Agency (WADA).

The data on the IOC quota systems per discipline and nation were derived from 51 explanatory competition books of the seven Olympic winter disciplines under investigation. These books are available for every Games and discipline in the online library of the IOC. Both sources are used to derive the data on market size and market competitors.

3.2 A discipline’s market size and competitors

Small markets like skeleton (two events and six medals), bobsleigh, luge and figure skating are excluded from of this paper. This is because our focus is on demonstrating the applicability of a concept and this works best in the markets for the seven disciplines which are relatively

² Gracenote is a company that collects and manages sports data.

award-rich. For the purpose of this exercise, the disciplines included are characterised by having at least four male and four female medal events in 2018: Alpine skiing, biathlon, cross country skiing, speed skating, freestyle skiing, short track speed skating (i.e. short track) and snowboarding all meet the inclusion criterion.

As previously discussed, the number of Olympic diplomas distributed by the IOC in a discipline differs from the number actually contestable by a nation. In this context, the market size of a discipline is determined by the number of (a) distributed diplomas and (b) contestable diplomas. The number of contestable diplomas per nation and per discipline can be derived from the qualification criteria statements, which often differ between Games.

The market competitors are defined as (c) competing nations and (d) diploma-winning nations and medal-winning nations. The value of (c) reflects the number of nations capable of producing of at least one athlete to qualify for the Games, and (d) represents the number of competitive nations winning an Olympic diploma (or medal) in the disciplines included in the research. The ratio between (c) and (d) shows the percentage of nations that possess the competitiveness to enter the market for diplomas or medals.

3.2 Market entry and exit indices

In order to examine market barriers from a strategic perspective, Porter (2008b) as well as Scherer and Ross (1990) proposed measuring market entry (M_{entry}) and market exit (M_{exit}) of firms when analysing market domination. Similarly in elite sport, researchers have discussed M_{entry} and M_{exit} as an economic measure of domination in Olympic disciplines (e.g., De Bosscher et al. 2012, Weber et al. 2017, Du Bois and Heyndels 2008, Truyens et al. 2016). Drawing on this research, M_{entry} is defined as the number of nations that enter the discipline's market by winning a diploma in time t compared with the previous Games, $t-1$. M_{exit} by contrast is defined as the number of nations that exit a market by not winning a diploma in time t compared with the previous Games, $t-1$. $M_{entry}(t)$ and $M_{exit}(t)$ are defined per discipline as:

$$(2) \quad M_{entry}(t) = \sum_{i \in s(t)} (I_i(t) - I_i(t-1))$$

$$(3) \quad M_{exit}(t) = \sum_{i \in s(t-1)} (I_i(t-1) - I_i(t))$$

where $s(t)$ is the set of nations winning an Olympic diploma in time t , and $I_i(t)$ takes the value of 1 if nation i won a diploma at time t , and 0 if otherwise. Data on market entry provides evidence that some nations manage to enter the market at a given time and thus give an indication of the feasibility for other nations to enter a market in the event that they have a comparable degree of competitiveness, or are capable of developing it. Therefore, when notable values of market entry are identified, the respective nations are listed in the table notes of Appendices 1-6. Market exit shows the threat to award-winning nations of being driven out of the market at the next Games.

3.3 Market potential of a discipline

The new index introduced in this paper measures the quantitative market potential of an Olympic discipline (MP_{OS}). Since market size and growth are the most commonly used measures to describe market potential (Meffert et al. 2015, Bea and Haas 2013, Mundy and Bullen 2015), MP_{OS} includes the number of contestable diplomas (N_{cd}) at a point of time (t). This item reflects the total number of potential customers (N) in the formula (1) used by Mundy and Bullen (2015). The ratio between the number of diploma-winning nations (n_{dw}) and qualified nations (n_q) indicates the gap between the competitive nations and the qualified nations that often are doing little more than making up the numbers in a discipline (Baimbridge 1998), while M_{entry} indicates the extent of new nations entering the market. These two variables replace the company's estimated market share (MS) in formula (1) and inform management decisions on the possibility of actually winning any market share. The MP_{OS} at time t for a given discipline is defined as:

$$(4) \quad MP_{OS}(t) = N_{cd}(t) * \frac{n_{dw}(t)}{n_q(t)} * (M_{entry}(t))$$

To illustrate the point, the resulting score of 78 for the MP_{OS} (diplomas) in 1992 Alpine Skiing (see Table 1) is derived from: 40 contestable diplomas * (15 diploma-winning nations / 53 competing nations) * 7 nations entering the diploma market compared to 1988.

