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The search for optimal Competitive Balance in Formula One*

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Abstract. In this paper an analysis of the determinants of attractiveness of the Formula One is attempted. Therefore the concept of competitive balance will be explained and applied. The principal item of this analysis will be the result that there is an optimal level of competitive balance which maximizes the attractiveness. This concept will be applied through an empirical analysis of the determinants of the German Formula One number of TV viewers. It is shown that the influence of competitive balance is not totally clear. A too high level of competitive balance seems to be as detrimental as a too low level of competitive balance.

Keywords: Sports Economics, Formula 1, competitive balance, attractiveness of sports

JEL-classification: L83 (Sports)

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1 Introduction

One of the main factors for attractiveness of sports is competitive balance. Aside from formal criteria like the proverbial level playing field, the uncertainty of outcome will determine whether a discipline attracts millions of viewers or is just one side issue in Monday's local newspaper. Domination of one protagonist, from this point of view, is not positive for the number of TV viewers. On the other hand spectators like heroes and superstars which stand out from the competitors or underdogs who unexpectedly win.

The main issue of this paper is how these two seemingly contradictory effects influence the attractiveness of motor racing, namely Formula One racing.

Formula One is a sport which is especially popular in Europe and South America. It is not researched in such a way as other big "American Sports" like Basketball, Baseball or American Football (Vrooman 1995), although it is the biggest and most valuable annual worldwide sport event (Deloitte 2008).¹ The interesting thing from the perspective of sport economics about Formula One is its competition modus: The direct simultaneous comparison of competitors is different to sports like Basketball, Baseball or American Football. Another interesting fact about Formula One racing is that it combines both aspects of individual and team sports. On the one hand it is the driver standing in the main focus of the audience's interest but on the other hand the identification with the team plays a role, too. Therefore Formula One can be claimed to be a hybrid between team and individual sports. The point of this paper is the analysis of the individual's outcome.

This subject of investigation is a question of sports economics. Since Rottenberg's (1956) view on the Baseball players labor market sport economics began to become a respected topic in economics. During the following decades many different aspects of sports economics were investigated. On the one hand some people took a look at the theory of sport leagues like Vrooman (1995) and on the other hand the question of demand for sports were researched, like in Borland and Macdonald

¹ Of course, there are some worldwide sport events which have more spectators like the Fifa Football World Cup, the Fifa Football Euro Championship or the Olympic Games, but these events are not organized annually. The NFL Superbowl also causes a high and often higher worldwide TV interest than a single Formula One race, but it only takes place once a year.

(2003) who investigate the sources and determinants of the demand for professional sporting events. Some papers which broach the issue of Formula One are Spenke and Beilken (2000) and Mastromarco and Runkel (2004). While Spenke and Beilken just use the database of Formula One races for the analysis of their data analysis tool, Mastromarco and Runkel analyse the effects of rule changes in Formula One and its impacts on competitive balance. Another interesting paper which motivated our analysis is Kipker (2002). Kipker describes the determinants of competitive balance which are supposed to influence the suspense of competition. He describes three levels of competitive balance, uncertainty of race outcome, uncertainty of championship outcome and the absence of long-term dominance. The viewer interest is measured by the number of TV viewers. Kipker also describes the effects of superstars in Formula One.²

While the previous paper takes a focus on the competitive balance as a factor which is supposed to create suspense and an attractive competition, we want to show that the attractiveness of a sport can not only be described with high levels of competitive balance. Therefore we will describe a theory whose quintessence is the idea of an optimal level of competitive balance. We assume that a too low level is as detrimental as a level which is too high. Normally it can be assumed that a sport is attractive if the championship is very close and a balanced competition exists. In this paper we try to show that this balanced competition is not the only competition-related determinant of the attractiveness of Formula One. Especially “duels” at the top of the overall standings also play an important role.

The paper is structured in the following way. Chapter 2 gives a short overview about the theoretical assumptions and explains the determinants of attractiveness and explains how we quantify the attractiveness of Formula One. In section 3 the data used for the analyses is examined. A description of the empirical method and the results follow in chapter 4. Section 5 concludes.

