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스포츠매니지먼트학 석사학위 논문

**Determinants of Audience Demand for the Telecasts
of the China Open Tennis Matches**

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시청 수요의 영향 요인 분석

2021년 8월

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다호

Determinants of Audience Demand for the Telecasts of the China Open Tennis Matches

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이 논문을 스포츠매니지먼트학 석사 학위논문으로 제출함
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Abstract

This study's purpose is to explore the factors that may affect the audience demand for broadcast tennis matches of China Open. The data were gathered from a total of 102 matches – the televised tennis matches of China Open from 2015 to 2019. Four dependent variables (TV ratings) representing audience demand for broadcast tennis matches, surveyed nationwide, tier1 cities, tier2 cities and tier3 cities, were regressed on a series of antecedent factors associated with each match.

The tier of cities showed an effect on the tennis television ratings. The means of television ratings in higher tiers cities are significantly higher than that in lower tiers cities. Regarding the form of consumer preferences factors, higher television ratings nationwide and in tier2, tier3 cities were associated with the presence of local player. And higher television ratings in tier1 cities were associated with higher facial attractiveness of players. In addition, matches with the presence of super star showed positive effects on television ratings nationwide and in tier1, tier2 cities. In terms of quality of sporting contests factors, higher TV ratings were related with the match with the greater importance. With respect to quality of viewing and supply capacity determinants, the broadcast channel seems to be the most powerful predictor of TV ratings. Other than the broadcast channel, prime time matches also appeared to have a positive effect on the TV ratings significantly. Through the comparison of the factors influencing the ratings of cities at different levels, this study found that these differences are mainly concentrated in the first category of factors: the form of consumer preferences.

By providing a good knowledge of the determinants of audience demand for televised sports, this study delivers significant information to sports marketers and event organizers. In particular, in the local held tennis event context. And this finding can provide a reference for the organizers of the China Tennis Open for the sale of media broadcasting rights.

Keywords: Demand for sport, Sports audience demand, the China Open, City tier

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Chapter 1. Introduction

1.1. Study Background

The most fundamental empirical question in professional sporting market analysis is understanding the nature and determinants of demand. Without some understanding of demand, team managers, sporting league or event administrators, and public policymakers and regulators simply cannot make accurate judgments on problems of critical relevance to them (Borland & Macdonald, 2003).

Nowadays, television is already the major revenue stream for many professional sports league, tournament, and event organizers, and it is rapidly becoming so for others. With the understanding of sports audience demand, broadcasters should see an increase in advertising revenue as the size of their television audiences grows. However, there is far less academic study on TV demand than there is on live match attendance, indicating that additional research is needed in this area. Therefore, this study will concentrate on sports television demand while considering audience demand.

The study of the drivers of demand for sporting events, as well as many other areas of sports economics, has exploded in recent decades. Without a doubt, this expansion has increased our understanding of the demand for such competitions. However, there is still much to be learned. Previous research has generally based on the data of Europe and the United States, as well as sports such as football, basketball and baseball. As a result, the ‘generalizability’ of findings from sports demand studies must be viewed with caution. Consumer demand for sports entertainment has been mostly concentrated on team sports until recently. By now, there is a substantial body of literature about the factors that influence team sports consumption (Borland & Macdonald, 2003; Buraimo, 2008). Researchers studying sports demand primarily looked at team sports like football (Peel & Thomas, 1992) and baseball (Ryu, Kim, Paik & Cheong, 2019).

Only a few authors, on the other hand, have studied demand for individual sports (Konjer, Meier & Wedeking, 2015). Demand for individual sports is comparatively understudied. The purpose of this study is to close a void in practical research on demand for individual sports by targeting at tennis. As for related research in the field of tennis, the authors of most previous researches noted that research remains relatively limited. Indeed, most of those studies to date have looked at Grand Slam matches; none, therefore, have looked at Open Championships in individual countries. In particular, none have explored the demands of TV audiences for the China Open, despite this is a second-highest level tennis event only after the four Grand Slams and being arguably the most prestigious international tennis event in Asia. This study seeks to provide the first insight into TV viewing preferences in the China Open, in order to assess the relative impact of uncertainty of outcome, match quality, athletic expertise, the presence of star players and so on.

A flow of research in sports media and marketing has looked into the effects of various influencing factors on audience demand for mediated sports programming, which is most commonly assessed by television ratings. However, the findings of different researches occasionally contradict one another, and the literature does not give a comprehensive series of antecedent factors of televised sports consumption. This is in that professional sports are culturally reliant, and the socioeconomic climate neighboring each country's professional events may influence public consumption of media sports in different ways (Ryu, Kim, Paik & Cheong, 2019). As a result, so as to comprehend the causes of audience demand for viewing televised sports, these variables must be investigated in every cultural and sports-specific context in which the sports event operates. China's research on leagues and events mostly focuses on qualitative summary studies of marketing strategies, organizational models, and communication methods. As Asia's largest sports industry market and sports broadcasting market, there is basically no quantitative research on sports demand. Therefore, this study select the China Tennis Open, a representative large-scale international event in China, as the object to explore the demand of sports audiences.

1.2. Purpose of Research

A peculiar data set of televised tennis match audiences from China, Asia's largest and most competitive TV market, are to be examined. This study aims to determine from the literature the elements that probably affect audience demand for broadcast tennis competitions, and to practically evaluate how those elements influenced audience demand for the China Open TV broadcast tennis competitions from 2015 to 2019.

The following is the order in which the study proceeds: first, reviewing previous research on professional sports demand, and then designing research questions to be investigated. Following a discussion of data samples, independent and dependent variables, the results of a number of ordinary least squares (OLS) regressions are being presented.

Chapter 2. Theoretical Background

2.1. Demand for Sport

The term ‘fan interest’ encapsulates the essence of demand for a match, tournament or event. This interest manifests itself in the following of the competition (for example, reading online reports or newspaper reports), purchasing contest-related merchandise (for instance, souvenir, sponsor products or gambling), or ‘following’ the contest (for instance, observing the competition description (competition live broadcast on TV/online) (Neale, 1964). In general, the sources of sports demand may include broadcasting, sponsorship, merchandising and so on.

The usefulness that fans gain from these derivation can be attributed to two factors: first, identification with a player or team competing in the sports event, and second, the match’s quality. Fan identification with a player or team is typically based on a geographical or emotional link, and has a solid foundation in the fan’s self-identity. The exhibition of physical or mental competence and the unpredictability of outcome are the two main characteristics of contest quality (Borland & Macdonald, 2003). For example, ‘The higher the quality of a match, the greater the grace and dexterity with which it is crafted. The larger the amount of instances of incredible physical performance that occur in it, the better.’ concluded by Rottenberg (2000).

According to Borland & Macdonald(2003), a conventional consumer-theory model underpins the economic theory of demand for sport contest attendance. The use of the consumer-theory model identifies five broad categories of demand factors for sport contest attendance: (1) form of consumer preferences: consume and viewing habit; history of a team or player; (2) economic: price: gate and travel costs; GDP; income; size of the market (including demographic composition of population); macro-economic aspects (rate of unemployment);

(3) quality of viewing: size and quality of stadium; timing of competition; holiday; (4) characteristics of the sporting competition: outcome uncertainty; team or player quality; match quality; match significance; (5) supply capacity: broadcast platform coverage. This is a relatively pioneering and authoritative classification of determinants of sports demand, and it has also been widely adopted by later researchers.

(1) form of consumer preferences: Several studies have discovered proof that habit is a significant predictor of demand. In sports, this habit is mostly manifested in fan identification(loyalty). Generally, the greater the geographic and emotional proximity, the stronger the fan identification. According to Szymanski (2003), attendance was highest when the host team had a two-to-one chance of winning the game and fans went to sports to see their team win.

(2) economic: Demand would be expected to be positively connected to the income the population or audience that makes up the possible audience for a sporting event, as well as the size of the potential market's population for a sporting event. In addition, GDP and working hours are two more macroeconomic factors that may influence demand (Borland & Macdonald, 2003).

(3) quality of viewing: Aspects of quality of viewing at sports matches may be the impact of adverse weather conditions; timing of the match -- when the competition is happened, whether it is a holiday, and the time of day (morning, afternoon, night) the contest is held (Borland & Macdonald, 2003).

(4) characteristics of the sporting contest: In professional sport field, the primary product is the competition between two players or teams (Borland, & Macdonald, 2003). Spectators favored to see successful and skilled players and were more inclined to attend a match if their team had superstars (Szymanski, 2003). Scholars discovered that demand for relevant product aspects of sport entertainment increases with the sports reputation and importance of an event or game (Buraimo, 2008). Peel and Thomas (1992)'s settlements from the analysis of the 1986/87 English Football League season suggest that the uncertainty of a competition have an obvious effect on attendance. Leifer(2000) suggest that

long-term uncertainty obviously affect fan interest.