The index in (4) can be interpreted as follows: the higher the value, the higher the market potential for a new nation to enter the market for the discipline concerned: A high number for $N_{cd}(t)$ indicates a relatively large market size; high ratios indicate a relatively wide spread of medal winning nations in time t ; while high $M_{entry}(t)$ indicates low market entry barriers, and *vice versa*. These latter two measures account for the call by sports economists to apply dynamic and static indices to capture different aspects of competitive balance when conducting a market analysis over time (e.g., Eckard 2001, Buzzacchi et al. 2003, Du Bois and Heyndels 2007, Du Bois and Heyndels 2008). The ratio applied in this study is a static index that uses performance data of nations at a point in time (Baimbridge 1998, Houlihan and Zheng 2013), while M_{entry} is a dynamic measure that use data in time t and $t-1$ to analyse domination over time (e.g., De Bosscher et al. 2012, Weber et al. 2017).

By multiplying the factors in formula (4), readers need to be aware that if no market entry is identified in t , the index will have a score of zero. Analysing the MP_{OS} for every Games separately from 1992 to 2018 allows for relevant changes to be identified, which in turn provides the basis for reasoned explanation.

4. Results

4.1 Economic measures applied to alpine skiing

With reference to market size and competitors, Table 1 shows that the IOC kept the number of medal events and contestable awards in alpine skiing constant between 1992 and 2014. In collaboration with the FIS, the IOC included the alpine team event in the 2018 programme and thereby increased the number of contestable medals and diplomas by one. After reaching a low

point of 45 qualified nations in 1994, this number has increased consistently over subsequent Olympic cycles and reached a peak of 80 competing nations in 2018. This is the highest number of qualified nations in all of the disciplines investigated and provides evidence for the globalisation of alpine skiing in terms of nations meeting the minimum qualification standards set by the FIS. However, it is noteworthy that the number of medal-winning and diploma-winning nations has remained constant at around ten and 14 respectively since 2010. Comparing these number indicates a gap in the level of competitiveness of nations qualifying for the Games and those capable of actually winning an Olympic award. This development is reflected by the decrease in the percentage of medal- and diploma-winning nations over time.

Table 1: *Development of market size, competitors, market entry and market potential in alpine skiing from 1992 to 2018.*

The overall low values of $M_{entry}(t)$ and $M_{exit}(t)$ in alpine skiing for medals and diplomas indicate a relatively low likelihood of new entrants as well as only a limited threat for competitive nations being forced out. The highest values were recorded in 1992 ($M_{entry} \text{ medals} = 6$ and $\text{diplomas} = 7$). Hence, alpine skiing can be said to be characterised by high market barriers for Olympic medals and diplomas and no evidence of a material impact following the inclusion of the mixed team event in 2018.

The $MP_{OS}(t)$ index combines these items by multiplying the number of contestable awards by the proportion of award-winning nations and the number of nations achieving market entry. The highest values are identified in 1992 (MP_{OS} for medals = 41; MP_{OS} for diplomas = 78). This is due to the high percentages of medal- and diploma-winning nations (23% respectively 28%), and the successful medal market entry of six nations after the fall of the Iron Curtain: Germany, Luxemburg, New Zealand, Norway, Spain and the USA, while the Unified Team entered the diploma market only. Thus in alpine skiing, where the number of contestable medals

and diplomas has been constant apart from 2018, it follows that changes as measured by the $MP_{OS}(t)$ are a function of market entry and the proportion of nations winning awards. When analysing the changes of the $MP_{OS}(t)$ in more detail, market entry is used as a proxy that allows us to identify nations that have increased their competitiveness compared with the previous Games ($t-1$).

The higher values of the market potential for diplomas rather than medals indicate that it is generally easier for nations to enter the diploma market than the medal market, with the 2010 Games being the only exception. The exception for medals is due to the market entry of four nations compared with only one nation in the diploma market: Czech Republic, Germany and Italy won diplomas but no medals in 2006, and these same nations managed to enter the medal market in 2010. Slovenia won neither medals nor diplomas in 2006 but managed to increase its competitiveness remarkably in 2010 entering directly into the medal market. In addition to identifying the actual nations, which manage to enter a market, it is strategically relevant information for NSAs targeting alpine skiing that the identified increase of medal- and diploma-winning possibilities created by adding the mixed team event did not trigger market entry by new nations. As a consequence, the measured MP_{OS} -values for medals and diplomas did not increase considerably in 2018 compared with 2014.

4.2 Development of market potential

Table 2 shows the summary MP_{OS} scores for the seven disciplines under review and discipline-specific versions of Table 1 can be found in the Appendices 1-6 to highlight the structural market changes.

