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The impact of Formula 1 on regional economies in Europe

Rasmus K. Storm[a], Tor Georg Jakobsen[b] and Christian Gjersing Nielsen[c]

ABSTRACT
The tangible effects of hosting major sporting events have been thoroughly examined in recent years. The consensus among scholars is that the effects on tourism, inbound foreign investments and gross domestic product (GDP) from hosting, for example, the Olympic Games or the football World Cup are absent. Further, only a few studies have been conducted on one of the most commercially successful (major) sporting events: Formula 1 motor racing. This paper applies regression models to test the effects on GDP, employment and tourism in European regions that have hosted Formula 1 grand prix from 1991 to 2017. The output from the models suggests that hosting Formula 1 races does not produce positive effects.

KEYWORDS
Formula 1; economic impact; Europe

JEL H41, L83, Z23
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INTRODUCTION

Stakeholders advocating the use of public funds to finance the hosting of major sporting events frequently argue that these investments pay off in terms of increased economic activity (Storm, Thomsen, & Jakobsen, 2017). Politicians, decision-makers and even public authorities often claim that such events are considered a benefit due to the tangible effects they bring (Jakobsen, Solberg, Halvorsen, & Jakobsen, 2013). Usually the argument is that the events are worth the cost because they boost tourism and create a branding effect that showcases the host nation or city (Zimbalist, 2017). However, research suggests that this is seldom the case.

Preuss (2015) argues that (economic) legacies stemming from major sporting events must be considered as no more than 'potential'. At the outset, there may be potentially tangible (economic) benefits forecast that exceed the costs associated with hosting the sporting events, but there is no guarantee that these will materialize in reality (Larissa, 2017). Studies on the Olympic Games (e.g., Baade & Matheson, 2016), the FIFA World Cup (e.g., Baade & Matheson, 2004; Zimbalist, 2015), major league sport franchises in the United States (e.g., Baade, 1994; Baade & Matheson, 2001; Richardson, 2002), college sports (in the United States) (e.g., Baade, Baumann, & Matheson, 2011), and motor sports (e.g., Baade & Matheson, 2000; Coates & Gearhart, 2008) (also in the United States) show that positive impacts are rare, and can in some cases even be negative as the costs associated with hosting the events crowd out more efficient use of the funds (Coates & Humphreys, 2003a, 2003b, 2008). In this paper, we examine how a particular major event, a Formula 1 (F1) grand prix, affects local economies.

F1 is an interesting case because of its commercial appeal (Mourâo, 2017) and large international consumer interest. The concept of a grand prix race dates back to 1894,[1] with F1 adopting its current format as a world championship series in 1950 with races being run in seven different countries: Britain, Monaco, the United States, Switzerland, France, Belgium and Italy (Jenkins, Pasternak, & West, 2016). Since then, the series has spread to more continents and it now (2019) has hosts in 21 countries.[2]

F1 broadcasts reach millions of viewers around the globe. The 2011 Australian Grand Prix in Melbourne alone had 120,000 unique spectators, while 20 million people followed it on television in European Union

CONTACT
[a] **(Corresponding author)** rasmus.storm@idan.dk
Danish Institute for Sports Studies, Århus C, Denmark; and NTNU Business School, Norwegian University of Science and Technology, Trondheim, Norway.
[b] tor.g.jakobsen@ntnu.no
NTNU Business School, Norwegian University of Science and Technology, Trondheim, Norway.
[c] christian.nielsen@idan.dk
Danish Institute for Sports Studies, Århus C, Denmark.
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countries, according to Ernst and Young (2011). In 2016, F1 was acquired by Liberty Media for US$8 billion (Liberty Media Corporation, 2016) and had a total turnover of US$1.8 billion in 2017, according to the British newspaper *The Independent*.[3] Figures estimated by Jenkins et al. (2016) show that the overall global viewership is around 425 million people and 'is only surpassed by the Olympic Games and the World Cup football tournament, both of which are held only every four years' (p. 11). Its worldwide viewership and high turnover suggest that the F1 races could draw enough attention to boost tourism or create other forms of increased economic activity in the host regions or cities, and hence create positive effects (Remenyik & Molnár, 2017).