(5) supply capacity: Viewing a sporting competition must take place at a particular situation. Therefore, the supply capacity of sports content suppliers is very important, and the supply coverage of suppliers will also affect demand.

2.2. Sports Audience Demand

Demand for sport contests is studied using an economic method that finds both ‘direct’ and ‘derived’ demands. When a consumer gains utility from a sports competition, there is direct demand. Direct demand includes (a) demand for stadium attendance at sports events and (b) demand for pay-per-view viewing of sporting events. And on the other hand, when a sporting event is used as an input in the creation of another products or service, it is referred to as derived demand (Borland & Macdonald, 2003). This research discriminates audience demand as one key branch of direct demand for sport.

Demand analysis is a big component of the sports economics researches, and a lot of it has been focused on stadium attendance, which is a big source of revenue for teams with regard to gate receipts and ancillary spending. While recently, leagues, teams and event organizers have been able to take advantage of the broadcast market since the introduction and widespread of television. Broadcast money is significantly more important to some leagues and teams than gate receipts (Buraimo, 2008).

Pacey and Wickham conducted the first study of sports broadcast audience demand (1985). Their study of Nielsen ratings for college football evaluates the effect of match quality on TV audience demand and offers policy recommendations for the broadcast market. In NBA, Hausman and Leonard (1997) look at the impact of superstars. They discovered that the number of super stars in the game had a substantial impact on the TV ratings for various broadcast class. Other recent researches which have studied TV audience demand are Uribe, Buzeta, Manzur and Alvarez's (2021) study of football in the FIFA world cup

and Konjer, Meier and Wedeking's study of tennis in Germany.

The solid pool of practical study on demand functions for team sports has uncovered some major antecedent factors of demand, as shown by some outstanding reviews (Borland & Macdonald, 2003). The majority of research, however, have concentrated on stadium attendance—which is usually quantified in terms of the number of tickets sold or gate revenues—rather than television viewing. Given that the sale of broadcast rights is the most important source of funding for most professional sports, it's remarkable that television viewing has received so little academic attention. Furthermore, the conclusions show that live attendance and television demand differ in several ways (Buraimo & Simmons, 2009). Sports audience demand may be more sensitive to local teams or players or superstars with more media coverage, rather than sports contest characteristics that sports fans usually pay more attention to. Findings show a considerable liking for TV broadcast during prime time and on weekends when it comes to opportunity costs (Buraimo, 2008). Moreover, compared with the attendance, the sports TV audience demand is less affected by weather conditions.

Researches on sports TV audience demand is the same as the researches on attendance, and they are mainly concentrated on team sports rather than individual sports. Researches on TV ratings for cycling races were given by Rodriguez, Perez, Puente, and Rodriguez (2013) and a series of studies of influencing factors of German tennis TV ratings were conducted by Konjer, Mutz, & Meier (2015, 2016, 2019).

2.3. Determinants of Sports Audience Demand in the China Open Tennis Tournament Context

There has been no unified framework for categorizing the determinants, therefore each different scholar has taken his or her own reach to identifying the significant determinants that affect audience demand for broadcast sports. This is due to the fact that the elements influencing television audience demand for

sports programming differ depending on the distinct characteristics and culture of each sports event (Ryu, Kim, Paik & Cheong, 2019). For example, Scott Tainsky(2010) added American-specific market and festival variables to the research on the influence factors of NFL TV ratings, showing that sharing a market and Thanksgiving will have impact on the audience demand. These many approaches show that there is no universally agreed series of preliminary elements that influence sports TV audience demand, and these preliminary factors will be different depending on the culture and socioeconomic situations around the market where the sports leagues or events operate.

The conclusion of Konjer, Meier & Wedeking (2015)'s research suggests that although there may be a few differences based on objects of identification and competition structures, sport economics canonical models can be also useful in studying individual sports because demand for individual sports seems to be driven by a similar series of determinants as demand for team sports. Therefore, in order to study the audience demand of tennis as an individual sport, this study uses the above two parts of the general sports demand model and the classification of determinants as the basic framework.

Under the specific text of the China Tennis Open, this study adds five unique variables in addition to the factors that affect the demand of sports audience that are often examined in the previous research mentioned above: gender, facial attractiveness, defending champion, city tier and National Day.

Most previous studies focused on a certain sports league, so they focused on one gender. And professional tennis is one of the few types of sports with balanced gender development in the field of professional sports, and it will not be considered a typical male or female sport. Globally, male professional tennis and female professional tennis have received equal attention from population. However, in China, due to the existence of outstanding female tennis players like Li Na and Wang Qiang, and for a long time, the Chinese male tennis player absent from top professional tennis events, the Chinese public may pay more attention to female tennis matches than male tennis matches. Therefore, this study has added gender variables to explore whether gender may have an impact

on the demand of Chinese tennis audience.

Scholars have claimed that physical attractiveness (Mutz & Meier, 2016) and expertise (the quality or success of player) play a crucial role in sports audience demand. Tennis audience demand for female matches is positively influenced by facial attractiveness (Dietl, Ozdemir, Rendall, 2020). Researchers in the social sciences, economics, psychology, and anthropology have discovered that physical attractiveness has a variety of effects. The degree to which a person's physical characteristics are deemed aesthetically acceptable or beautiful is referred to as physical attractiveness. The concept of physical attractiveness encompasses fundamental impressions shared by all human societies, such as facial symmetry (Grammer & Thornhill, 1994). Given the existence of the beauty bias, in the realm of sports, the concept of beauty has also gotten a lot of attention, and previous findings strongly show that sports have comparable selection mechanisms and biases. This is inseparable from the commercial nature of modern sports, especially football, baseball, tennis and other sports with high-level professional development. The attractiveness of athletes in these sports are more closely related to the popularity of the public, advertisers and sponsors. Consumers were compelled to watch MLB games because of the physical appeal of the athletes, according to Trail and James (2001). They also discovered a link between player physical attractiveness and increased goods purchasing. This also proves that physical attractiveness has a positive effect on both the direct and derived demands of sports demand. Anna Kournikova, a former Russian tennis star, has been praised for receiving so much attention for her attractiveness. Pfister (2001) developed the phrase 'Kournikova syndrome' to allude to the popularity of female athletes who meet the hegemonic ideal of femininity as Kournikova became one of the most mediated celebrities with high-income despite never winning a WTA tournament singles title (Harris & Clayton, 2002). The rationality and necessity of exploring the impact of facial attractiveness on the sports audience demand under the tennis context are obvious. First of all, as mentioned above, tennis is highly professional, and compared with most other sports, the attention of male and female competitions is more balanced, so

physical attractiveness is more likely to become the predictor of tennis audience demand. Second, In compared to other sports (particularly team sports such as football or baseball), the TV camera only focuses on two players in the court, decreasing data noise (Dietl, Ozdemir, Rendall, 2020). According to the existing researches, attractive players always outperformed unattractive players in tennis (Bakkenbull & Kiefer, 2015). According to Meier and Konjer (2015), attractiveness didn't have a significant influence when women observed male matches, but it did when attractive female players were on the field. Men, on the other hand, seemed to pay more attention when attractive female players were on stage and less attention when attractive male players were on stage. Scholars have claimed that physical attractiveness (Mutz & Meier, 2016) and expertise (the quality of the player) play a crucial role in sports audience demand. Tennis audience demand for female matches is positively influenced by facial attractiveness (Dietl, Ozdemir, Rendall, 2020). Because facial attractiveness is found to be the most powerful factor of physical attractiveness, researchers who looked into physical attractiveness focused mostly on face features. This study will concentrate solely on face attractiveness, with facial symmetry scores serving as a surrogate for physical attractiveness.

Recent research by Reams and Shapiro (2017) on Ultimate Fighting Championship matches also found that demand was most affected by matches featuring the league's highest ranked fighters, as well as current and former champions. Defending champion represents there is a champion in last year in the match. Moreover, in the field of professional tennis, the concept of the defending champion is very important. It can show the continuity of an athlete's athletic ability and is often mentioned by the narrator in television broadcasts. Therefore, this study introduces the variable of the defending champion in order to explore the persistence of the audience's perception of the China Tennis Open.

While 'demand for sport' researchers centered on characteristics that are peculiar to sports, economic and demographic factors were also utilized to explain sports demand (Dietl, Ozdemir, Rendall, 2020). Because China has a large population and huge geographical differences, it is very necessary to

include city tier variable. The city tier is divided according to the population size and the degree of economic development. After discovering how the city level affects the demand for sports audience, it is possible to see the effect of the economy on the demand for sport to a certain extent.

As mentioned earlier, sports demand has a strong cultural dependence. Different countries, different geographical environments, economic development levels, and cultural backgrounds will cause sports demand to show different characteristics. The China Tennis Open is usually held in Beijing at the end of September and early October each year. This time period happens to be an important holiday in China: National Day, public of the whole country will enjoy a one-week holiday, which is expected to have an impact on sports TV ratings, so this study added a National Day variable.