When comparing the market potential of the seven disciplines at the 2018 Games, the values for the diploma markets are generally higher than for medals. While this result could be expected, relevant differences of the 2018 MP_{OS} values are identified between the disciplines under investigation. The new disciplines that were introduced after 1988 show higher market potential scores than the traditional disciplines (e.g., alpine skiing, cross-country skiing),

although speed skating (i.e. a traditional discipline) with a high MP_{OS} in 2018 and short track (i.e. a new discipline) with a low MP_{OS} in 2018 are exceptions. Appendix 1 shows an increase of medal events in speed skating from 12 to 14 between 2014 and 2018, with the number of contestable medals increasing by two and the number of contestable diplomas decreasing by four. This market growth in the number of events was managed by the IOC and the International Skating Union (ISU) by adding male and female mass start to the programme whilst simultaneously applying a stricter quota system to every speed skating event compared with 2014. The significant increase of MP_{OS} as measured for medals (0 to 77) and diplomas (35 to 116) was due to the increase in the proportion of medal- and diploma-winning nations and entry to the medal market by six nations (i.e. Belarus, Italy, Japan, Norway, USA and OAR), and nine nations in the diploma market (i.e. Austria, Belarus, Denmark, Estonia, Finland, Italy, Latvia, Switzerland and OAR). Appendix 2 illustrates that following its introduction in 1992, short track in 2018 shows relatively low scores for the percentage of medal- and diploma-winning nations (36% and 55%) compared with freestyle skiing (52% and 67%) and snowboarding (57% and 67%); as well as low scores for market entry to the medal ($M_{\text{entry}} = 1$) and diploma markets ($M_{\text{entry}} = 2$).

Focusing on the strategically relevant changes in market potential, the most significant increase in market potential for Olympic diplomas is identified in freestyle skiing from 2010 ($MP_{OS} = 104$) to 2014 ($MP_{OS} = 241$). Since freestyle skiing became an Olympic discipline in 1992, Appendix 3 highlights a notable increase in events and contestable awards due to the inclusion of male and female individual events: aerials (1994), ski cross (2010), and half-pipe and slope style skiing (2014). Meanwhile, freestyle skiing is characterised by the highest scores for market entry in both medals and diplomas. In 2014, seven nations were found to have entered the diploma market (i.e. Finland, Germany, Great Britain, Italy, Kazakhstan, New Zealand and Ukraine); and in 2018, seven nations entered the medal market (i.e. Great Britain, Kazakhstan, Norway, New Zealand, Switzerland, OAR and Ukraine). These relatively high

levels of market entry resulted in a remarkable increase in the MP_{OS} for medals at the 2018 Games ($MP_{OS} = 109$) compared with the 2014 Games ($MP_{OS} = 27$). Furthermore, notable increases in the MP_{OS} for diplomas were identified in cross country skiing (2002) and in biathlon (2006). The IOC increased the number of contestable diplomas in cross country skiing from 34 in 1998 to 42 in 2002 (see Appendix 4). During this period, five nations entered the diploma market (i.e. Belarus, Canada, France, Slovenia and the United States), and four nations entered the medal market (i.e. Canada, Estonia, Germany and Switzerland). Similarly in biathlon, the IOC and the International Biathlon Union (IBU) added male and female pursuit events to the 2006 programme (see Appendix 5). In the same edition of the Games, six nations managed to enter the diploma market compared with 2002 (i.e. China, Finland, Italy, Latvia, Moldavia and Poland).

A notable increase in the market potential for medals is identified in speed skating from 2002 ($MP_{OS} = 0$) to 2006 ($MP_{OS} = 54$) and in snowboarding from 2010 ($MP_{OS} = 29$) to 2014 ($MP_{OS} = 81$). The MP_{OS} of speed skating in 2002 reached the value of zero because there was no market entry. In 2006 the inclusion of two more medal events (i.e. male and female team pursuit) resulted in two more contestable medals and market entry of four nations (i.e. China, Italy, South Korea and Russia), as shown in Appendix 1. Similarly for snowboarding in 2014 there was an increase of market potential due to the inclusion of four new medal events (i.e. male and female slope style and parallel slalom) and the medal market entry of six nations (i.e. Czech Republic, the UK, Germany, Japan, Norway and Slovenia). By including these new events, the IOC increased the number of contestable medals in snowboarding from 18 in 2010 to 30 in 2014 (see Appendix 6).

Table 2: *Market potential of Olympic winter disciplines between 1992 and 2018.*

In summary, the relevant increases of market potential observed in cross-country skiing (2002 for diplomas), biathlon (2006 for diplomas), speed skating (2018), snowboarding (2006 and 2014), freestyle skiing (2014 and 2018 for medals), and speed skating (2018) provide the rationale for more detailed discussion.

5. Discussion

This paper introduces the $MP_{OS}(t)$ to quantify the market potential of an Olympic discipline and compares it over time. The focus is on the underlying governing mechanisms of market growth as governed by the IOC in collaboration with the IF to explain the market governing role of these organisations influencing changes in the measured market potential.