In general, when F1 races and circuits are established the economic benefits are reported to be significant. A clear example of this is the Circuit of Americanas in Austin, Texas, where the economic impact of F1 races alone added up to US$2.8 billion – equivalent to 25,000 jobs – from 2012 to 2015, according to calculations published on the circuit's webpage.[4] Figures such as these, indicating great economic stimulus, have often prompted public authorities to subsidize F1. As pointed out by the international financial magazine *Forbes*, all current F1 races except the British Grand Prix receive substantial public funding (Jenkins et al., 2016; Mourão, 2017).[5]

For example, the establishment of the Yas Marina F1 circuit in Abu Dhabi, United Arab Emirates (UAE), in 2009 was part of a deliberate effort to turn the city into a global sport and major events destination (Oxford Business Group, 2016). In order to develop its hospitality industry and attract foreign visitors, the Abu Dhabi government provided the US$1.3 billion in construction costs[6] for the circuit as well as spending another US$1 billion on new venues and other renovation projects in the city.

Compared with other major sporting events, F1 races are held every year in the respective host nations. This makes it easier to use infrastructural investments connected to hosting F1 races compared with – for example – the Olympics or the football World Cup, which are becoming increasingly renowned for demanding new stadiums that turn into white elephants after the events are held (Alm, Solberg, Storm, & Jakobsen, 2014). As infrastructural costs connected to F1 races are relatively small and circuits often can be reused, economic net effects on the host city or nation are more likely to materialize.

However, judging whether 'investments' of public money in F1 races are appropriate depends on whether the economic activity associated with the events is significant enough to justify them (Baade & Matheson, 2000). To the best of our knowledge, no previous academic studies have investigated this issue. Studies of F1 that do exist are mainly produced by hired consultancy firms that apply input–output (IO) or computable general equilibrium (CGE) methodologies, which have been increasingly criticized for being too simplistic (Dwyer, Forsyth, & Spurr, 2005). In doing so, they apply inflated multipliers, overestimate benefits and leave out the (opportunity) costs of hosting an event (Taks, Késenne, Chalip, Green, & Martyn, 2011). This is a problem because politicians and public authorities are left with misleading evidence that could lead to the wrong decisions being made regarding financial support for F1 races and/or circuits. To address this, we apply robust regression modelling techniques on available objective data to test the effects of hosting an F1 race.

The paper is structured as follows. It next reviews the existing literature on the effects of major sporting events and F1. It then examines the methodologies used in existing studies that prompted the authors to apply the regression techniques used in the present paper. The paper then presents the data together with a brief overview of the methodological issues connected to the regression estimation strategy. The results are next presented and discussed, followed by a conclusion focusing on the implications and limitations of the findings and prospects for future research on the subject.

THE EFFECTS OF MAJOR SPORTING EVENTS: A REVIEW OF THE LITERATURE

The legacies and impact of sporting events of varying scale have received increased attention in recent decades (Kassens-Noor, Wilson, Müller, Maharaj, & Huntoon, 2015). According to Andranovich, Burbank, and Heying (2001), this is due to greater competition between cities with regard to their overall development and growth. To many governments, especially politicians in major cities, sporting events are a significant tool for urban development because they are seen as a potential solution to the new challenges of globalized capitalism. Put differently, sporting events now play 'an integral role in how cities see themselves, and [are] becoming one of the anchors of consumption-based development' (Black, 2008, p. 116).

However, and as mentioned in the introduction, hosting events such as the Olympics, the World Cup and European Football Championship usually demand the use of taxpayers' money to yield the benefits they promise (Baade & Matheson, 2000). Public funds are therefore often used to construct facilities and other infrastructure, or simply to acquire the hosting rights to these events (Mourão, 2017). As this public spending is often substantial (Flyvbjerg & Stewart, 2016), and public budgets are scarce by definition, scrutinizing the ambition of sport event legacies has become imperative to the point of being a public concern (Crompton, 1995).

Several methodological approaches have been used to estimate the economic benefits of sporting events, including F1, the most common being IO modelling (Jasmand & Maennig, 2008). For example, Kim et al. (2017) estimated that the Chinese F1 Grand Prix in Shanghai had an economic impact of no less than '205.85 million yuan (approx. US$30.6 million) of output, 75.51 million yuan (approx. US$11.2 million) of income and 17.80 million yuan (approx. US$ 2.6 million) of indirect tax' (p. 70), and created 1409 full-time-equivalent jobs. Although foreign spectators made up less than 6% of the total number of spectators, they accounted for more than one-quarter of the total expenditures, leading to the conclusion that host cities should focus on increasing the number of international attendees to maximize economic impact.