Table 1 shows the influencing factors of the audience demand of the China Open set by this study.

Table1. Classification and source of independent variables

Classification	Explanatory Variable	Reference
	local player	Szymanski, 2003
	gender	Konjer, Meier, & Wedeking, 2015
form of consumer preferences	facial attractiveness	Meier & Konjer, 2015
	superstar	Hausman & Leonard, 1997
	defending champion	Reams & Shapiro, 2017
economic	city tier	
	National Day	Forrest, Simmons & Buraimo, 2005
quality of viewing	timing	Buraimo, 2008
	year	Ryu, Kim, Paik & Cheong, 2019
	match significance	Meier & Konjer, 2015
characteristics of the sporting contest	athletic expertise	Meier & Konjer, 2015
	match intensity	Meier & Konjer, 2015
	outcome uncertainty	Peel & Thomas, 1992
supply capacity	HD channel	Meier & Konjer, 2015

Chapter 3. Research Questions

Based on the literature and theories of sports demand and sports audience demand reviewed above, combined with the characteristics of the specific context of the China Tennis Open tennis tournament, the general question raised by this study is:

RQ1: What are the factors that determine the TV ratings of the China Open tournament?

And in the process of collecting data in the pre-work, this study found that the same match corresponds to a rating from the whole country and three ratings from the cities of different tiers. This on the one hand confirms the rationality of the aforementioned introducing that add the city tier into the determinants to be examined, and on the other hand, it also leads to the second question that this study wants to explore:

RQ2: Do the factors determining the TV ratings of the China Open tournament different by tier of cities?

Chapter 4. Methods

4.1. Sample and Data

Although network broadcasting platforms are gradually emerging, so far, the viewing habits of sports audiences are still mainly on TV, and the exclusive broadcasters of important sports events are usually TV broadcasters, so sports TV audience demand researches generally have used TV ratings and TV viewer size to measure. Therefore, this study will use TV ratings data to estimate demand functions, similar to other studies on sports audience demand in sports (Dietl, Ozdemir, Rendall, 2020). Due to the impact of the Covid-19, the China Open will not be held in 2020, so this study selected the latest five years of data as from 2015 to 2019. The TV ratings data is from KUYUN, a leading multi-media big data service company in the field of real-time TV ratings monitoring in China. KUYUN data comes from the live data return of the terminal. Terminals include smart TV and set-top box that basically cover all types of terminals related to TV in Chinese households. 90% of newly shipped TVs in the domestic market are smart TV and set-top box include traditional set-top box and IPTV set-top box. KUYUN's real-time TV viewership monitoring is considered to be clean data that can truly reflect the true status of Chinese TV at the moment, and has been widely recognized by TV agencies, television content production companies, advertisers and TV viewers. CCTV sports has always been the exclusive official partner media of the China Tennis Open. CCTV-5 is a professional sports channel of the official Chinese national broadcaster CCTV that mainly broadcasts sports events and sports reports. CCTV-5 is the only national sports channel in China that covers all regions in China. It has the exclusive rights to broadcast many top international sports events and occupies more than 80% of the TV sports market share in China. CCTV-5+ is the second sports channel of CCTV and it is a HD TV channel focusing on sports live events,

videos and highlights. Since CCTV5+ is a high-definition premium channel, only users who have installed a high-definition digital TV set-top box and purchased a high-definition channel service can watch it.

Tennis is primarily an individual sport in which two players compete against each other. Competitive players gather on a regular basis at various competitions all through the year, earning ranking points based on their playing performance. Organizers utilize seeding procedures based on the Association of Tennis Professionals (ATP) and the Women's Tennis Association (WTA) rankings to make certain that the top players play each other in the tournament's latter rounds (competition balance). The China Open tournament is a second-highest level tennis event only after the four Grand Slams and being arguably the most prestigious international tennis event in Asia. The tournament take place in Beijing, China in early October each year. The China Open has 64 female players in total, with winners determined after six rounds, and 32 men players, with winners determined after five rounds. This study focuses on all the single-player matches of the China Open broadcast by CCTV from 2015 to 2019 using match data from tennis1.win007.com, a professional tennis data website. This results in 102 match-observations in total.

4.2. Measurement of Variables

The operational definitions of each independent variable are listed in Table2.

Table.2 Operational definitions of independent variables

Classification	Independent	Coding	Operational definitions
Form of audience preference	Local player	CHINESE	1 = Matches with the presence of Chinese player; 0 = Otherwise
	Gender	FEMALE	1 = Female match; 0 = Male match
	Facial attractiveness	FATT	The sum of corrected scores of both players from Prettyscale.com
	Super star	SUMGS	The sum of Grand Slam titles won by both players
	Defending champion	DCHAMPION	1 = Matches with the presence of the last year China Open champion player
Characteristics of sporting contests	Match significance	ROUND	
		BEFOREFINAL	1 = Matches before quarter-final stage; 0 = Otherwise
		QUARTERFINAL	1 = Quarter-final match; 0 = Otherwise
		SEMIFINAL	1 = Semi-final match; 0 = Otherwise
		FINAL	1 = Final match; 0 = Otherwise
	Athletic expertise	LNSUMRANK	The nature logarithm of the sum of ranks of both players
	Match intensity	SUMGAME	The total number of games throughout the sets
	Outcome uncertainty	LNDIFFRANK	The nature logarithm of the difference between the ranks of both players
Quality of viewing	National Day	NATIONALDAY	1 = Televised matches in National Day holiday; 0 = Otherwise
	Timing	PRIMETIME	1 = Televised matches during 7:30pm~11:00pm; 0 = Otherwise
	Year	2015	1 = The China Open tournament in 2015; 0 = Otherwise
		2016	1 = The China Open tournament in 2016; 0 = Otherwise
		2017	1 = The China Open tournament in 2017; 0 = Otherwise
Economic	City tier	2018	1 = The China Open tournament in 2018; 0 = Otherwise
		2019	1 = The China Open tournament in 2019; 0 = Otherwise
		C	1 = The viewing area is nationwide; 0 = otherwise
		C1	1 = The viewing area is tier1 cities; 0 = otherwise
		C2	1 = The viewing area is tier2 cities; 0 = otherwise
		C3	1 = The viewing area is tier3 cities; 0 = otherwise
Supply capacity	HD channel	HDTV	1 = Matches televised in HD channel; 0 = Matches televised in free channel

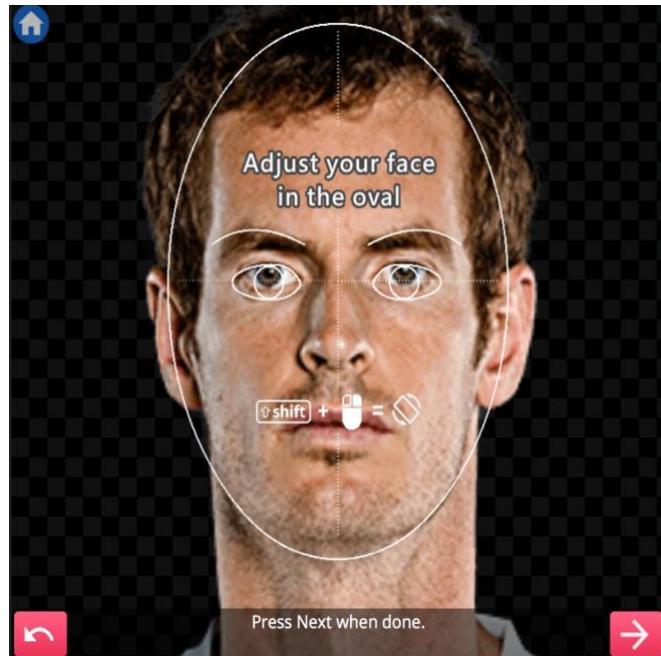
4.2.1. Form of Consumer Preferences

Because player ethnicity is a characteristic of fan identification, and identification of player's nationality has been shown to be very important for sports audience demand, here controls for nationality, categorizing players as domestic (Chinese nationality) or international in order to pay attention to the connection between fan identification and sports demand. If at least one Chinese player is on the pitch, the dummy variable CHINESE is set to 1.

A dummy variable indicating the player's gender is included in the analysis to control for sex-specific variances in audience demand. If the competition is played between female players, FEMALE is set to 1.

Previous related studies mostly used the Truth of Consensus method to score physical attractiveness. As mentioned above, facial symmetry is the most powerful indicator of physical attractiveness and in order to removing potential biases from surveys, this study draws on Dietl, Ozdemir & Rendall (2020)'s method of measuring facial attractiveness by using software called Prettyscale. Prettyscale uses 14 separate markers that must be physically placed on the players' photographs to obtain face symmetry scores. To begin, run many rounds of image searches from Google to find 3 photographs for every player. The image should ideally be a frontal headshot with the players' hairline, chin, and ears showing and no smiles or grimaces. Then, after uploading each image to the software, edit and zoom in the image as needed, choose the player's gender, and put the 14 various landmarks one by one using the mouse cursor (Figure 1).