² For a general exhibition of superstar effects, see Rosen (1981).

2 The theory of attractiveness of Formula One

The theoretical approach we will investigate is quite simple. The main point of our description is that there has to be an optimal level of competitive balance which maximizes the viewer's interest. We assume that Formula One is not attractive if all drivers have the same chances to win. In this case there would be no surprise if an unknown driver won a race or the championship. Thus a main condition for attractiveness is that there are real surprises like the victory of an outsider or the failure of a champion. On the other hand it is assumed that it is not really attractive if there is a driver who dominates the whole competition because this could lead to a situation where the championship is determined too early in the season. It is not our aim to show the exact optimum of competitive balance which maximizes the attractiveness. All we want to show is that this optimum could exist by analysing the following two working hypotheses:

Hypothesis 1: *A higher level of competitive balance leads to less attractiveness*

Hypothesis 2: *A duel at the top leads to more attractiveness*

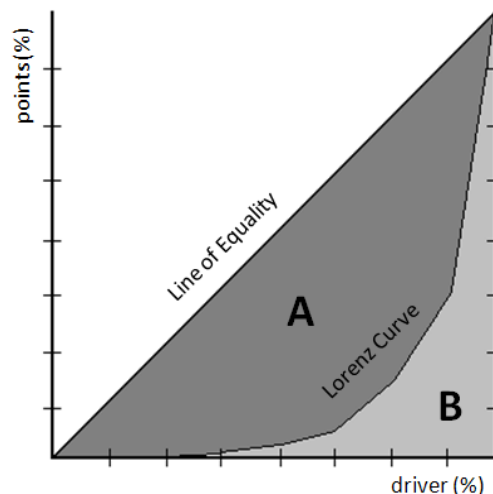
These rudimentary hypotheses will be specified later. If the analysis of both hypotheses results in a non-rejection we can assume that our considerations are right.

But before we can answer the question what influences the level of attractiveness of a sport it has to be clarified how to measure the attractiveness of a sport. Here it is suggested to operationalize attractiveness by viewer interest namely the number of TV viewers (Kipker 2002). This measure has certain advantages: it is quantitative and in principle easy to measure. Of course, there are other possible indicators for attractiveness like personal preferences or tickets sold for seats at the circuit. In particular personal preferences could indicate the attractiveness much more accurate than the number of TV viewers. However the problem is that it is hardly possible to directly collect data on preferences. An advantage of the number of tickets sold would be that they can be surveyed even more easily than the number of TV viewers. But as the number of seats at the cir-

cuits is limited this data is truncated.³ This is the essential advantage of the number of TV viewers as a measurement because the number of viewers is quasi unlimited. In Germany, e. g., there are ca. 35 Mio television sets for 80 Mio citizens (GEZ n. d.). In addition, no Formula One event ever came near a full use of the capacity, i.e., a viewer level around 90 percent. Thus, virtually everyone who wants to watch a Formula One race can watch it.

To answer the question how to find parameters that influence the attractiveness we suggest the concept of competitive balance (Utt and Fort 2002). The level of competitive balance is high if there are similar chances to win for all participants. Referred to Formula One this means that all drivers have the same chance to win a race and the championship. The opposite is true for a low level of competitive balance. However if you take into account that there are different Formula One cars with different engines which are driven by persons of different talents the assumption of same or just similar chances to win has to be doubted. To quantify competitive balance the Gini coefficient which is a concentration index is a very useful tool. It is mostly used in the analysis of team sports like baseball, basketball or American Football (Utt and Fort 2002). The application for individual sports like Formula One, however, is rare. However in this case the application of the Gini coefficient seems to be meaningful as the drivers score different points for ending a race in different places.

Figure 1: Graphical illustration of the Gini coefficient



Source: Own Illustration.