Huang, Mao, Kim, and Zhang (2014), also applying IO modelling, similarly reported sufficient spending among non-locals at the Shanghai Grand Prix in 2012. However, they estimated a much higher economic impact of 1179 million yuan (US$174.28 million) in output, 453 million yuan (US$66.96 million) in income and 120 million yuan (US$17.74 million) of indirect tax and created 9048 full-time-equivalent jobs. Moreover, a report from Ernst & Young (2011), commissioned by the Victorian government estimated, using a CGE model, that the Australian F1 Grand Prix in Melbourne in 2011 increased the Victorian gross state product by US$32–39 million, creating between 351 and 411 full-time-equivalent jobs. This led Tourism Victoria (2011) to claim that: 'Hosting the Formula One Australian Grand Prix brings significant benefits to Victoria.' Remenyik and Molnár (2017) use descriptive statistics on hotel nights and visitors attending the Hungarian Grand Prix to argue that it is imperative to the Hungarian tourist industry to keep the event on the F1 race calendar.

While these studies suggest that F1 generates significant economic benefits for the host cities and/or regions, they all have something in common: they leave out the cost of the event (Taks et al., 2011). According to Késenne (2005) and Andreff (2017), economic impact studies are, in many cases, simply used to justify the realization of large sporting events and do not base their findings on valid methodologies. These studies often use exaggerated multipliers that inflate the impact (Matheson, 2009; Siegfried & Zimbalist, 2000), and although impact studies are different, and some are more sophisticated than others, they typically do not take crowding-out effects or 'switching' into consideration (Burns, Hatch, & Mules, 1986). Furthermore, leakages or imports from other nations to produce the event are not often dealt with (Matheson, 2008, 2009).[7] Finally, opportunity costs (Black, 2008) and relevant environmental issues (Cairns, 2009) are rarely considered. Hence, Késenne (2005) concludes that 'even a properly conducted economic impact study does not provide a sensible argument for the government to support a project [alone]' (p. 134).

Cost–benefit analysis (CBA), on the other hand, estimates the net welfare effect of an event by taking all benefits *and* costs into consideration, and is therefore better designed to answer public policy questions (Barget & Gouguet, 2010). Abelson (2011) argues that stakeholders advocating to host a sporting event should not rely on CGE or IO models, but only claim that the event provides economic benefits to the community if it passes a CBA. Demonstrating how one can apply a proper CBA – thus addressing these problems – Késenne (2005) shows how a sporting event can produce a negative net benefit taking these issues into consideration, even though the traditional economic impact study would have yielded a (significantly) positive result.

Pearson (2007) applies a CBA to the Australian F1 Grand Prix in Melbourne in 2005, estimating the net benefits to be negative (A$6.7 million). Also applying CBA to the 2011 and 2012 Australian F1 Grands Prix in Melbourne, Campbell (2013) (mid)estimates net losses of A$52.7 million and A$60.5 million, respectively. Even though the estimates hold some uncertainty, his report concludes that: 'Given the magnitude of these loss estimates and the reliability of the major costs and benefits, our strong conclusion is that the race reduces the economic welfare of Victoria and that it should be discontinued' (p. 5).

Additionally, Campbell (2011) criticizes Tourism Victoria for its interpretation of the report from Ernst & Young (2011) on the 2011 Australian F1 Grand Prix in Melbourne. As a CGE cannot measure the net benefits on the community, he argues that 'Tourism Victoria have misconducted the Auditor General's appeal for cost–benefit analysis and transparent modelling' (p. 10). Similarly to Abelson (2011), he further argues that gross state product and expenditure are poor measures of economic welfare.

Mules (1998) argues that taxpayer-financed subsidies to host events such as the F1 Grand Prix in Australia are not justified by the effects of the event. As these are marginal, 'it is difficult to avoid the conclusion that the taxpayer is generally the loser in the hosting of major sporting events' (p. 42). To politicians and the public, it can, however, be difficult to understand that sporting events can have a negative net effect on welfare due to the inflow of money into the community, but this is first and foremost due to the costs being overlooked (Fairley, Tyler, Kellett, & D'Elia, 2011). Furthermore, '"Booster coalitions" invoke a familiar litany of presumed benefits, with relatively minor variations, to support their arguments that sport mega-events will bring major gains to the "whole community"' (Black, 2008, p. 470).

Siegfried and Zimbalist (2000) also point to flaws in the typical impact-analysis approach. They argue that comparing places that host sporting events (in their case, major league matches) with places that do not is a much more appropriate way to measure potential economic development caused by – in their case – team sports franchises. It does not take the question of costs into direct consideration, but allows one to control for other factors affecting the impact and see whether there are any lagged effects. Coates and Gearhart (2008) and Baade and Matheson (2000) deploy (such) appropriate modelling specifically in relation to the Daytona 500 circuit in Volusia County and NASCAR tracks and events (both in the United States), finding that cities aiming to host a race or a circuit should not expect the impact usually claimed by advocates.