Figure1. Facial symmetry analysis on prettyscale.com



Afterwards, recording any photo anomalies that may happen due to the player's smiling or grimacing expression for each image. Anomalies can also happen if the camera perspective is slanted horizontally or vertically. In this procedure, purposefully eliminating photos that appear to be photoshopped or were clearly taken not within the player's professional periods. Facial symmetry scores for 294 images were calculated in total. Next, performing individual fixed effects regressions for female and male players, correcting for anomalies such as horizontal (Horizontal), vertical (Vertical), smiling (Smile) with closed lips, and grimace (Grimace); Grimace also includes photographs of players laughing.

$$\begin{aligned} \text{Facial Symmetry}_{id} = & \beta_0 + \beta_1 \text{Horizontal}_i + \beta_2 \text{Vertical}_i + \beta_3 \text{Smile}_i + \\ & \beta_4 \text{Grimace}_i + \beta_5 \text{HorizontalGrimace}_i + \\ & \beta_6 \text{VerticalGrimace}_i + \alpha_d + \varepsilon \end{aligned}$$

Table3. Regressions with player fixed effects for image corrections by gender

Variables	Female	Male
Horizontal	-6.247 (-1.08)	-2.368 (-0.90)
Vertical	-11.108 (-1.50)	-9.521*** (-2.76)
Smile	-8.094*** (-3.11)	-7.632*** -2.73
Grimace	-19.157*** (-10.26)	-10.314*** (-4.03)
HorizontalGrimace	6.670 (0.92)	1.224 (0.19)
VerticalGrimace	0.519 (0.07)	-1.594 (-0.31)
Constant	82.902*** (56.66)	78.447*** (122.28)
Observations	174	120
Number of players	58	40
R ²	0.524	0.344
FE	yes	yes

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

For image corrections, Table3 displays the regression results with player fixed effects. The individual fixed effects for every player are then predicted, and the constant from the regressions is added to the individual fixed effects. Because this is a simple transformation, a constant being added to the corrected measures has no effect on the regression findings.

Regardless of the scale, history, bonuses, points and influence of the event, the Grand Slam series (Australia Open, French Open, Wimbledon Championships, The US Open) can be regarded as the most important event in professional tennis. Therefore, winning the Grand Slam title is the ultimate

dream for every professional tennis player, the supreme glory. In the field of professional tennis, only those who have won a grand slam are eligible to be called a superstar, and the more Grand Slam won, the stronger the athletes have a superstar influence over the course of a long period of time in their careers. The number of Grand Slam titles accounts for prior performances (superstar position) that may not be fully represented by rankings because the ATP and WTA rankings are updated on a regular basis and thus control for current (short-term) performance. The sum of both players' Grand Slam titles is SUMGS. To create the variable, adding up each player's Grand Slam titles at the start of the event, then tally the total number of Grand Slam wins for both players for each match.

Given the continuity of sporting events and media coverage of former champion, the defending champion is also thought to be able to affect sports TV ratings. If there is a champion of last year's event on the field, then DCHAMPION's value is taken as 1, otherwise it is taken as 0.

4.2.2. Economic

According to the size of the population and the level of economic development, Chinese cities are divided into five levels. The smaller the number, the higher the level. Due to data limitations, this study only analyzes the whole country, tier1 cities, tier2 cities, and tier3 cities. The city tier contains a set of dummy variables: C represents the whole country, C1 represents the tier1 cities, C2 represents the tier2 cities, and C3 represents the tier3 cities.

4.2.3. Quality of Viewing

The one week between the end of September and the beginning of October is a public holiday National Day in China. According to the historic annual calendar data, if the match is held on a public holiday, the value of the NATIONALDAY is 1.

Taking scheduling effects into consideration, the quality of viewing that

affects viewership (opportunity costs) is evaluated. It will determine if the match will be shown in primetime, as prior research has shown that matches broadcast during prime time draw more viewers (Buraimo, 2008). PRIMETIME is a dummy variable that is set to 1 if a match is televised during primetime 19:30-23:00 (Konjer & Meier, 2015).

The quality of viewing affecting viewership (opportunity costs) also include a time trend. Here is a set of year-based trend variables YEAR (2015, 2016, 2017, 2018) that are used to track the evolution of demand for tennis telecasts in China over time.

4.2.4. Characteristics of the Sporting Contest

According to previous researches, the success of teams or players in a match can be tested by the ranking each team or player; the match quality can be measured by the average ranking or the sum of rankings of teams or players (Borland & Macdonald, 2003); the difference in rankings of teams or players can be used to measure the uncertainty of the outcome; and match significance can be measured by the competition round.

As players proceed to the key stages of a competition, it is reasonable to suppose that a match will become more appealing to a wider audience. The significance of the match is represented by the stage. ROUND is a set of dummy variables that regulates the tournament's various phases (BEFOREFINAL, QUARTERFINAL, SEMIFINAL, FINAL). The more the later stage, the greater the significance of the match.

In the previous measurement of competition quality, some used wage bills (Buraimo, 2008), some used rankings (Konjer, Meier & Wedeking, 2015), and some used points. According to econometric studies (Garca and Rodrguez, 2009), the majority of TV viewers appear to judge sports expertise using relatively simple indicators. Although tennis has a high degree of professionalism and a complete salary system, considering that tennis is based on each tournament as a reward unit instead of an annual salary system, the number of rewards varies

from tournament to tournament. And if participating in more competitions means may get more rewards, so rewards does not represent the expertise of athletes. Moreover, because the tennis pointing system has changed in recent years, in order to ensure the standard uniformity of the data set during the five-year period, this study does not use points to measure athletic expertise. Because the real-time ranking system of professional tennis is based on points that come from the sum of points players earned in the past 52 weeks, the better the performance in the tour, the more points get, therefore the ranking is the most direct reflection of player's short-term athletic expertise. After pre-test, in order to ensure the normal distribution of the data and avoid multicollinearity, this study uses the natural logarithm of the rankings' sum of two competing players (LNSUMRANK) to measure the athletic expertise.

By calculating the number of games played across the sets, this study adjusts for competitive intensity (NUMBEROFGAMES). Only two-game leads are enough to win a tennis match. A higher number of games equals a more competitive contest.

As mentioned earlier, many related researches have proved that uncertainty of outcome seems to influence sports demand. This means that event organizers do have a reasonable basis for adopting rules and restrictions aimed at achieving competitive balance. The seed system of tennis matches is based on this. Uncertainty about match outcomes is a hot topic in sports demand research. Attendance is typically predicted to rise when the level of uncertainty surrounding the outcome of a match rises. The empirical data in the literature, however, is mixed. There have been two basic techniques to measuring outcome uncertainty: first, a measure of difference in winning percentage or ranking of teams or players (Konjer, Mutz & Meier, 2019); and second, a measure of the chance that a team or player will win obtained from betting odds (Meier & Konjer, 2015). Because the betting odds data system of tennis is not as developed as that of football, and it is basically concentrated on European tournaments data, coupled with the rigor and representativeness of the tennis ranking system and seed system, this study chooses to use the natural logarithm of the difference

between the two players' rankings (LNDIFFRANK) to measure the uncertainty of the expected outcome of the match.

4.2.5. Supply Capacity

Broadcasting channel also affects audience demand for media sports. Unlike previous studies that mostly used pay-TV to measure this impact, since China does not yet have a mature pay-TV system, this study uses definition as the channel distinction (HDTV). There are two channels that broadcast the China Open tennis matches: CCTV5 and CCTV5+, both of which belong to CCTV. CCTV5 can be watched by users who have installed a set-top box and has a wider coverage; while CCTV5+ can be watched by users who have installed a high-definition set-top box and purchased a high-definition service. When the match is broadcast through CCTV5+, the HDTV value is 1; when the game is broadcast through CCTV5, the HDTV value is 0.

4.3. Statistical Model

First, this study designed a multiple regression analysis model that included all variables:

$$\begin{aligned} \text{rating} = & \beta_0 + \beta_1 \text{CHINESE} + \beta_2 \text{FEMALE} + \beta_3 \text{FATT} + \beta_4 \text{SUMGS} + \\ & \beta_5 \text{DCHAMPION} + \beta_6 \text{ROUND} + \beta_7 \text{LNSUMRANK} + \\ & \beta_8 \text{SUMGAME} + \beta_9 \text{LNDIFFRANK} + \beta_{10} \text{NATIONALDAY} + \\ & \beta_{11} \text{PRIMETIME} + \beta_{12} \text{Year} + \beta_{13} \text{Citytier} + \beta_{14} \text{HDTV} + \varepsilon \end{aligned}$$

However, in the test of heteroscedasticity problem, it is found that the model has serious heteroscedasticity. After data analysis and testing, it is found that heteroscedasticity mainly comes from city tier variable. Therefore, this study removes city tier variable from the multiple regression equation and adopts another method: analysis of variance (ANOVA) to check the impact of city tier.