5.1 Disciplines characterised by high market potential

The results show that new disciplines such as snowboarding and freestyle skiing have a relatively high market potential for new nations to win Olympic awards, with short track being the exception. The market data highlight the notable increase in Olympic events in freestyle skiing and snowboarding since they were added to the Olympic programme in 1992 and 1998, respectively. These new disciplines are characterised by being high risk sports, that is, in order to win, athletes have to continuously create new ‘tricks’, which results in a high error rate during the competition. The performance in traditional competitions in alpine skiing, cross country or speed skating is mainly determined by technologically advanced equipment in combination with the physical conditioning of athletes, which in turn determine the ability to ski or skate fast on a pre-defined track. In contrast, snowboarding and freestyle skiing include an element of subjective scoring for style and difficulty (big air, slopestyle), or physical contact between athletes (ski cross and snowboard cross). Consequently, there are more unpredictable variables at play than in alpine skiing or speed skating, which make these new competition formats more unpredictable. This development of the Olympic winter programme by the IOC in collaboration with the FIS has changed the Olympic Winter Games and allowed more nations to win an

Olympic award: Competitive summer sports nations like Australia, New Zealand and the UK all won medals in these two new disciplines in 2018. By contrast, the nations' dominating short track like South Korea, China, Canada and United States have been successful in protecting their market position and increase their market domination. This has led to a reduction in the number of diploma-winning nations since 2006, despite the efforts of the IOC in doubling the events between the introduction in 1992 (n = 4) and 2002 (n = 8), and the ISU proposing stricter quotas in all individual short track events (i.e. max 3 athletes per nation), compared with speed skating for example (i.e. max 4 athletes per nation until 2014).

Referring to similar findings in economics, Sutton (2001) argued that market growth does not necessarily increase the number of successful competitors, because dominant firms might protect and even increase their market position by preventing new firms from entering the market. Also Porter (2008b) pointed out that growing markets offer opportunities for strong competitors to improve their market position. The results in short track, cross country skiing and speed skating support this argument in the markets for Olympic awards. However, in freestyle skiing and snowboarding, more competitive nations win diplomas as a result of, among other things, the increase in events implemented by the IOC since 1992 and the characteristics of performance in these sports as described above. Hence, sport-specific differences regarding the relationship between the growth in market size and increases in market potential to enter a medals and/or diplomas market are identified in this study.

Consistent with Porter (2008b), an external analysis from a MBV allows NSAs of dominant and emerging winter sports nations to derive strategically relevant information on the underlying market governing mechanisms applied by the IOC and IFs in relation to market growth and market entry. Hence, the relevant changes as measured by the MP_{OS} in cross country skiing (2002 for diplomas), biathlon (2006 for diplomas), snowboarding (2006 and 2014), freestyle skiing (2014 and 2018) and speed skating (2018) require further explanation.

5.2 Market potential affected by the IOC and IFs

In collaboration with the FIS, the IOC introduced a new event format to the Olympic programme of cross-country skiing in 2006: men's and women's Olympic sprint. As a result, the two market-governing organisations created the conditions for the successful entry of new nations. Similarly in biathlon, the introduction of the mixed team event in 2010 allowed the IBU to discriminate effectively against traditionally strong nations and to maintain relatively high scores for market entry until 2014. However, the effect was limited in both disciplines to these editions of the Games and was stronger for diplomas than for medals. A possible explanation for this observation is that the traditionally strong nations in these disciplines (e.g. Germany, Norway, Russia and Sweden) adapted more slowly to the changes of the programme but managed to crowd-out the new nations in the longer run (e.g. Belarus, Bulgaria and Latvia).

By adding half-pipe and slope style events to freestyle skiing in 2014, the IOC and the FIS triggered the entry of seven nations into the diploma market, of which Great Britain, Kazakhstan, New Zealand and Ukraine managed to convert these diplomas into medals in 2018. In snowboarding, the inclusion of snowboard cross triggered market entry at diploma level for Australia, Canada, Germany, Russia, Slovakia, and Spain; moreover, Austria, Canada, Finland, Germany, Norway and Slovakia entered the medal market. In 2014, the inclusion of men's and women's slope style and parallel slalom created the conditions for less established winter sport nations like the Czech Republic, Great Britain, and Slovenia to enter the medal market. Hence, there is strong evidence that market growth has a stronger effect on the increase of the medal market potential of new disciplines than in traditional disciplines. This finding provides relevant information for NSAs of emerging winter sports nations (e.g. Australia, China, Great Britain, Kazakhstan, New Zealand and Slovakia) in identifying winter sports disciplines that might be targeted strategically. This assertion is perhaps attributable to the traditionally strong winter sports nations not yet establishing high market barriers for medals in these new disciplines by investing heavily in infrastructure, expert personnel and innovation of equipment to build competitive advantage. Therefore, the gap in the competitiveness of the nations contesting these

new markets is not as large as it is in the traditional disciplines, which have been exposed to a ‘sporting arms race’ (De Bosscher et al. 2015) for much longer.