³ Thus, you cannot really estimate the common interest because you do not know how many tickets could be sold. One possibility to cope with this problem could be to include the shadow market prices for tickets. This procedure, though,

In figure 1 the concept of the Gini coefficient is illustrated in a graphic way. The denomination of the axes are the percentage of drivers and the percentage of points which are gained by the drivers. The so-called Line of Equality and the Lorenz Curve are also depicted. The Line of Equality shows the hypothetical situation when all drivers gain the same amount of points. The Lorenz Curve shows the actual concentration of the points scored. Because the points which are gained by the drivers in every race are accumulated through the season there would be a situation of perfect equality or balance if 10 percent of all drivers accumulated 10 percent of all points and e.g. 50 percent of all drivers have 50 percent of all points. But in a situation where 50 percent of all drivers only have 10 percent of all points there is a smaller level of balance. This disparity can now be quantified by the Gini coefficient. The Gini coefficient is constructed by the ratio of area A to the sum of area A and B. A high Gini coefficient implies a high disparity which in turn represents a small competitive balance.⁴ If a high level of competitive balance attracts more spectators than a smaller level, small values of the Gini coefficient are an indicator for attractiveness. An overview about the exact approach and the used scoring vector will be given in the following chapter.

A second index which can be used as a parameter influencing the attractiveness of Formula One is the relative distance between the first and the second driver in the overall standings. This distance signifies the competitive balance at the top of the ranking. If the difference between the first and the second driver becomes too large there is the problem that the sport could become boring. We assume that a very high relative distance between the first and the second driver in the overall standings reduces the spectator's interest because the exciting aspect of a duel of these two drivers disappears. Relative distance between first and second driver and not absolute distance between them is used as the amount of points and also the magnitude of the differences between drivers increases during the season. Thus, the absolute distance after the third race and the last race, e. g. cannot be compared meaningfully.

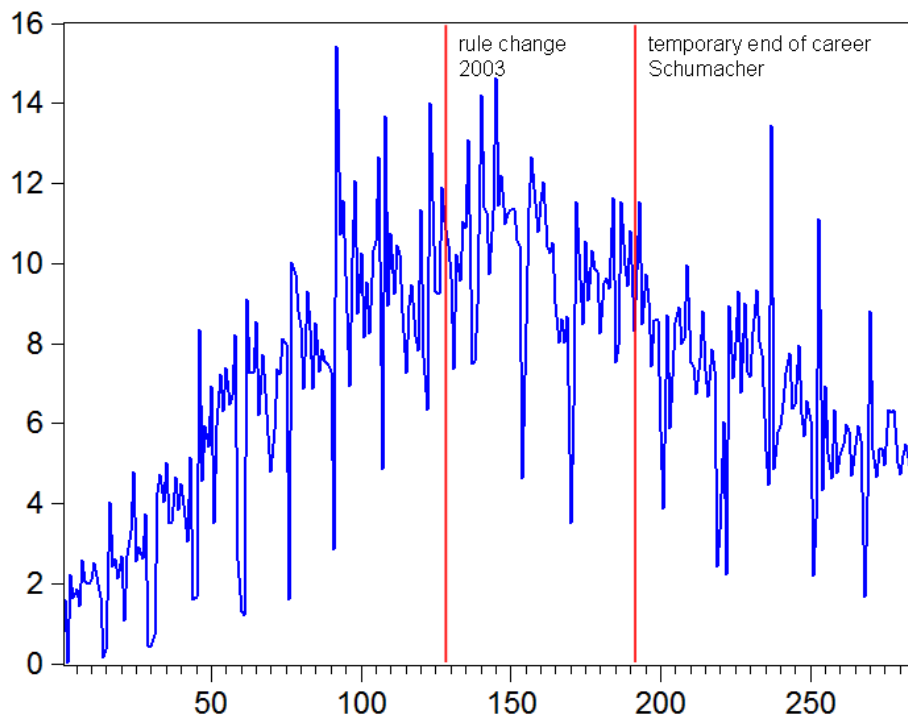
would negate the advantages of easy access to data.

⁴ The range of the Gini coefficient is between 0 and 1 where 0 means total equality while 1 denotes total concentration.

3 The data employed in the analysis

In this chapter an overview about the data used in the analysis will be given. First, we will have a look at the number of TV viewers. As it can be seen in figure 2 the viewer levels of the German TV network RTL for the seasons 1992 until the season 2009 are employed. Germany is one of the countries with the highest number of Formula One supporters and the exclusive use of German data is due to data availability.