In this paper, we follow the logic of these scholars whilst extending the scope of earlier studies on F1 from focusing on one specific race, host city or region to more areas with F1 races. There are three reasons for this approach. First, conducting a proper CBA (as recommended by the contemporary literature) is costly and would require sourcing data that are not easily accessible. Second, owing to the high of costs of a CBA, it would limit the analysis to only very few F1 races, which makes it difficult to generalize the findings. Third, while IO, CGE and CBAs have already been done on F1 races, no analyses deploying regression modelling (on objective data) exist. Expanding on existing research, we assess whether we can identify the economic benefits connected to F1 races on a more general level. The following section presents our approach in more detail.

DATA, METHODS AND EMPIRICAL MODELS

Data and methods

In taking an appropriate modelling approach, we apply dynamic panel data to the period 1991–2017. The advantage of this approach is that we can use objective data that are not affected by inflated multipliers or similar problems associated with strong assumptions built into the modelling techniques of the approaches described above. While we recognize that using a panel-data regression technique is not without its problems, we believe that the benefits of the approach add to the existing literature by yielding results that can be compared with those produced by studies applying different methodologies. Overall, we will gain a better understanding of the scope of the potential benefits (or costs) that can be expected from hosting F1 races.

We investigate 10 European regions with variations in our independent variable *F1race*.[8] This means that these regions are those that have both hosted and not hosted an F1 race during the period of investigation.[9] Many cities host F1 races annually, the most famous being Monaco. However, because Monaco hosts a race every year, it is impossible to determine whether any differences observed between Monaco and cities without an F1 race are due to the Grand Prix or other differences between the cities. Thus, some relevant regions are – for methodological reasons – left out of the analysis and only (all) years with and without hosting an F1 race in the (10) relevant regions are included in the deployed data. In this sense, we compare the years of hosting an F1 race with the years without (in the same regions) to identify an F1 race's potential effect on our dependent variables (see below). Given the available data, we argue that this is the best possible approach in comparable terms between treated (F1 race regions) and untreated (without F1 races) data groups. Table A1 in Appendix A in the supplemental data online lists the years in which the 10 regions have hosted a race.[10]

We run models with *gross domestic product* (GDP; measured in €) to test the effect of hosting an F1 race on the overall economy, and *nights spent* on tourist accommodation to test F1's effect on tourism. We also run models with *employment* and *GDP per capita.* The data were collected from Eurostat (2018) with *nights spent* log transformed in order to reduce skewness and kurtosis.

The reason for running both GDP and GDPpc models is because arguments in favour of hosting F1 are rarely presented to affect GDP per capita, but reported to produce the impact in absolute figures (e.g., producing an effect of, say, US$500 million in additional tourist spending). Thus, using absolute figures tests the question of economic effects in intuitively straightforward values and is also a more sensitive approach than GDPpc. However, as GDPpc is a common variable for use in econometric testing; we also include this (dependent) variable in one set of models.

Regarding the *employment* variable, impacts are often argued to increase the amount of jobs in the area in question why testing this assumption is also relevant. All data – both dependent and independent – are annual.

We focus on Europe because objective data relevant for analysis are not available for other world regions. From this perspective, we anticipate that nation aggregate data on GDP or tourist visits are too 'insensitive' to measure impacts, and hence use lower level regional data from Eurostat.

The Eurostat database contains comparable regional statistics for European Union member nations. The data used for this study cover 3.06 million people per region on average, with a standard deviation (SD) of 2.3 million, which is not a perfect level of sensitivity but reasonable enough for potential effects to be measured.[11] At least this is the closest we can come in terms of data power if we want to apply objective data – as stated above – because lower level data (which would potentially be more sensitive) are not available.

Another weakness is that while Eurostat's database covers a great deal of topics measured over several years, there is little publicly available information that is relevant for constructing explanatory (independent) variables in our regression models. Accordingly, our models are relatively simple. From a theoretical perspective, only the available Eurostat data on crime (GDP and tourism), employment (GDP), and education (GDP) are suitable to include as controls. We ran models with these variables (not reported), producing results that are consistent with the overall results. The crime variable was not included as only three years of data were available.