Finally, in 2018 and the case of speed skating, the IOC and the ISU not only introduced mass start events for men and women, they also reduced the quotas for participation in every event compared with 2014. In 2014, there was a maximum quota of four athletes per nation in each male and women individual event for 500m, 1,000m and 1,500m and a maximum of three athletes in the individual events for 3,000m (women), 5,000m (male and women) and 10,000m meters (men). (IOC 2013). In 2018, these quotas were changed such that three men per nation could compete in events up to 5,000m and three women in events up to 3,000m; while for the longer distance events, the quotas were cut to two in the 5,000m (women), 10,000m (men) and both the male and female mass start events (IOC 2017b). Furthermore, the competitiveness of athletes from Russia was massively reduced due to the ROC being suspended by the IOC Executive Board from the 2018 Games (IOC 2018). This suspension resulted in the participation of Russian athletes only on the invitation of the IOC, which resulted in a decrease in diplomas won by Russian athletes from 12 in 2014 to two in 2018, and a decrease in medals won from 3 to 1. These adaptations in the market structure provide strategically important information about targeting particular events, which offer emerging nations improved medal-winning opportunities in speed skating (i.e. MBV).

Hence, the increase in market potential that has been demonstrated can be caused by either improved (or decrease) competitiveness of nations, or the IOC and IFs lowering the market entry barriers (e.g. increase of contestable medals and diplomas, more strict quota system); as well as a combination of both factors. Further analysis of market dynamics for every discipline and time period exceeds the scope of this article. However, decision-makers within NSAs aiming to target disciplines strategically must identify these factors and the underlying mechanisms that influence the respective discipline’s market potential. Referring back to the evaluation reports of the Olympic winter disciplines including the respective evaluation criteria

published by the IOC (2012, 2011, 2002), these governing documents provide strategically relevant information on the underlying factors evaluated by the IOC when adapting the programme. Any changes in the programme, or of the qualification procedures, are likely to be in line with the IOC's general desire to increase the global interest in the Olympic Winter Games and to sell an attractive product to broadcasters and sponsors. This objective is documented by the increasing revenues from these stakeholders published in the IOC's marketing reports (e.g., IOC 2015, IOC 2014a), while Agenda 2020 (IOC 2014b) outlines the strategic development of the Olympic Games. The proposed changes in the Olympic programme to be events-based rather than sports-based, creates the conditions for the programme to become more flexible: a development, which outlines the challenge for nations aspiring to stay competitive in the future. This issue might become even more important, because the Agenda foresees that OCOG may propose new sports or events to be included in the Olympic programme. This point is demonstrated by the case of Japan, which was provided with more influence on the Olympic programme for Tokyo 2020 by the IOC in 2016. This strengthening of the OCOG has been formalised in the Olympic Charter (IOC, 2015), which allows the host nation to influence the development of the Olympic programme, possibly in its own favour and thereby affect the external competitive environments of every other participating nation. It is therefore proposed that an examination of the Winter Olympics from the MBV is likely to become more significant in the future because of the projected development of the Olympic programme as outlined in Agenda 2020.

5.3 Alternative strategies of nations towards the governing of international sports

Strategies of NSAs that are based on targeting disciplines or events characterized by an increased market potential are reactive to decisions made by the IOC and the IFs. Alternative strategies could however be more proactive in relation to the governing of international sports competitions, with an obvious example being adaptations to the 'rules of competition and qualification' in favour of the dominant (or emerging) nations. Reflecting on barriers to market

entry such as market entry costs, government controlled entry quotas, and exclusive supplier agreements (i.e. Porter, 2008b; Wheelen & Hunger, 2010); similar lobbying strategies to increase (or decrease) entry barriers can be applied to the markets for Olympic awards. Such governing measures might include: the quota system to favour (or limit) dominant winter sports nations; regulations concerning competition materials that increase (or decrease) investment costs as well as the dependency of a nation's athletes on key suppliers in the relevant sports industry (e.g. Atomic, Head and Fischer in alpine skiing). Additionally, electing a dominant (or emerging) nation to host the qualification competitions for the Winter Olympics, might allow such nations to benefit from home advantage. Returning to Porter's (2008b) argument about understanding the underpinning mechanisms that govern market structure, the governance of Olympic sports might offer dominant nations the opportunity to shape the market structure of a discipline to their advantage. This point is particularly valid in international sports, because the dominant nations in a sports discipline are commonly represented by their board or commission members in the IFs or even the IOC. The Danish NSA (i.e. Danmarks Idrætsforbund) has identified this issue and developed an index of the nation's representation in international sports organisations to make comparisons between the political power of nations in international sports (Broberg et al. 2016). Similar to a dominant firm that aims to adjust the market structure to its own advantage (Porter 2008b), the strategic approach of UK Sport for example, to install British officials on the boards of IFs, suggests an approach to being proactive in protecting the nation's market position in its strong disciplines as well as potentially targeting future structural adaptations to the Olympic disciplines such as new events or adaptations to the rules of competition and qualification.

6. Conclusion

The competition between nations in Olympic winter disciplines shows some similarities to the competition between firms in an industry's markets and thereby confirms the applicability of

the respective economic measures in this context. The proposed analysis offers decision-makers in NSAs a measure to monitor competition in the different disciplines to be targeted and to base their investment decisions on sound evidence from a MBV of the Olympic Winter Games.