Figure 2: Formula One number of viewers of German RTL (March 1992 – November 2009)



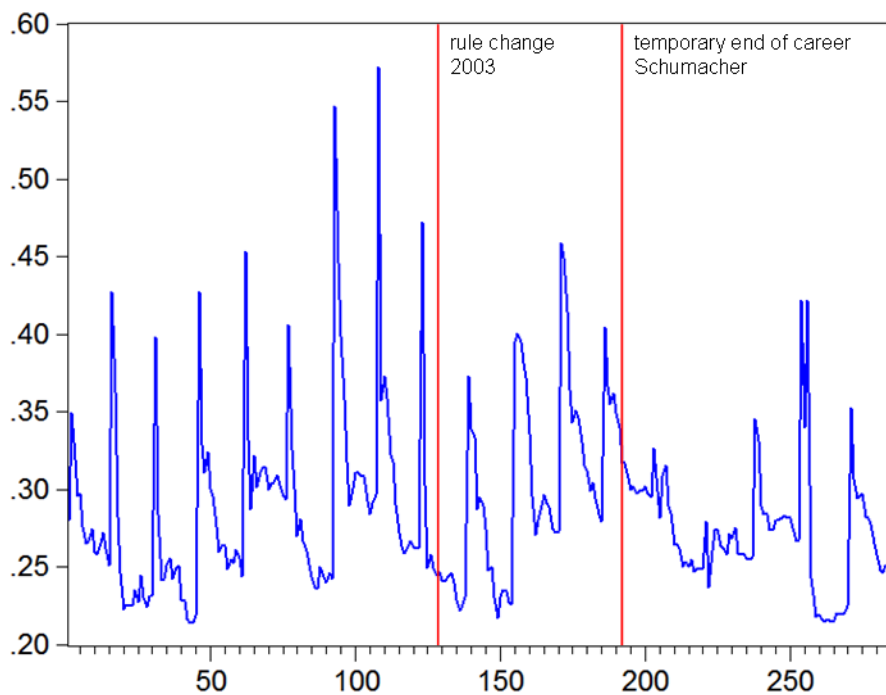
Source: Media Control (2010).

The abscissa is scaled by the number of races starting with the first race in 1992. It is not useful to scale the abscissa in years because the seasons are not evenly distributed over the years. In addition, time between two races is not equidistant. But mostly the season starts in March and ends in October with two week intervals between races. The number of races has varied in the different seasons and has increased over the years. The ordinate is scaled with the number of RTL-TV viewers in million persons. Two important points in time are marked by the vertical lines. The first line marks the rule change at the beginning of the season in 2003 when the score vector was changed while the second line stands for the point in time when Michael Schumacher temporarily finished his Formula One career at the end of the 2006 season (October 2006). These two points

in time are highlighted because they will be analysed in the empirical chapter later on. The rule change, which will be explained more precisely in the next chapter, consisted of an enlargement of the point ranks. The number of ranks where points could be gained was increased from 6 to 8 and the amount of scored points was also enlarged.⁵

As it can be seen in figure 2 there are huge differences in the viewing levels between two consecutive races. One of the reasons for this is that there are races in American time zones, European time zones and Asian-Pacific time zones (compare Kipker 2002). Thus, some races take place at times which are not convenient to European TV viewers because some Asian races start in the early morning. This fact will be taken into account in the empirical part of this survey. Another point to mention is that the first race of every season is not included in the analysis. The reason for this approach will be explained later on.