Specifications

We present a broad set of models: eight with *GDPpc*, four with *nights spent* as the dependent, eight with *GDP* and eight with *employment* as the dependent. Eight of the models test the effect of *F1race* in the same year, and another eight of the models test the effect of *F1race* in the year before measuring the dependent variable. The argument for the latter option is that it could take time for the effect of an F1 event to manifest itself in the dependent variable.

We investigate dynamic panel data where there is a time trend present. First, we present fixed effects (FE) models to account for unit-level unobserved heterogeneity and include a lagged dependent variable. This is done by including the unit-specific dummy variable D_i, which takes into account the time-invariant independent variables that cannot be included in our model, as well as unmeasured time-invariant variables (Mehmetoglu & Jakobsen, 2017). The rationale behind employing region FE is that the regions are not necessarily comparable because of factors that we cannot include in the models (there are very little data and a limited N). In an ordinary least squares (OLS) regression, we would not be certain of what type of effect we were measuring. The above-mentioned differences between regions are, in our FE models, captured by their unique intercepts, and we can overcome much of the problem of spurious relationships, leaving a purer relationship between the independent and dependent variables. Our models testing effects in the same year and in the year before measuring the dependent variable are expressed in equations (1) and (2), respectively:

$$y_{it} = \alpha + y_{it-1}\beta + x_{it}\beta + D_i\beta + \varepsilon_{it} \tag{1}$$

$$y_{it} = \alpha + y_{it-1}\beta + x_{it-1}\beta + D_i\beta + \varepsilon_{it} \tag{2}$$

However, as the FE estimates are known to suffer from Nickell bias (Nickell, 1981), we also present models using the Arellano–Bond estimator (AB) (Arellano & Bond, 1991). These models are specified as a system of equations, one for each time period, including different instruments (constructed based on lagged values of the dependent) for each equation. The AB dynamic panel data estimator uses moment conditions to remove bias introduced by the correlation between the unobserved panel effects and the lagged dependent variable. We make use of the *xtabond2* command in Stata (Roodman, 2009), where the first-difference transformation removes both the constant term and the individual effect, as expressed in equations (3) and (4):

$$\Delta y_{it} = \alpha \Delta y_{it-1} + x_{it}\beta + \Delta v_{it} \tag{3}$$

$$\Delta y_{it} = \alpha \Delta y_{it-1} + x_{it-1}\beta + \Delta v_{it} \tag{4}$$

We also ran additional sensitivity models (not presented), including OLS regression, random effects, first differences and the original AB models, all yielding similar results from that of the main analysis.

As we are investigating the whole population of European regions that have both hosted and not hosted F1 races during the relevant period, we are generalizing within stochastic model theory rather than within sample theory. That is, we are generalizing from the observations made to the process or mechanism that brings about the actual data (Gold, 1969; Henkel, 1976; Mehmetoglu & Jakobsen, 2017).

Table 1 presents data ranging from 1991 to 2016 showing *nights spent* on accommodation in the host city, and from 2000 to 2015 for *GDPpc* and *GDP*. *Employment* data range from 1999 to 2017. For the independent variable *F1race*, there are a total of 119 observations of hosting a race and 141 observations of not hosting one.

We also ran the models using different lags and leads. The argument for leading the independent variable is that we allow for some of the benefits to accrue in the years before hosting an F1 race, while the argument for testing further lags is to assess whether there are any legacy benefits from hosting (see also Jakobsen et al., 2013). Of these models, we only present those where there is a significant effect (i.e., with three- and four-year lags; see below). These models are expressed in equations (5) to (8):

$$y_{it} = \alpha + y_{it-1}\beta + x_{it-3}\beta + D_i\beta + \varepsilon_{it} \tag{5}$$

$$y_{it} = \alpha + y_{it-1}\beta + x_{it-4}\beta + D_i\beta + \varepsilon_{it} \tag{6}$$

$$\Delta y_{it} = \alpha \Delta y_{it-1} + x_{it-3}\beta + \Delta v_{it} \tag{7}$$

$$\Delta y_{it} = \alpha \Delta y_{it-1} + x_{it-4}\beta + \Delta v_{it} \tag{8}$$

RESULTS AND DISCUSSION

Regarding the effect of *F1race* on *nights spent*, we find no significant effect and the signs change from positive to negative from the FE to the AB models. For the models with GDPpc as the dependent, the effect is negative for both hosting a race in the same year and hosting in the previous year, though neither result is statistically significant (Tables 2 and 3).

Our models with GDP and employment in Tables 4 and 5 show negative effects. However, they are not significant for *employment*. The AB estimations produce the same results.