This research contributes to the literature on the management of national elite sport systems to produce Olympic success (Robinson and Böhlke 2013, De Bosscher et al. 2015, De Bosscher et al. 2008a). While these researchers refer to management tools like benchmarking and best practices commonly described in the mainstream management literature of the firm to increase its operational efficiency (e.g., Porter 2008c, Camp 1995), this paper offers an additional tool to inform more strategic investment by an NSA. In line with Porter (2008b), through understanding the underpinning mechanisms that influence the structure of the Winter Games (i.e. industry) and the potential of an Olympic discipline (i.e. market), decision-makers of competitive nations can derive strategic intelligence to (a) exploit these changes and (b) even shape the market structure to their own advantage. While variant (b) refers to the problematic lobbying of dominant firms to influence market regulations (Scherer and Ross 1990, Sutton 2001); variant (a) refers to the strategic positioning of firms in identified markets to be targeted by combing the RBV with the MBV (Hooley et al. 2017, Wheelen and Hunger 2010). Similar to firms, NSAs can manage their portfolio of supported sports to position their nation at the Olympic Games by targeting those disciplines, in which their NGBs possesses distinctive resources and capabilities to produce sustainable Olympic success (Robinson and Minikin 2012, Truyens et al. 2014), and fit this RBV to an analysis of the dynamics at the Olympic Games. The MBV introduced in this paper supports decision-makers within NSAs to make more informed strategic decisions about targeting a particular discipline. An in-depth- analysis of market entry allows NSAs to drive their strategic decision-making based on the identification of other nations that managed to exploit structural market changes to enter a specific discipline's awards' market, and possibly apply benchmarking processes to learn from them (Robinson and Böhlke 2013).

This paper is limited to a quantitative analysis of market potential excluding, for example, the costs to produce an award-winning athlete in a particular discipline in a given nation, or a churn analysis of the market share won by those nations entering and leaving the market to identify whether those nations that routinely win medals are an oligopoly. Furthermore, commercial broadcasters and sponsors, or the OCOG staging the Games in the host nation, influence, arguably at least, the governing of the Olympic programme and therefore the industry structure in which nations compete. Hence, analysing the respective forces of these stakeholders is also valid for strategic analysis from an MBV. Following leading scholars in strategic management (Vining 2011, Barney and Hesterly 2010, Hooley et al. 2001, Wheelen and Hunger 2010, Grant 2008), Porter's (1998) model of the Five Competitive Forces provides a promising approach to conduct more comprehensive analyses than have been conducted previously. Finally, the governance structure and respective management processes of IFs (e.g., Chappelet 2016b, Chappelet 2016a, Nagel et al. 2015, Ruoranen et al. 2016), offer a promising approach for further investigation into the underlying forces and mechanisms at work in governing international sports; as well as the techniques used by IFs to adapt the market structure of their disciplines at the Olympic Games. These proposals for future research frame the gaps in knowledge to be addressed in subsequent work.

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Table 1: *Development of market size, competitors, market entry and market potential in alpine skiing from 1992 to 2018.*

		1992 ^a	1994	1998	2002	2006	2010 ^b	2014	2018
Discipline's market size	Olympic Events	10	10	10	10	10	10	10	11
	Contestable Medals	30	30	30	30	30	30	30	31
	Contestable Diplomas	40	40	40	40	40	40	40	41
Discipline's competitors	Qualified Nations	53	45	50	51	60	71	74	80
	Medal-winning Nations	12	10	9	9	8	10	10	10
	Diploma-winning Nations	15	12	14	13	14	14	14	14
	Percentage of Medal-winning Nations	23%	22%	18%	18%	13%	14%	14%	13%
	Percentage of Diploma-winning Nations	28%	27%	28%	25%	23%	20%	19%	19%
	Market entry	M _{entry} (Medals)	6	2	2	1	1	4	2
	M _{exit} (Medals)	3	4	3	1	2	2	2	3
	M _{entry} (Diplomas)	7	1	3	2	3	1	2	2
	M _{exit} (Diplomas)	4	4	1	3	2	1	2	2
Market potential	MP _{OS} (Medals)	41	13	11	5	4	17	8	12
	MP _{OS} (Diplomas)	78	11	34	20	28	8	15	16

Note. ^aGermany, Luxemburg, New Zealand, Norway, Spain and the USA, while the Unified Team entered the diploma market only. ^bCzech Republic, Germany and Italy won diplomas but no medals in 2006, and managed to enter the medal market in 2010. Slovenia won neither medals (i.e. top 3) nor diplomas (i.e. top 8) in 2006 but increased its competitiveness remarkably in 2010 when Tina Maze won two silver medals.

Table 2: Market potential of Olympic winter disciplines between 1992 and 2018.