Figure 3: Values of the Gini-coefficient



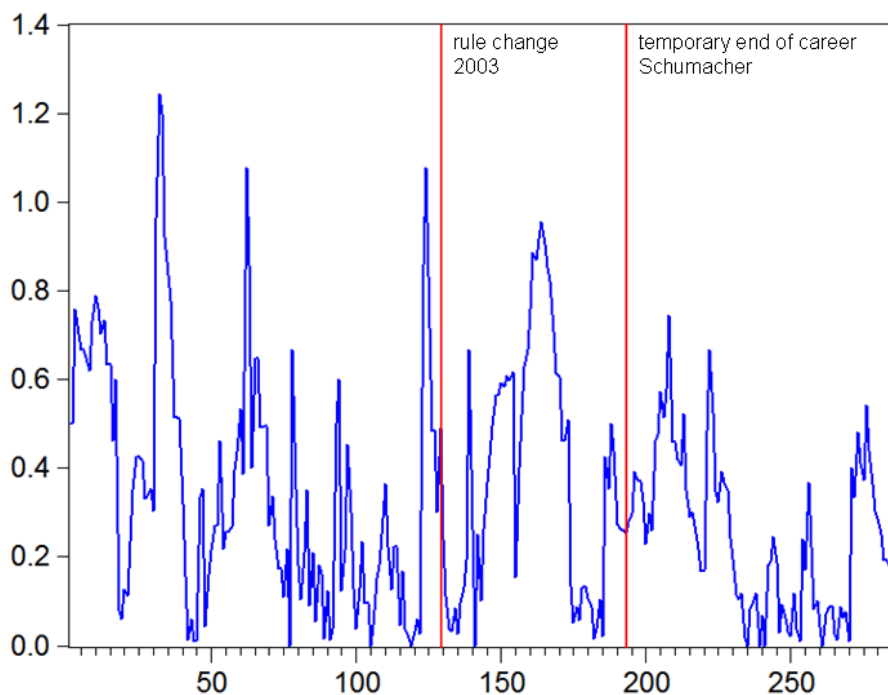
Source: own illustration.

Figure 3 shows the Gini coefficient of the cumulated points achieved. This corresponds to the Gini coefficient calculated on the basis of the overall standings. An important point to mention is

⁵ Thus, the scoring vector representing these rules changed from $s_1 = (10; 6; 4; 3; 2; 1)$ to $s_2 = (10; 8; 6; 5; 4; 3; 2; 1)$.

that the actual used scoring vector s_2 was not employed here because in the original scoring vectors only the first six places and since 2003 only the first eight places are considered. The different number of results endowed with championship points before and after 2003 further impedes the comparison of these different scoring vectors. This leads to the approach to replace the vectors s_1 and s_2 by a modified vector $s_3 = (22; 21; \dots ; 2; 1)$ what means that the driver who wins a race gets 22 points, the second driver 21 and so on.⁶ Thereby every ranking is considered and the level of competitive balance can be analysed for all drivers. Another important fact is that the scoring vector is independent of rule changes, e. g. the modification in 2003. As in figure 2 the points in time when the rule changed and Michael Schumacher temporarily ended his career are marked.

Figure 4: Relative distance between first and second driver



Source: own illustration.

Figure 4 shows the time series of relative distance of the first and the second driver in the overall standings. For this analysis the original vectors are used. The reason is that this index shall give information about the tenseness of the duel. If the modified scoring vector was used instead, this tension which is generated by the real distance in the overall standings would not be considered.

⁶ 22 points were chosen as the maximum score as in most of the races included in the analysis this corresponds to the

Only if the original distances in the overall standings are considered, this information can be used. As the distance between the points of the first and the second driver has to be identical after the first race of each season these races are not included in the analysis (this procedure was also followed in figure 2 and 3).

4 Empirical Analysis

With regards to the competitive balance one could assume that a high level of competitive balance increases the number of TV viewers because they want to watch a competition which is not dominated by only one or a few group of drivers. It could guarantee a kind of tension if every driver has similar chances to win the competition. But this would imply that no favourites or outsiders exist whose wins could be a big surprise. Superstars or losers would not exist anymore. This lead to the assumption that a too high level of competitive balance reduces the interest in this sport. That is the reason for the following hypotheses which are specifications of the working hypotheses of chapter 2.