For our lagged models (equations 5–8), we find significant results when lagging our independent variables three and four years for the models investigating GDPpc, GDP and employment (only the AB estimation). Here, the results are negative at either the 5% or 10% levels. This can read in Tables 6–8. The results imply that there actually are some negative legacy results from hosting an F1 race for the regions in question.

Overall, the analysis challenges the positive side of the debate about the economic benefits of hosting an F1 race, at least at the regional level in Europe. On the contrary, there could actually be a delayed negative effect when it comes to regional GDPpc and absolute GDP. We also find lagged negative effects in relation to employment.

Table 1. Descriptive statistics, 1991–2017.

Name	*N*	Mean	SD	Minimum	Maximum	Period
GDPpc	156	25,756.69	6068.12	11,849.04	41,954.37	2000–15
ln Nights spent (*nights spent*)	210	15.524	0.980	13.854	17.224	1991–2016
Formula 1 race (*F1race*)	260	0.458	0.499	0	1	1991–2016
GDP (€, millions)	157	20,447	38,889	20,447	152,137	2000–15
Employment (%)	184	64.917	7.655	44.1	76.4	1999–2017

Note: GDP, gross domestic product.

Table 2. Fixed effects (FE) estimation of a Formula 1 race on GDPpc and tourism.

	GDPpc	GDPpc	Nights spent	Nights spent
Dependent$_{t-1}$	0.900***	0.900***	0.749***	0.750***
	(0.041)	(0.042)	(0.177)	(0.177)
F1race	−348.293		0.001	
	(217.674)		(0.014)	
F1race$_{t-1}$		−334,275		−0.014
		(255.260)		(0.016)
Intercept	3199.715**	3208.956**	3.903	3.894
	(1064.978)	(1123.332)	(2.735)	(2.746)
N	146	146	200	200
Groups	10	10	10	10
R^2 (within)	0.849	0.849	0.610	0.610
F	259.36	270.43	9.19	8.97
Period	2001–15	2001–15	1991–2016	1991–2016

Note: *Significant at 10%; **significant at 5%; ***significant at 1%. Nights spent is log transformed.

Table 3. Arrelano–Bond (AB) estimation of a Formula 1 race on GDPpc and tourism.

	GDPpc	GDPpc	Nights spent	Nights spent
Dependent$_{t-1}$	0.898***	0.898***	0.501**	0.499**
	(0.042)	(0.043)	(0.197)	(0.195)
F1race	−310.895		−0.006	
	(222.591)		(0.020)	
F1race$_{t-1}$		−316.247		−0.027
		(268.060)		(0.019)
N	136	136	186	186
Groups	10	10	10	10
F	247.63	146.22	3.47	4.36
Period	2002–15	2002–15	1992–2016	1992–2016

Note: *Significant at 10%; **significant at 5%; ***significant at 1%. Nights spent is log transformed. GDP, gross domestic product.

Table 4. Fixed effects (FE) estimation of a Formula 1 race on gross domestic product (GDP) and employment.

	GDP	GDP	Employment	Employment
Dependent$_{t-1}$	0.854***	0.853***	0.828***	0.820***
	(0.020)	(0.020)	(0.015)	(0.027)
F1race	−1136.335*		−0.799	
	(523.691)		(0.534)	
F1race$_{t-1}$		−1319.319***		−0.821
		(809.565)		(0.629)
Intercept	12,398.730***	12,572.110***	11.656***	12.244***
	(1456.684)	(1513.440)	(1.093)	(1.918)
N	147	147	174	174
Groups	10	10	10	10
R^2 (within)	0.919	0.920	0.762	0.762
F	1127.10	1073.63	1755.88	1483.26
Period	2001–15	2001–15	2000–17	2000–17

Note: *Significant at 10%; **significant at 5%; ***significant at 1%. Nights spent is log transformed.

Table 5. Arrelano–Bond (AB) estimation of a Formula 1 race on gross domestic product (GDP) and employment.

	GDP	GDP	Employment	Employment
Dependent$_{t-1}$	0.850***	0.848***	0.807***	0.800***
	(0.025)	(0.024)	(0.025)	(0.025)
F1race	−1542.332*		−0.450	
	(797.189)		(0.505)	
F1race$_{t-1}$		−1914.978		−0.526
		(1089.631)		(0.606)
N	137	137	164	164
Groups	10	10	10	10
F	1243.36	891.74	570.76	543.24
Period	2002–15	2002–15	2001–17	2001–17

Note: *Significant at 10%; **significant at 5%; ***significant at 1%. Nights spent is log transformed.