		1992	1994	1998	2002	2006	2010	2014	2018
Alpine skiing	MP _{OS} (Medals)	41	13	11	5	4	17	8	12
	MP _{OS} (Diplomas)	78	11	34	20	28	8	15	16
Biathlon	MP _{OS} (Medals)	18	9	15	12	10	41	45	10
	MP _{OS} (Diplomas)	32	103	48	18	102	48	66	0
Cross country	MP _{OS} (Medals)	3	8	18	40	22	12	5	10
	MP _{OS} (Diplomas)	31	67	50	111	42	12	20	27
Speed skating	MP _{OS} (Medals)	21	43	10	0	54	59	0	77
	MP _{OS} (Diplomas)	50	86	12	28	48	52	35	116
<i>Freestyle skiing</i>	MP _{OS} (Medals)		23	22	15	22	6	27	109
	MP _{OS} (Diplomas)		67	86	82	94	104	241	27
<i>Short track</i>	MP _{OS} (Medals)		15	3	22	0	0	11	15
	MP _{OS} (Diplomas)		31	17	28	35	11	19	11
<i>Snowboarding</i>	MP _{OS} (Medals)				5	57	29	81	85
	MP _{OS} (Diplomas)				44	127	64	123	80

Note. Disciplines in italic were introduced after the 1988 Games.

Appendix. 1: Market analysis of speed skating from 1992 to 2018.

		1992	1994	1998	2002	2006 ^a	2010	2014	2018 ^a
Discipline's Market Size	Olympic Events	10	10	10	10	12	12	12	14
	Contestable Medals	30	30	30	30	32	32	32	34
	Contestable Diplomas	36	36	36	36	38	38	38	34
Discipline's Competitors	Qualified Nations	23	21	25	23	19	24	23	29
	Medal-winning Nations	8	10	8	6	8	11	7	11
	Diploma-winning Nations	12	16	10	11	12	15	15	21
	Percentage of Medal-winning Nations	35%	48%	32%	26%	42%	46%	30%	38%
	Percentage of Diploma-winning Nations	52%	76%	40%	48%	63%	63%	65%	72%
Market Barriers	M _{entry} (Medals)	2	3	1	0	4	4	0	6
	M _{exit} (Medals)	3	1	3	2	2	1	4	2
	M _{entry} (Diplomas)	4	5	1	3	3	3	3	9
	M _{exit} (Diplomas)	5	1	7	2	2	0	3	3
Market Potential	MP _{OS} (Medals)	21	43	10	0	54	59	0	77
	MP _{OS} (Diplomas)	50	86	12	28	48	52	35	116

Note. ^a China, Italy, South Korea and Russia entered the medal. ^b Belarus, Italy, Japan, Norway, USA and OAR entered the medal market; and Austria, Belarus, Denmark, Estonia, Finland Italy, Latvia, Switzerland and OAR entered the diploma market.

Appendix. 2: Market analysis of short track from 1992 to 2018.

		1992	1994	1998	2002	2006	2010	2014	2018
Discipline's Market Size	Olympic Events	4	6	6	8	8	8	8	8
	Contestable Medals	8	14	14	20	20	20	20	20
	Contestable Diplomas	8	14	14	20	20	20	20	20
Discipline's Competitors	Qualified Nations	16	19	18	26	24	23	25	22
	Medal-winning Nations	7	7	4	7	6	5	7	8
	Diploma-winning Nations	14	14	11	12	14	13	12	12
	Percentage of Medal-winning Nations	44%	37%	22%	27%	25%	22%	28%	36%
	Percentage of Diploma-winning Nations	88%	74%	61%	46%	58%	57%	48%	55%
Market Barriers	M_{entry} (Medals)		3	1	4	0	0	2	2
	M_{exit} (Medals)		3	3	1	1	1	0	1
	M_{entry} (Diplomas)		3	2	3	3	1	2	1
	M_{exit} (Diplomas)		3	5	2	1	2	3	1
Market Potential	MP_{OS} (Medals)		15	3	22	0	0	11	15
	MP_{OS} (Diplomas)		31	17	28	35	11	19	11

Appendix. 3: Market analysis of freestyle skiing from 1992 to 2018.

		1992	1994	1998	2002	2006	2010	2014 ^a	2018 ^b
Discipline's Market Size	Olympic Events	2	4	4	4	4	6	10	10
	Contestable Medals	6	12	12	12	12	18	30	30
	Contestable Diplomas	8	16	16	16	16	24	40	40
Discipline's Competitors	Qualified Nations	21	21	25	21	22	27	30	27
	Medal-winning Nations	4	8	9	9	10	9	9	14
	Diploma-winning Nations	8	11	15	12	13	13	20	18
	Percentage of Medal-winning Nations	19%	38%	36%	43%	45%	33%	30%	52%
	Percentage of Diploma-winning Nations	38%	52%	60%	57%	59%	48%	67%	67%
Market Barriers	M _{entry} (Medals)		5	5	3	4	1	3	7
	M _{exit} (Medals)		1	4	3	3	2	3	2
	M _{entry} (Diplomas)		5	6	1	2	2	7	1
	M _{exit} (Diplomas)		2	2	4	1	2	0	3
Market Potential	MP _{OS} (Medals)		23	22	15	22	6	27	109
	MP _{OS} (Diplomas)		67	86	82	94	104	241	27

Note. ^aFinland, Germany, Great Britain, Italy, Kazakhstan, New Zealand and Ukraine entered the diploma market. ^bGreat Britain, Kazakhstan, Norway, New Zealand, Switzerland, OAR and Ukraine entered the medal market.