Then, the multiple regression equation model is adjusted as follows:

$$\begin{aligned} \text{rating} = & \beta_0 + \beta_1 \text{CHINESE} + \beta_2 \text{FEMALE} + \beta_3 \text{FATT} + \beta_4 \text{SUMGS} + \\ & \beta_5 \text{DCHAMPION} + \beta_6 \text{ROUND} + \beta_7 \text{LNSUMRANK} + \\ & \beta_8 \text{SUMGAME} + \beta_9 \text{LNDIFFRANK} + \beta_{10} \text{NATIONALDAY} + \\ & \beta_{11} \text{PRIMETIME} + \beta_{12} \text{Year} + \beta_{13} \text{HDTV} + \varepsilon \end{aligned}$$

Before the formal statistical analysis, the White test was first performed on the data. The result showed that the model does not have heteroscedasticity problems and satisfies the assumption of the least squares method. Therefore, it is feasible to use the least squares method for model estimation, and no further data adjustment steps are required.

In order to answer the second research question, the rating from different tier of cities were used as dependent variables, and the model mentioned above was run 3 times more.

$$\begin{aligned} \text{rating(tier1/tier2/tier3)} = & \beta_0 + \beta_1 \text{CHINESE} + \beta_2 \text{FEMALE} + \beta_3 \text{FATT} + \\ & \beta_4 \text{SUMGS} + \beta_5 \text{DCHAMPION} + \beta_6 \text{ROUND} + \\ & \beta_7 \text{LNSUMRANK} + \beta_8 \text{SUMGAME} + \\ & \beta_9 \text{LNDIFFRANK} + \beta_{10} \text{NATIONALDAY} + \\ & \beta_{11} \text{PRIMETIME} + \beta_{12} \text{Year} + \beta_{13} \text{HDTV} + \varepsilon \end{aligned}$$

As for city tier variable, in order to make full use of the collected data, and to test whether there are obvious differences in the ratings from cities of different tiers, an ANOVA analysis with city tier as the categorical independent variable and TV rating as the dependent variable is implemented.

Chapter 5. Results

5.1. Descriptive Statistics

According to one-way analysis of variance, there is significant difference in the average ratings of cities at different tiers (see Table4). As shown in Table5 and Table6, means without same superscript are statistically different at $p<0.05$. In the comparison of the average ratings of the three tiers of cities, the difference between the tier1 cities and the tier3 cities is significant. Therefore, overall conclusion that the mean values of these three tiers are not the same mainly comes from the comparison between tier1 and tier3.

Table4. Analysis of Variance

Source	SS	df	MS	F	Prob>F
between groups	0.142	2	0.071	5.42	0.0049
within groups	3.963	303	0.013		
total	4.105	305	0.013		

Bartlett's test for equal variances: $\chi^2(2) = 15.0857$, Prob> $\chi^2 = 0.001$

Table5. Summary of rating

tier	Mean	Std. Dev.	Freq.
1	0.199a	0.136	102
2	0.175ac	0.110	102
3	0.147bc	0.093	102
total	0.174	0.116	306

Table6. Comparison of rating by tier (Scheffe)

Row Mean - Col Mean	1	2
2	-0.025	
	0.301	
3	-0.053	-0.028
	0.005	0.223

Table7. Descriptive statistics

Explanatory factors		Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
Dependent Variables								
	RATING	102	0.156	0.098	0.0236	0.582	1.545	6.665
	RATING1	102	0.199	0.136	0.033	0.871	2.002	8.987
	RATING2	102	0.175	0.110	0.026	0.650	1.522	6.585
	RATING3	102	0.147	0.093	0.018	0.497	1.421	5.888
Independent Variables								
form of consumer preferences	gender	FEMALE	102	0.618	0.488	0	1	
	local player	CHINESE	102	0.284	0.453	0	1	
	facial attractiveness	FATT	102	163.910	12.261	130.1	186	-0.290
	super star	SUMGS	102	2.627	4.931	0	24	2.272
	defending champion	DCHAMPION	102	0.098	0.299	0	1	7.355
Quality of Sporting Contest	ROUND							
	match significance	BEFOREFINAL	102	0.627	0.486	0	1	
		QUARTERFINAL	102	0.167	0.375	0	1	
		SEMIFINAL	102	0.127	0.335	0	1	
	match intensity	FINAL	102	0.078	0.270	0	1	
		SUMGAME	102	21.255	5.586	10	36	0.676
		LNDIFFRANK	102	3.213	1.129	0.693	6.011	0.229
		LNSUMRANK	102	3.847	0.884	1.609	6.186	0.243
Quality of Viewing	National Day	NATIONALDAY	102	0.843	0.365	0	1	
	primetime	PRIMETIME	102	0.353	0.480	0	1	
	YEAR							
	year	2015	102	0.216	0.413	0	1	
		2016	102	0.186	0.391	0	1	
		2017	102	0.176	0.383	0	1	
		2018	102	0.275	0.448	0	1	
		2019	102	0.147	0.356	0	1	
Supply Capacity	HD channel	HDTV	102	0.216	0.413	0	1	

Table7 shows the descriptive statistics of the dependent variables (rating, rating1, rating2, rating3) and independent variables.

5.2. Regression Analysis

5.2.1. Preliminary Analysis

According to West, Finch, and Curran(1995), if Skewness's absolute value is less than 3, and the absolute value of Kurtosis is less than 8, it can be basically considered that the data set conforms to the normal distribution of the variable. After pre-testing, the data set in this study generally satisfies the normal distribution condition of the data (see Table7). And after testing, the residual of the regression equation also satisfies the normal distribution ($p=0.000 < 0.05$, see Table8).

Table8. Skewness/Kurtosis tests for Normality of residual

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	ahj chi ² (2)	Prob>chi ²
residual	102	0.0000	0.0000	34.94	0.0000

Then, the independent variables in the regression model were tested for autocorrelation. The results show that the 13 independent variables in the model do not have autocorrelation (see Table9), which meets the prerequisites of regression analysis.