Table 6. Estimation of a Formula 1 race on GDPpc using three- and four-year lags.

	FE	FE	AB	AB
Dependent$_{t-1}$	0.894***	0.888***	0.897***	0.890***
	(0.041)	(0.040)	(0.041)	(0.038)
F1race$_{t-3}$	−365.654**		−282.231*	
			(126.752)	
F1race$_{t-4}$		−420.657**		−375.938*
		(153.528)		(205.247)
Intercept	3395.660**	3576.759***		
	(1071.456)	(1048.590)		
N	146	146	136	136
Groups	10	10	10	10
R^2 (within)	0.849	0.849		
F	298.57	275.36	246.60	259.58
Period	2001–15	2001–15	2002–15	2002–15

Note: *Significant at 10%; **significant at 5%; ***significant at 1%. AB, Arrelano–Bond estimator; FE, fixed effects.

Table 7. Estimation of a Formula 1 race on gross domestic product (GDP) using three- and four-year lags.

	FE	FE	AB	AB
Dependent$_{t-1}$	0.851***	0.844***	0.848***	0.843***
	(0.019)	(0.019)	(0.024)	(0.024)
F1race$_{t-3}$	−1409.861***		−1747.210**	
			(648.202)	
F1race$_{t-4}$		−1614.156***		−1806.720**
		(428.135)		(624.961)
Intercept	12,782.430***	13,428.980***		
	(1364.009)	(1418.326)		
N	147	147	137	137
Groups	10	10	10	10
R^2 (within)	0.920	0.920		
F	1145.42	1069.76	1092.74	796.76
Period	2001–15	2001–15	2002–15	2002–15

Note: *Significant at 10%; **significant at 5%; ***significant at 1%. AB, Arrelano–Bond estimator; FE, fixed effects.

Table 8. Estimation of a Formula 1 race on employment using three- and four-year lags.

	FE	FE	AB	AB
$Dependent_{t-1}$	0.827***	0.841***	0.795***	0.799***
	(0.029)	(0.025)	(0.027)	(0.026)
$F1race_{t-3}$	−0.400		−0.337	
	(0.245)		(0.199)	
$F1race_{t-4}$		−0.146		−0.241*
		(0.119)		(0.116)
Intercept	11.606***	10.632***		
	(1.960)	(1.632)		
N	174	174	164	164
Groups	10	10	10	10
R^2 (within)	0.752	0.750		
F	658.37	564.08	476.74	478.44
Period	2000–17	2000–17	2001–17	2001–17

Note: *Significant at 10%; **significant at 5%; ***significant at 1%. AB, Arrelano–Bond estimator; FE, fixed effects.

The conclusion will discuss the implications of the findings together with the limitations of the study and future research perspectives.

CONCLUSIONS, IMPLICATIONS AND FUTURE RESEARCH

Summary

In this paper we have employed robust panel data regression techniques on objective data to conduct a study examining the tangible economic effects of F1 races. We limited the analyses to European regions owing to the lack of comparable data on all F1 race hosts.

The regression output of our models suggests that, at the (power) level of analysis offered by the data, it is not possible to support the claim that hosting an F1 race event yields positive effects on (per capita) GDP, employment or tourism in the regions covered. On the contrary, it seems that negative legacies can materialize three to four years after the event. These results are consistent with existing research that finds economic effects from major sporting events are usually absent and sometimes even negative.

With regard to our lagged models, it is difficult to ascertain why the effect is negative – and why it is a lagged one. As pointed out by Värja (2016), one explanation might be that the negative effects are caused by the inefficient use of public money. As mentioned above, the hosting of an F1 race usually requires host nations or cities to pay large subsidies to cover hosting fees, and prepare the race circuit and related infrastructure. The negative effect suggests that there are substantial opportunity costs associated with being an F1 host. This is consistent with the evidence provided by proponents of the CBA approach (e.g., Késenne, 2005; Taks et al., 2011).

Another possibility is that (private) tourist spending associated with the races is offset by the lack of spending by tourists who are negatively affected by the brand of F1, for example, in relation to environmental issues, and thus choose not to visit the host city or nations (anymore). Some local residents could also be affected by the hosting role to such an extent that, after some years of experiencing the races, they choose to leave the region during the event, thus reducing spending in the area and resulting in a negative impact (Preuss, 2005).