Appendix. 4: Market analysis of cross country skiing from 1992 to 2018.

		1992	1994	1998	2002 ^a	2006	2010	2014	2018
Discipline's Market Size	Olympic Events	10	10	10	12	12	12	12	12
	Contestable Medals	26	26	26	32	28	28	28	28
	Contestable Diplomas	34	34	34	42	36	36	36	36
Discipline's Competitors	Qualified Nations	39	33	35	32	46	50	54	65
	Medal-winning Nations	5	5	8	10	12	11	9	8
	Diploma-winning Nations	9	11	13	17	18	16	15	16
	Percentage of Medal-winning Nations	13%	15%	23%	31%	26%	22%	17%	12%
	Percentage of Diploma-winning Nations	23%	33%	37%	53%	39%	32%	28%	25%
Market Barriers	M_{entry} (Medals)	1	2	3	4	3	2	1	3
	M_{exit} (Medals)	3	2	0	2	1	3	3	4
	M_{entry} (Diplomas)	4	6	4	5	3	1	2	3
	M_{exit} (Diplomas)	5	4	2	1	2	3	3	2
Market Potential	MP_{OS} (Medals)	3	8	18	40	22	12	5	10
	MP_{OS} (Diplomas)	31	67	50	111	42	12	20	27

Note. ^aBelarus, Canada, France, Slovenia and the United States entered the diploma market; and Canada, Estonia, Germany and Switzerland entered the medal market.

Appendix 5: Market analysis of biathlon from 1992 to 2018.

		1992	1994	1998	2002	2006	2010	2014	2018
Discipline's Market Size	Olympic Events	6	6	6	8	10	10	11	11
	Contestable Medals	14	14	14	20	26	26	27	27
	Contestable Diplomas	18	18	18	26	34	34	35	35
Discipline's Competitors	Qualified Nations	28	28	30	34	36	32	36	28
	Medal-winning Nations	6	6	8	7	7	10	12	10
	Diploma-winning Nations	10	16	16	12	18	15	17	15
	Percentage of Medal-winning Nations	21%	21%	27%	21%	19%	31%	33%	36%
	Percentage of Diploma-winning Nations	36%	57%	53%	35%	50%	47%	47%	54%
Market Barriers	M_{entry} (Medals)	6	3	4	3	2	5	5	1
	M_{exit} (Medals)	4	3	2	4	2	2	3	3
	M_{entry} (Diplomas)	5	10	5	2	6	3	4	0
	M_{exit} (Diplomas)	4	4	5	6	0	6	2	2
Market Potential	MP_{OS} (Medals)	18	9	15	12	10	41	45	10
	MP_{OS} (Diplomas)	32	103	48	18	102	48	66	0

Note. ^aChina, Finland, Italy, Latvia, Moldavia and Poland entered the diploma market.

Appendix. 6: Market analysis of snowboarding from 1992 to 2018.

		1992	1994	1998	2002	2006 ^a	2010	2014 ^b	2018
Market Structure	Olympic Events			4	4	6	6	10	10
	Contestable medals			12	12	18	18	30	30
	Contestable Diplomas			16	16	24	24	40	40
Discipline's Competitors	Competing Nations			14	12	17	17	31	30
	Medal-winning Nations			8	5	9	9	14	17
	Diploma-winning Nations			10	11	15	15	19	20
	Percentage of Medal-winning Nations			57%	42%	53%	53%	45%	57%
	Percentage of Diploma-winning Nations			71%	92%	88%	88%	61%	67%
Market Barriers	M _{entry} (Medals)				1	6	3	6	5
	M _{exit} (Medals)				4	2	3	1	2
	M _{entry} (Diplomas)				3	6	3	5	3
	M _{exit} (Diplomas)				2	2	3	1	2
Market Potential	MP _{os} (Medals)				5	57	29	81	85
	MP _{os} (Diplomas)				44	127	64	123	80

Note. ^aAustralia, Canada, Germany, Russia, Slovakia, and Spain entered the diplomas market; and Austria, Canada, Finland, Germany, Norway and Slovakia entered the medal market. ^bBulgaria, Czech Republic, Italy, Spain and Sweden entered the diplomas market; and Czech Republic, the UK, Germany, Japan, Norway and Slovenia entered the medal market.