Hypothesis 1: *A higher level of competitive balance leads to a weaker viewer interest.*

Referring to the relative distance between the first and the second driver we assume that a large distance decreases the suspense and therefore the attractiveness of the competition. From these thoughts the following hypothesis is derived:

Hypothesis 2: *A small distance between the first and the second driver increases the interest of the TV viewers.*

To analyze the hypothesis a model has to be constructed and estimated. An ordinary least squares (OLS) regression is complex enough to analyse the problem. As regressands two time series are used. In estimation a (figure 5) the number of TV viewers of the German TV network RTL (compare Kipker 2002) are used as regressand. In estimation b (figure 6) the market ratio which gives information about the viewing rate is used. The regressors are identical in both models: a

number of drivers in the races.

constant term (C), a trend variable (trend), a quadratic trend variable (trend²), the Gini coefficient (Gini), the relative distance (relative distance), a so-called prime time dummy (Pt dummy), a night dummy, a Schumacher dummy and a rule change dummy. The rationale behind the use of the Gini coefficient and the relative distance were already explained above. The use of a constant term seems to be necessary because it can be assumed that there is always a basic level of viewers. The trend and the quadratic trend are used because the first inspection of the data make a trend development appear probable. But this approach can also be explained with regards to content. As it can be seen few lines below the Schumacher hype is covered by the Schumacher dummy. Next to Schumacher there was also an increasing presence of German Formula One drivers in these years. Between 1992 and 1997 the number of German Formula One drivers increased from 1 to 3. In 1994 Heinz-Harald Frentzen and in 1997 Ralf Schumacher, Michael Schumacher's brother, joined the Formula One (Formula One Administration Ltd 2009).

The prime time dummy is used for those races which are shown in German TV at the prime time between 06:00 p.m. and 12:00 p.m. in the evening. These are races taking place in North or South America. The value of this dummy is 1 if the race takes place in America and otherwise 0. The night dummy is very similar to the prime time dummy. It is 1 if the race takes place in East or Southeast Asia or in Pacific regions. It is called the night dummy because it applies to races which live TV coverage takes place in the early morning hours in Germany between 04:00 a.m. and 08:00 a.m. The Schumacher dummy is used because there was a Schumacher-hype in Germany during Michael Schumachers career until 2006. Through the use of this dummy we hope to isolate these special Schumacher-effects (Kipker 2002). The rule change dummy is used because we want to analyse the effects of the rule changes at the beginning of the year 2003.⁷

⁷ Langen, Krauskopf and Bünger (2010) have shown that the modification of rules in Formula One can play an important role for the outcome of the championship.

Figure 5: Estimation a⁸

dependent variable	number of TV viewers
independent variables	Coefficient
C	-1.478480***
trend	0.106740***
trend ²	-0.000289***
Gini	7.118657***
relative distance	-0.840806**
Pt dummy	1.351560***
night dummy	-3.462045***
Schumacher dummy	0.938303**
rule change dummy	-2.396442***
F-statistic	182.0259***
Adjusted R-squared	0.835565

*** 1% level of significance, ** 5% level of significance, * 10% level of significance

Source: Own estimations.

The F-statistic is very high and significant. Although the R-squared is very high (0.83) this result should not be overrated because some dummy variables are used which automatically increase the R-squared. All coefficients are significant on a 5 percent level and with exception of the Schumacher dummy and the coefficient of the relative distance even significant on a 1 percent level. The constant variable C has a negative coefficient which seems to be unusual when interpreting the term as a constant basis level of TV viewers. But this result should also not be over-interpreted because the values of the other coefficients are relatively high. Therefore a positive total of viewers can easily be reached.

The coefficient of the trend variable is positive while the coefficient of the quadratic trend variable is negative. That shows that a quadratic trend of viewer interest exists with an increase in the beginning and a decrease in later periods. Most dummy variables can be interpreted with ease. The prime time dummy has a positive coefficient and the night dummy a negative coefficient. That shows that the viewer interest increases respectively decreases if the race is shown at German prime time respectively at night. Also the positive coefficient of the Schumacher dummy is not remarkable. An interesting result is the negative coefficient of the rule change dummy, espe-

⁸ Heteroscedasticity consistent estimators are used.

cially if one presumes that the rule modification in 2003 was intended to increase the attractiveness of Formula One.

The Gini coefficient has a high positive value. This means that a high Gini coefficient leads to a higher viewer interest. As a high Gini coefficient means a low competitive balance this result can be interpreted in the following way: The viewers do not want to have a high level of competitive balance. Instead they want to have a competition which is not balanced.