Table9. Correlation analysis of independent variables

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
A	1.000																		
B	0.2723	1.0000																	
C	0.0056		1.0000																
D	0.4258	0.4268		-0.2158															
E	0.0000	0.0000	1.0000																
F	-0.1470	-0.4462		1.0000															
G	0.1403	0.0000	0.0294																
H	0.0115	-0.0798	-0.0097	0.2871															
I	0.9089	0.4252	0.9227	0.0034	1.0000														
J	0.3508	0.1031	0.2167	-0.2527	-0.0869	1.0000													
K	0.0003	0.3025	0.0287	0.0104	0.3851														
L	-0.1652	-0.1353	-0.0558	0.1197	0.0295	-0.5804	1.0000												
M	0.0970	0.1750	0.5777	0.2307	0.7686	0.0000													
N	-0.1757	0.0587	-0.1119	0.0949	0.0717	-0.4960	-0.1709	1.0000											
O	0.0773	0.5577	0.2629	0.3426	0.4738	0.0000	0.0859												
P	-0.1839	-0.0706	-0.1736	0.1708	0.0264	-0.3786	-0.1305	-0.1115	1.0000										
Q	0.0643	0.4806	0.0810	0.0861	0.7919	0.0001	0.1912	0.2646											
R	0.5067	-0.1022	0.2422	-0.2451	-0.1004	0.5016	-0.0702	-0.3537	-0.3660	1.0000									
S	0.0000	0.3068	0.0142	0.0130	0.3152	0.0000	0.4832	0.0003	0.0002	1.0000									
T	0.4529	-0.1973	0.0783	-0.0272	-0.0166	0.3653	0.0050	-0.3074	-0.2826	0.8371	1.0000								
U	0.0000	0.0469	0.4338	0.7861	0.8688	0.0002	0.9600	0.0017	0.0040	0.0000									
V	0.0926	-0.0065	0.0929	-0.1152	-0.2204	0.1695	-0.0241	-0.2393	0.0256	0.1068	0.0523	1.0000							
W	0.3548	0.9481	0.3529	0.2491	0.0260	0.0886	0.8099	0.0154	0.7987	0.2854	0.6017								
X	0.0348	-0.0944	0.0046	-0.0066	0.1015	-0.1523	0.0550	0.0869	0.0898	-0.1511	-0.1513	0.0929	1.0000						
Y	0.7286	0.3455	0.9632	0.9472	0.3103	0.1266	0.5826	0.3854	0.3696	0.1296	0.1290	0.3530							
Z	-0.0135	-0.1760	-0.0876	0.2487	0.2279	0.0097	-0.0426	0.0140	0.0243	0.0830	0.0621	-0.3637	-0.1878	1.0000					
A'	0.8931	0.0768	0.3815	0.0117	0.0212	0.9232	0.6705	0.8888	0.8082	0.4067	0.5355	0.0002	0.0588						
B'	0.0334	0.1692	0.1837	-0.0355	-0.1577	0.1083	-0.0788	-0.0318	-0.0459	0.0402	-0.0310	-0.0014	0.0155	-0.2509	1.0000				
C'	0.7391	0.0892	0.0645	0.7230	0.1133	0.2788	0.4309	0.7508	0.6468	0.6880	0.7572	0.9892	0.8771	0.0110					
D'	-0.1207	-0.0062	0.0820	0.1295	-0.0661	-0.0688	0.0000	0.0544	0.0563	-0.1918	-0.1673	0.1290	0.0348	-0.2428	-0.2215	1.0000			
E'	0.2268	0.9505	0.4123	0.1946	0.5090	0.4918	1.0000	0.5868	0.5743	0.0535	0.0928	0.1965	0.7283	0.0140	0.0253				
F'	0.1480	-0.0133	0.0746	-0.2309	-0.1289	0.0650	0.0196	-0.0375	-0.0977	0.0798	0.0736	0.1445	0.0514	-0.3226	-0.2943	-0.2847	1.0000		
G'	0.1376	0.8945	0.4562	0.0196	0.1966	0.5160	0.8446	0.7086	0.3284	0.4255	0.4621	0.1473	0.6081	0.0009	0.0027	0.0037	0.0037	1.0000	
H'	-0.0776	0.0419	-0.2826	-0.0982	0.1424	-0.1381	0.1114	0.0073	0.0848	-0.0348	0.0493	0.1030	0.0988	-0.2177	-0.1987	-0.1922	-0.2554	1.0000	
I'	0.4381	0.6760	0.0040	0.3260	0.1534	0.1663	0.2649	0.9418	0.3968	0.7286	0.6226	0.3030	0.3231	0.0279	0.0453	0.0529	0.0096	0.0000	
J'	0.2507	0.0692	0.0240	-0.1739	-0.0126	0.1576	0.0213	-0.1289	-0.1530	0.2041	0.1756	0.0951	0.1115	-0.2750	-0.2509	-0.2428	0.5855	0.1188	
K'	0.0110	0.4892	0.8108	0.0804	0.9002	0.1137	0.8316	0.1965	0.1248	0.0396	0.0775	0.3417	0.2646	0.0052	0.0110	0.0140	0.0000	0.2345	

After testing, there is no multicollinearity problem among the independent variables ($VIF < 10$), therefore, the regression equation is meaningful (see Table10).

Table10. Multicollinearity analysis

Variable	VIF
FEMALE	2.21
CHINESE	2.08
FATT	1.83
QUARTERFINAL	1.24
SEMIFINAL	1.47
FINAL	1.43
SUMGAME	1.32
LNDIFFRANK	4.42
SUMGS	2.06
LNSUMRANK	5.83
DCHAMPION	1.30
NATIONALDY	1.41
PRIMETIME	1.28
HDTV	2.13
2016	1.85
2017	1.94
2018	3.37
2019	2.37
Mean VIF	2.20

Finally, before analyzing the regression model, White's test was carried out. The result found that there is no heteroscedasticity in the regression equation ($p>\chi^2 = 0.4534$) and the regression equation is meaningful, so the next step is to analyze the determinants.

5.2.2. Determinants of TV rating from the whole country

The model explains 80% of the variance (see R^2 in Table11).

Table11 shows that two of the form of consumer preferences factors were discovered to be significant predictor of TV ratings. In terms of the local player factor, the matches with Chinese players were associated with 0.048% higher TV ratings (Coef.=0.048, RSE=0.018, $p<0.05$), compared to the competitions without Chinese players. However, Gender and Facial Attractiveness are not significant predictors of television ratings (Coef.=0.019, RSE=0.012, ns; Coef.=0.001, 0.001, ns). The sum of Grand Slams (SUMGS) is another significant form of consumer preferences predictor of television ratings. It has a positive effect on TV ratings -- every additional Grand Slam won by the players was related to a 0.004% increase in the TV ratings (Coef.=0.004, RSE=0.002, $p<0.05$). And defending champion, the proxy measure of the viewer identification of the event, was also found not to be the predictor of the TV ratings (Coef.=0.045, RSE=0.028, ns)

There are only one of the quality of sporting contests factors are significant predictor of television ratings according to Table 11. The match significance element, FINAL, was associated with a significant increase of 0.122% in TV ratings (Coef.=0.122, RSE=0.022, $p<0.01$), compared to the BEFOREFINAL competitions; but the difference between BEFOREFINAL competitions and QUARTERFINAL/SEMIFINAL competitions was not statistically significant (Coef.=0.007, RSE=0.015, ns; Coef.=0.004, RSE=0.018, ns). The LNDIFFRANK, the proxy measure of the outcome uncertainty, seems to be not a significant influencing factor of TV ratings (Coef.=0.001, RSE=0.007, ns). Another rank-related factor and the proxy measure of the quality of players, the

LNSUMRANK, was also discovered not to be a influencing factor of the TV ratings (Coef.=-0.009, RSE=0.009, ns). Sum of games, the proxy measure of the intensity level of the match was also found not to be the antecedent factor of the television ratings (Coef.=0.001, RSE=0.001, ns).

Regarding quality of view factors, match time seems to be the most significant predictor of the TV ratings. Nevertheless, the National Day did not significantly influence the TV ratings. Particularly, night matches (7:30p.m.-11:00p.m.) were associated with an increase of 0.096% in the TV ratings (Coef.=0.096, RSE=0.013, p<0.01), compared to the day competitions. And compared to the reference year 2015, the years 2016, 2017, 2018, 2019 did have not significant statistical difference in affecting the television ratings.

Finally, according to the findings, broadcast channel plays a strong favorable influence in ratings. HD channel was discovered to have a significant effect on the TV ratings. Free broadcast channel was associated with an increase of 0.131% in TV ratings, compared to the HD channel (Coef.=0.131, RSE=0.023, p<0.01).

Table11 lists regression coefficients and robust standard error for TV ratings in the whole country and three divisions (tier1 cities, tier2 cities and tier3 cities).

Table11. Liner regression results

		All ($R^2=0.809$)		T1 ($R^2=0.789$)		T2 ($R^2=0.809$)		T3 ($R^2=0.805$)	
	Independent	Coef.	RSE	Coef.	RSE	Coef.	RSE	Coef.	RSE
Form of consumer preferences	gender	0.019	0.012	0.020	0.017	0.020	0.013	0.017	0.011
	local player	0.048**	0.018	0.041	0.025	0.040**	0.020	0.038**	0.017
	facial attractiveness	0.001*	0.001	0.002**	0.001	0.001*	0.001	0.001*	0.001
	super star	0.004**	0.002	0.007**	0.003	0.004**	0.002	0.003*	0.001
	defending champion	0.045	0.028	0.043	0.036	0.049	0.030	0.039	0.027
Quality of Sporting Contest	match significance (vs BEFOREFINAL)								
	QUARTERFINAL	0.007	0.015	0.018	0.023	0.008	0.017	0.005	0.014
	SEMIFINAL	0.004	0.018	0.035	0.027	0.008	0.021	0.000	0.017
	FINAL	0.122***	0.022	0.208***	0.038	0.145***	0.024	0.110***	0.020
	match intensity	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001
	outcome uncertainty	0.001	0.007	0.002	0.010	0.002	0.008	-0.000	0.007
	athletic expertise	-0.009	0.009	-0.015	0.012	-0.011	0.010	-0.008	0.008
Quality of Viewing	National Day	0.001	0.033	-0.002	0.050	0.001	0.038	-0.001	0.031
	primetime	0.096***	0.013	0.121***	0.019	0.104***	0.015	0.091***	0.012
	Year (vs 2015)								
	2016	-0.021	0.014	-0.013	0.021	-0.025	0.016	-0.016	0.013
	2017	-0.010	0.017	-0.007	0.023	-0.009	0.019	-0.000	0.017
	2018	-0.010	0.021	-0.002	0.032	0.002	0.024	-0.001	0.021
	2019	0.016	0.042	0.044	0.063	0.027	0.048	0.030	0.040
Supply capacity	HD channel	-0.131***	0.023	-0.148***	0.034	-0.155***	0.026	-0.132***	0.022

Notes: n=102. Dependent variable is TV rating. *p<0.1; **p<0.05; ***p<0.01

5.2.3. Determinants of TV rating from the three divisions (tier 1, tier 2 and tier 3)

The results are generally robust across all three tiers of all cities in China.