With regard to the negative effect being lagged, it is likely that the 'investment' simply does not take effect until some years after, as can be the case with other – more long-term – investments. It is possible that spending cuts in other areas of the public budget related to the prioritization of F1 are gradually implemented, or that other structural arrangements in the public sector simply slow down the pace of the (negative) impact. Provided we only have limited data at hand for analysis, we cannot answer this question in more detail. We will touch on this issue further below after we have reflected on the implications of the study.

Implications

The implications of our findings are that politicians, public authorities and other stakeholders should reconsider the argument that using public funds to host F1 races is a sound investment. Even though claims about significant benefits are commonly made, most economic scholars agree that they almost never prove to be the reality when examined closely – particularly for major sporting events (Coates & Humphreys, 2008).

In connection to this, other effects, such as intangible forms of utility gained among citizens in the host nations and cities, can also be used to justify the hosting of F1 races (e.g., see Humphreys, Johnson, Mason, & Whitehead, 2018, on the value of medal success in the Olympic Games; Johnson & Whitehead, 2000, on the value of sport stadiums; and Wicker, Whitehead, Johnson, & Mason, 2016, on German football). However, evidence should be found to prove that such intangible effects exist before using them as argumentation. Based on the available evidence, we argue that hosting an F1 race does not produce net positive tangible effects, and hence does not justify the use of large amounts of public funds on such events.

Limitations and future research

The approach deployed in this paper has some limitations that point towards future research opportunities. First, the available data used in our regression models are not very detailed or sensitive. We have not been able to model data from many regions and our models would have benefited from the inclusion of more explanatory (control) variables if the data were available. Data covering more regions may have yielded a more nuanced result. Further, there is a problem of the power of the data. If comparable data on a lower stratum than the regions deployed existed, our models could potentially produce more measurable effects than explored in this study because the data would be more sensitive.

Based on these limitations, the results should be seen only as a first step towards developing more comprehensive studies on the impact of F1 in the future. A recommendation would be to have national statistics bureaus in the nations hosting F1 races outside European member nations gather regional level data that make it possible to conduct more in-depth studies. Moreover, we recommend that data are collected on lower level strata, so that, for example, econometric modelling – as presented here – would gain more power from the data. While we realize that these suggestions are very specific recommendations, it is imperative to advance the research on F1 – and similar events – until stronger evidence is found. This would certainly benefit the decision-making process and public debates on the demand for public subsidies for events such as F1. Modelling data entailing not only more (and smaller) regions but also more explanatory variables is another relevant suggestion for future research.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

NOTES

1. See https://en.wikipedia.org/wiki/Grand_Prix_motor_racing.
2. Australia, Bahrain, China, Azerbaijan, Spain, Monaco, Canada, France, Austria, Britain, Germany, Hungary, Belgium, Italy, Singapore, Russia, Japan, the United States, Mexico, Brazil and the United Arab Emirates (UAE). Source: www.formula1.com.
3. See http://www.independent.co.uk/sport/motor-racing/formula1/f1-revenue-loss-cut-liberty-media-first-year-ferrari-mercedes-a8189876.html.
4. See http://www.circuitoftheamericas.com/economic-impact.
5. See https://www.forbes.com/sites/csylt/2017/03/13/the-1-billion-cost-of-hosting-an-f1-race/#462bab2b4f79.
6. See https://bleacherreport.com/articles/2270347-abu-dhabi-grand-prix-2014-10-key-facts-about-yas-marina-circuit#slide1.
7. A variation of this problem is highlighted by Dwyer et al. (2005), who argue that 'When there is an increase in spending in the economy from visitors from abroad, the exchange rate will be bid up, discouraging exports and economic activity in other parts of the economy' (p. 353).
8. This includes Baden-Württemberg, Cadiz, Emilia-Romagna, Leicestershire, Liege, Lisbia, Nièvre, Rheinland-Pfalz, Steiermark and Valencia.
9. The span of the investigated period is chosen due to the format of the available Eurostat data.
10. As can be seen in Table A1, there are some cases of circuits with sporadic hosting, such as in Belgium and the two locations in Germany. If this is somehow connected to GDP or tourism issues, it could potentially create a problem for the analysis. We searched for information on these issues, only finding sporadic information. Regarding the German tracks, this on-and-off host status is due to a biennial swap deal between Hockenheimring and Nürburgring. No information indicates that this deal is connected to issues related to GDP or tourism. The swap deal, in fact, makes the analysis stronger because it is possible to compare years with and without races. With regard to the Belgium race track, it appears that it was dropped in 2006 due to maintenance issue.
11. Numbers are from 2016.

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