Hypothesis 1 cannot be rejected for this reason. The coefficient of the relative distance is negative. This means that a high relative difference between the first and the second driver leads to low viewer interest. For this reason hypothesis 2 cannot be rejected either. These two results seem to contradict each other. But this contradiction can be explained. On the one hand the spectators do not want to have a competition which is too balanced and on the other hand they do not want to have a competition without an interesting duel at the top. This shows that an absolute competitive balance is as detrimental as a too low level of competitive balance in the top region of the competition.

Figure 6: Estimation b19

dependent variable	viewing rate
independent variables	Coefficient
C	21.73453***
trend	0.414048***
trend^2	-0.001229***
Gini	20.37742***
relative distance	-6.083538***
Pt dummy	-15.99070***
night dummy	11.78425***
Schumacher dummy	1.471344
rule change dummy	-11.07776***
F-statistic	125.4253***
Adjusted R-squared	0.777414

Figure 7: Estimation b210

dependent variable	viewing rate
independent variables	Coefficient
C	22.89844***
trend	0.424239***
trend^2	-0.001291***
Gini	19.37797**
relative distance	-5.485605***
Pt dummy	-15.91289***
night dummy	11.87955***
rule change dummy	-10.31951***
F-statistic	143.3755***
Adjusted R-squared	0.777627

*** 1% level of significance, ** 5% level of significance, * 10% level of significance

Source: Own estimations.

⁹ Heteroscedasticity consistent estimators are used.

¹⁰ Heteroscedasticity consistent estimators are used.

After analysing the number of TV viewers the viewing rate which is the relative number of TV viewers is taken into consideration (figure 6). This analysis of the viewing rate leads to similar results as the analysis of the number of TV viewers with one important difference: The Schumacher dummy loses its statistical significance.

After eliminating this variable the F-statistic increases which shows that the Schumacher dummy seems to be dispensable for this specification (figure 7). Without the Schumacher dummy it can be seen that the two most important variables can be interpreted in the same way as in estimation a (figure 5). One interesting difference is the inversion of the signs for the prime time dummy and the night dummy. The coefficient of the prime time dummy becomes negative while the coefficient of the night dummy becomes positive. This can be explained by the relatively high respectively low TV consumption at prime time respectively at night. If some Formula One consumers watch TV at a time when just few other people watch TV this will increase the relative viewing levels. At prime time this effect runs in the opposite direction. This is a phenomenon analysed by Kipker (2002).

In consequence the results of estimation b2 (figure 7), i. e., employing relative viewer levels instead of absolute amounts, do not lead to the rejection of the two hypotheses, either. They therefore confirm the conclusions drawn from the first estimation.

4 Conclusion

In this paper possibilities to measure the attractiveness of Formula One are discussed and analysed how this attractiveness is influenced. It was assumed that the competitive balance could play an important role for the attractiveness of Formula One. To quantify this, two different indices for assumed influence on the attractiveness were constructed. These were the Gini coefficient and the relative distance between the first and the second driver. To measure the level of attractiveness the German TV viewer levels were used. The estimation of this approach was done by using an OLS regression with Heteroscedasticity consistent estimators. Through this OLS it could be shown that the viewers do not have an absolute clear preference concerning the competitive balance. On the one hand there is the wish to see a thrilling duel at the top and on the other hand a high level of competitive balance is not interesting for the viewers. Furthermore we

could show that there has been a quadratic trend over time in the viewer levels. Another interesting result was that it could be shown that the Schumacher effect only plays a role if you use the number of TV viewers. Once we use the viewing rate the Schumacher effect does not play any role.

This result of an optimal level of competitive balance which maximizes the viewer's interests differs from the results of previous studies which mostly show that a high level of competitive balance maximizes the attractiveness of a sport. With our paper we can refute these assumptions concerning the competitive balance. This finding could be the basis for further empirical or theoretical work. In these further studies it could be attempted to construct a more detailed theoretical model which identifies the exact level of optimal competitive balance.

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