In terms of the form of consumer preferences factors, local player was discovered to be a significant predictor of TV ratings in tier2 cities and tier3 cities. The matches with Chinese players were associated with 0.040 and 0.038 percentage points higher TV ratings (Coef.=0.040, RSE=0.020, p<0.05; Coef.=0.038, RSE=0.017, p<0.05) in tier1 cities and tier2 cities, compared to the matches without Chinese players. However, local player had no significant impact on TV ratings in tier1 cities. Gender had no significant effect on television ratings in all three tier cities. In addition, Facial Attractiveness was discovered to be a positive influencer of the TV ratings in tier1 cities -- each additional facial attractiveness score of the player was associated with a 0.001% increase in the TV ratings (Coef.=0.002, RSE=0.001, p<0.05). However, facial attractiveness was not a significant predictor of TV ratings in tier2 cities and tier3 cities (Coef.=0.001, RSE=0.001, ns; Coef.=0.001, RSE=0.001, ns). The sum of Grand Slams (SUMGS) is another significant quality of sporting contests predictor of TV ratings in tier1 cities and tier2 cities. It was discovered to be a positive influencer of the TV ratings -- each additional Grand Slam won by the players was associated with a 0.007% increase in the TV ratings in tier1 cities (Coef.=0.007, RSE=0.000, p<0.05) and 0.004% increase in the TV ratings in tier2 cities (Coef.=0.004, RSE=0.000, p<0.05). Defending champion, the proxy measure of the viewer identification, was also found not to be the predictor of the television ratings in all three tier cities (Coef.=0.043, RSE=0.036, ns; Coef.=0.049, RSE=0.030, ns; Coef.=0.039, RSE=0.027, ns;).

With respect to the quality of sporting contests factors, FINAL was discovered to be a significant predictor of the TV ratings in all three tier cities. Associated with a significant substantial increase of 0.208% in TV ratings in tier1 cities, 0.145% in tier2 cities and 0.110% in tier3 cities (Coef.=0.208,

RSE=0.038, p<0.01; Coef.=0.145, RSE=0.024, p<0.01; Coef.=0.110, RSE=0.020), compared to the BEFOREFINAL competitions; but the difference between BEFOREFINAL competitions and QUARTERFINAL/SEMIFINAL competitions was not statistically significant in all three tier cities(Coef.=0.018, RSE=0.023, ns; Coef.=0.035, RSE=0.027, ns; Coef.=0.008, RSE=0.017, ns; Coef.=0.008, RSE=0.021, ns; Coef.=0.005, RSE=0.014, ns; Coef.=0.000, RSE=0.017, ns). The LNDIFFRANK, a representative measure of the outcome uncertainty, seems to be not a significant predictor of TV ratings (Coef.=0.002, RSE=0.010, ns; Coef.=0.002, RSE=0.008, ns; Coef.=-0.000, RSE=0.007, ns;) in all three tier cities. Another rank-related factor and the representative measure of the athletic expertise of players, the sum of rank, was also discovered not to be a influencer of the TV ratings (Coef.=-0.015, RSE=0.012, ns; Coef.=-0.011, RSE=0.010, ns; Coef.=-0.008, RSE=0.008, ns). Sum of games, the proxy measure of the intensity level of the match, was also found not to be the predictor of the TV ratings in all three tier cities (Coef.=0.001, RSE=0.002, ns; Coef.=0.001, RSE=0.001, ns; Coef.=0.001, RSE=0.001, ns).

Regarding quality of viewing factors, match time seems to be the most significant predictor of the TV ratings in all three tier cities. However, the National Day did not significantly affect the television ratings in all three tier cities. Specifically, night matches (7:30p.m.-11:00p.m.) were associated with an increase of 0.121% in the TV ratings in tier1 cities (Coef.=0.121, RSE=0.019, p<0.01), 0.104% in tier2 cities (Coef.=0.104, RSE=0.015, p<0.01) and 0.091% in tier3 cities (Coef.=0.091, RSE=0.012, p<0.05), compared to the day matches. Similar to the situation of the whole country mentioned above, when examining the ratings of the three tier cities separately, compared to the reference year 2015, the years 2016, 2017, 2018, 2019 did have not significant statistical difference in affecting the television ratings.

In terms of supply capacity, broadcast channel was discovered to have an important effect on the TV ratings in all three tier cities. Free broadcasting channel was associated with an increase of -0.148, -0.155, -0.132 percentage points in television ratings in tier1 cities, tier2 cities and tier3 cities, compared to

the HD channel (Coef.=-0.148, RSE=0.034, p<0.01; Coef.=-0.155, RSE=0.026, p<0.05; Coef.=-0.132, RSE=0.022, p<0.01).

Chapter 6. Discussion and Conclusion

This study checked the determining factors of audience demand for the televised China Open tennis competitions from 2015 to 2019. The results present that the TV ratings are influenced by various the form of consumer preferences, quality of sporting contests, quality of viewing, supply capacity and economic factors.

Firstly, through a one-way analysis of variance, it is concluded that there are differences in the average ratings of the TV broadcast of the China Open tennis match between different tiers of cities. The higher the city tier, the higher the television ratings may be. According to ‘Analysis of TV Audience Preference of Sports in China, 2015’, there are differences in the average ratings of the TV broadcast of the China Open tennis match between different tiers of cities due to the educational background, income, regional economy differences. This difference may be due to the relatively high level of economic development in the tier1 cities, the richer cultural and sports life of people, and a higher awareness of tennis sports. There will be a larger group of fans than in the tier2 and tier3 cities. The attention of the matches is higher, and people are more willing to watch the tennis game on TV.

Regarding the form of consumer preferences, due to stronger identity and psychological proximity, the presence of local players will generally have a positive effect on the TV ratings of the China Open tennis matches. The results indicate a strong preference for competitions with Chinese players involving. Chinese players, as expected, draw a larger number of TV rating. When a Chinese player is on the pitch, TV rating increases by 0.048%, validating prior sports demand research that revealed a home bias. However, this study also yielded surprising results. In first-tier cities, the attendance of local players does not seem to have a significant impact on television ratings. China’s professional tennis players are obviously in a situation of ‘women are strong and men are weak’. Female tennis players performance far better than male players in world

competitions. Therefore, most people ask that Chinese people pay more attention to female's tennis matches than male's tennis matches. That is, Chinese people may prefer to watch tennis matches attended by female athletes. However, unlike most previous studies that believe that male's matches will attract more audiences (Konjer, Meier & Wedeking, 2015; Dietl, Ozdemir & Rendall, 2020), and the hypothesis that TV viewers of the China Open seem to be more inclined to watch female's matches, the results of this study show that the viewing behavior of Chinese audiences for tennis matches is not affected by the gender of the athletes since there is no significant difference in the TV ratings of male and female players in the China Open tennis matches. This study adds the variable of facial attractiveness of athletes under the framework of sports demand, and explored whether the appearance of athletes in tennis matches will affect TV ratings. The results show that overall, facial attractiveness doesn't have a very significant impact on the TV ratings of tennis matches. However, in terms of the area of the audience, unlike the tier2 and tier3 cities, the television broadcast tennis match ratings in the tier1 cities are obviously affected by the athletes' facial attractiveness, that is, the appearance of the tennis players is an important predictor of China Open tennis match ratings in the tier1 cities. The reason for this result may be that people in tier1 cities have more advanced aesthetics, and sports marketing and other activities in big cities are more common, and people pay more attention to athletes with higher appearance who are favored by media and advertisers. According to a lot of previous research (Konjer, Mutz & Meier, 2019) and practical experience, players who are more successful in career and more attractive with good appearance are more likely to be mediatized. They'll be seen more in newspapers, on television, and in advertising. Consumers will recall athletes who have been highly marketed. Furthermore, the presence of super stars appears to raise audience demand of the China Open tournament. TV audience prefers matches with superstars: as the sum of Gram Slam title rises, viewership increases, implying that higher-prestige players (those with a higher Grand Slam titles number) attract more viewers. But this influence does not seem to exist in the tier3 cities. The cause may be similar to the reason for the

difference in facial attractiveness mentioned above, because superstars appear more frequently in mainstream sports media, people in the higher tier cities pay more attention to superstars while people in the lower tier cities do not. The reason why the defending champion does not affect the TV rating may be due to the limitation of the data set. On the one hand, the samples contain too few matches where the defending champion appears; on the other hand, it may also be because the Chinese audience does not have a strong continuity of understanding of the China Tennis Open, and accidental audiences are more.

As for the quality of sporting contests, competition stage is the only one significant predictor of the television ratings of China Open tennis matches. As the constantly positive and significant coefficients for FINAL imply, viewers prefer competition from the final stages of a tournament. Therefore, it can be partly considered that the audience prefers to watch more important matches. The intensity(excitement) of the match and the uncertainty of the outcome of the match do not have a significant effect on TV ratings. This is inconsistent with most related existing research results. Consumers appear to be uninterested in particularly close or balanced contests. The reason may be that most people's knowledge of sports content is not deep enough. Watching the match is just for fun or follows the social norms and don't care about the content of the competition on the field.

Regarding quality of viewing factors, the telecast channel seems to be the most powerful determinant of TV ratings of China Open tennis matches. It is rationalized that free broadcasting channels in China have wider reaches of coverage and higher habitual channel consumption than HD channels, all of which lead to increased audience demand for televised matches. The availability of competitions broadcast on HD channels tends to be more limited, compared to the competitions carrying though free channels. Other than the broadcast channel, matches that broadcast in prime time (19:30p.m.-23:00p.m.) indicated positive effects on the TV ratings of China Open tennis matches. Evidence for scheduling impacts was discovered, which supports the assumption that opportunity costs are relevant. This provides a reliable basis for the event organizing committee to

arrange the competition schedule. If wanting to balance the attention between the matches, organizers can put the matches that are usually not high in the evening; if wanting to maximize the attention of the matches with relatively high attention, organizers can schedule these matches to be played in the evening. Additionally, in opposition to the prevalent conclusions from the previous literature, the National Day didn't influence the audience demand for sports. This is may because this study examined China Open tournament only. Compared to other tournaments, China Open is usually held at the end of September and early October every year, and this time is the national holiday of China, so except for the qualifying matches or the first round before the holidays, the rest of the matches will basically be held during the holiday period. And another possible reason may be that because it is during the holiday, so many people will go out to play or travel around, then the TV ratings will be reduced accordingly.

Generally speaking, the Chinese audience demand for watching the China Tennis Open is not sensitive to the quality of the sporting contest. For casual sports audience, TV broadcasting provide a ‘low barrier’ venue. Consumers of television broadcasts incur no expenditures other than opportunity costs, and they can change their entertainment preferences at any time by pressing the remote control. As a result, TV viewers are more inclined to behave as rational customers or ‘armchair’ audiences rather than loyal followers (Konjer, Meier & Wedeking, 2015).

Through the comparison of the factors influencing the ratings of cities at different levels, this study found that these differences are mainly concentrated in the first category of factors: the form of consumer preferences. It shows that the audience’s inherent viewing habits are very different between different cities, which directly affects the viewing and influence of the China Tennis Open in different regions. From this perspective, event organizers need to use or change the consumption habits of audiences in different regions to achieve the goal of enhancing the impact of the event and attracting more audiences, although this will be a long-term process. However, factors such as the tournament quality or organization of sports competitions are relatively unimportant.

Chapter 7. Implications and Limitations

7.1. Implications

This study helps to advance the academic and practical development of sports management and marketing. To begin with, this research is one of the few in academia that attempts to investigate the determinants of audience demand for China Open tennis competitions. As previously discussed, the characteristics unique to every professional sport type, event, and nation play distinct roles in determining which factors affect audience demand for mediated sports. A element may be an important predictor in one professional event but not another. As a result, it is critical to conduct empirical research on the influencers of media sports audience demand in each context. The findings of this research provide insights that are directly appropriate to scholars and media practitioners in China, as well as useful benchmarks and references for researchers and practitioners in other sports, particularly individual sports.

Second, this research provides beneficial perception to professional sports event marketers. The sale of media rights and sponsorships are the two most important sources of revenue for professional sports, and the size of these two revenue streams is proportional to the size of the audience demand for television and other media. As a result, it is critical for league or event marketers to comprehend the key influencers of audience demand for broadcast sports competitions. The study's conclusions are useful in identifying which specific elements lead to the audience demand for professional tennis competitions in China. These findings allow tennis tournament organizers to make evidence-based decisions about how to distribute broadcast rights in China. Because China has a large area with a large population of people and significant regional characteristics, in addition to the ratings in the whole country, this study also examined the determinants of the ratings in tier1, tier2 and tier3 cities, and found

out the different factors affecting the ratings of cities in each tier. This finding can provide a reference for the organizers of the China Tennis Open for the sale of media broadcasting rights. For example, the organizing committee may consider cooperating with local TV stations in cities of different tiers according to the audience demand of cities of different tiers in addition to CCTV, which has been cooperating for a long time, and sell part of the broadcast rights of the matches to local sports TV channels.

Third, this study adds a facial attractiveness variable under the traditional sports audience demand framework, which supplements the theoretical framework to a certain extent. The findings demonstrate a direct link between facial attractiveness and television viewing. While public broadcaster's main function is to serving the public, they should be cautious from exploiting consumer discrimination in order to avoid promoting non-sports discriminatory types. Consumer biases will almost certainly be used by commercial broadcasters and organizations with exclusively profit-maximizing goals (Dietl, Özdemir, & Rendall, 2020). Because this study used statistics from the China national television broadcaster CCTV to examine TV rating, the results should be regarded with caution. The national television broadcaster, CCTV, has a public service function and is hence interested in broadcasting high-quality competitions featuring Chinese players. Exploiting consumer biases (taste-based discrimination) in the context of facial attractiveness runs the risk of strengthening taste-based discriminating types that aren't relevant to sports. However, for profit-maximizing broadcasters and advertising revenue-maximizing media firms, the situation may be different. They will almost certainly use attractiveness perceptions as demand factors and, as a result, evaluate additional revenue-generating possibilities.

7.2. Limitations

It is vital to point out some of the this study's limitations.

First, only the China Open tournament was examined. As a professional

sports event locally held in China, the China Open competitions are different from other tennis tournament competitions in many aspects. For instance, the prime goal audiences of the China Open matches may not be different for the other tournaments such as Grand Slams. Consequently, factors influencing TV audience demand for the China Open competitions should not be directly applied to other different tennis matches context and the results of this study should not be generalized beyond the locally held tennis matches context.

Second, due to the limitation of data collection, there are limitations in the research samples of this study. A small sample size may lead to inaccuracy of the results, and the demographic factors of the audience are not considered, so the conclusion may not be comprehensive.

Third, this study looked at the effects of 13 antecedent factors. Despite the fact that these variables were recognized through a thorough review of the literature, there are potential influencers that could have been investigated in this research. The lack of trustworthy historical data of online audience makes it impossible to estimate demand for online broadcast, despite the fact that studying online viewer demand would be of great interest. And future study should look into the effect of outcome uncertainty using more advanced measurements. This study had to make do with proxies because betting odds data was not available for the full time under consideration.

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국문초록

차이나 오픈 테니스 경기 티비 방송에 대한 시청 수요의 영향 요인 분석

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글로벌스포츠매니지먼트 전공

본 연구의 목적은 China Open의 중계된 테니스 경기에 대한 시청자 수요에 영향을 미칠 수 있는 요인을 탐색하는 것이다. 데이터는 2015년부터 2019년까지 China Open의 중계된 테니스 경기인 총 102개의 경기에서 수집되었다. 전국과 티어별 도시의 티비 시청률을 종속 변수로 치고 각 경기와 관련된 일련의 결정 요인을 독립 변수로 치는 회귀 모델을 설계하였다.

도시 계층은 테니스 티비 시청률에 영향을 미친다. 상위 계층 도시의 티비 시청률 평균값은 하위 계층 도시보다 훨씬 높다. 소비자 선호 요인 같은 경우에는, 전국, 티어1, 티어2의 티비 시청률은 로코 플레이어와 연관이 있다. 또한 티어1 도시에서 높은 티비 시청률은 플레이어의 신체적 매력이 더 높은 것과 관련이 있다. 슈퍼 스타가 포함하는 것은 전국과 티어1, 티어2 도시에서 티비 시청률에 긍정적인 영향을 미쳤다. 스포츠 경기의 퀄리티 측면에서 경기의 중요성이 높을수록 티비 시청률이 더 높아졌다. 시청 퀄리티 및 공급 능력 요인과 관련하여 방송 채널은 티비 시청률을 예측하는 가장 중요한 요인인 것으로

보인다. 방송 채널 외에도 황금 시간대 경기는 티비 시청률에 큰 영향을 미친다. 본 연구는 3개 서로 다른 계층의 도시 티비 시청률에 영향을 미치는 요인을 비교하여 차이가 주로 첫 번째 카테고리의 요인인 소비자 선호의 형태에 집중되어 있음을 발견했다.

본 연구는 미디어 스포츠에 대한 시청자 수요의 결정 요인에 대한 이해를 확립함으로써 스포츠 마케팅 담당자와 스포츠 이벤트 주최자에게 참고 자료를 제공한다. 특히, 테니스 이벤트 맥락에서 미디어 중계권의 합리적인 판매와 배분을 위한 참고 자료가 될 수 있다.

주요어: 스포츠 디맨드, 스포츠 시청자 수요, 차이나 오픈, 시티 티어

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