

Demand for public events in the COVID-19 pandemic: a case study of European football

Article

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Demand for Public Events in the COVID-19 Pandemic: A Case Study of European Football

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Abstract

Research question: This study looks at stadium attendances in elite-level European football, to suggest how people responded to the initial COVID-19 outbreak. This offers insight into how professional sports will emerge from social lockdowns and competition taking place behind closed doors.

Research methods: The analysis focuses on the top leagues of England, Italy, France, Spain and Germany. Using panel data methods and exploiting the variation in day-to-day attendances in these leagues, the impacts on implied spectator demand from the news of confirmed COVID-19 cases and deaths can be quantified.

Results and Findings: In Italy, England and Germany, stadium attendances were negatively affected by the previous day's newly confirmed domestic cases or deaths. In Spain and France, there was no attendance response to the early stages of the domestic outbreaks.

Implications: COVID-19 was affecting football match spectator demand before European countries enforced lockdowns and other restrictions to suppress the spread of the disease. This suggests that fans significantly responded to the risk of catching the virus. If this risk remains when stadiums reopen, then sports organisations should expect reduced ticket demand. This suggests that managers should adopt more dynamic and creative pricing strategies, and use their stadiums in more innovative ways, if they are to survive financially in a world where COVID-19 remains a threat to public health.

Keywords: Demand for sport, Stadium attendance, Coronavirus, European economy, Public health

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1 Introduction

On 11th March 2020, the World Health Organisation declared that the COVID-19 novel coronavirus had become a global pandemic. Over five months later (28th August 2020), health systems in numerous countries were still being overwhelmed by the impact of the outbreak and over 830,000 people had lost their lives to the virus.¹ Many countries experienced exceptionally sudden and deep economic recessions due to the measures taken to suppress or mitigate the pandemic.²

The focus here is on the early outbreak period of the virus in Europe, specifically in England, France, Germany, Italy and Spain, up to the first full weekend of March 2020. The analysis looks at stadium attendance data from elite-level association football matches, which is the most popular sport in the world.³ In the midst of a global pandemic this severe, a focus on sport may seem trivial, or even in poor taste. However, the demand for attending sports events in these countries may tell us something about how populations respond to a public health emergency, especially one which requires social distancing, under different policy regimes. There is also little doubt that sport, in particular football, forms a central part of the social fabric of the European regions most affected so far (Giulianotti, 2012). Indeed, Bergamo, the probable epicentre of the European coronavirus outbreak (Verdoni et al., 2020) and with the highest rate of COVID-19 deaths in Italy (Reuters, 2020), is home to Atalanta B.C., who this year reached for the first time in their history the quarter finals of the premier European competition, the UEFA Champions League, even as the outbreak took hold.⁴ During both World Wars, regional football continued in Europe, a testament to its social and political importance in troubled times (Benoit, 2008; Woolridge, 2002). But from the second weekend in March 2020, European professional sport, including football, was largely in shutdown until mid-May, when some competitions resumed, though with mostly empty stadiums.

This paper relates to two principal strands of literature. First, it contributes microeconomic evidence on the impacts of a pandemic or a public health emergency (e.g., Keogh-Brown et al., 2010, for a macroeconomic analysis, or Kuo et al., 2009; Page et al., 2012; Rassy & Smith, 2013, for studies focused on the tourism sector). Second, there is a vast literature analysing

¹Source: COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University; <https://coronavirus.jhu.edu/map.html>

²See for example the IMF World Economic Outlook, April 2020; <https://www.imf.org/en/Publications/WEO/Issues/2020/04/14/weo-april-2020>.

³For example, see the Nielsen World Football Report, 2018; <https://www.nielsen.com/uk/en/insights/report/2018/world-football-report/>.

⁴Indeed, it has been suggested that a match between Atalanta B.C. and Valencia CF on 19th February 2020 was ground zero for the spread of the virus in Spain as well as in Italy; see <https://rep.repubblica.it/pwa/generale/2020/03/20/news>.

and modelling the demand for professional sports and specifically football stadium attendances (e.g., for England see [Bird, 1982](#); [Buraimo, 2008](#); [Feehan et al., 2003](#); [Forrest & Simmons, 2002](#); [Simmons, 1996](#); [Simmons & Forrest, 2006](#), for France see [Andreff & Scelles, 2015](#), for Germany see [Pawlowski & Anders, 2012](#), for Italy see [Bond & Addesa, 2020](#), for Spain see [Garcia & Rodríguez, 2002](#), for evidence outside of the top European leagues see [Buraimo et al., 2018](#), and for women's football see [Valenti et al., 2020](#)), but little on the effects of shocks like COVID-19, with two exceptions. [Gitter \(2017\)](#) studied Mexican baseball attendance during the H1N1 'Swine flu' outbreak, finding reductions in game attendances of 15-30%. [Reade et al. \(2020\)](#) studied Belarussian Premier League football attendances after COVID-19, i.e., in one of the few countries where football was not shut down after the virus outbreak. In this quite particular context, [Reade et al. \(2020\)](#) found that demand decreased significantly during the initial period of maximum uncertainty about the impacts and risks of Covid-19, in March and April 2020, but then recovered in the following months, even as the numbers of reported cases and deaths increased.

The rest of the paper proceeds as follows: the next section describes the data on football match attendances and the COVID-19 outbreak; this is followed by the estimation strategy to assess the impact of the European COVID-19 outbreak on implied spectator demand; the next section presents the results; the penultimate section discusses the implications of these results in the context of the ongoing COVID-19 pandemic, focusing on European professional football; and the final section offers some concluding remarks, as well as identifying areas for further research.

2 Data

A dataset of match attendances and results was constructed from www.worldfootball.net for the big five European football leagues, i.e., the English, Italian, French, Spanish and German top leagues. In addition, the entire history of European domestic and continental professional football result outcomes was used to construct the Elo ratings of teams, as measures of their time-varying strengths.⁵ These measures also capture the recent form of teams, as the recursive updating of the ratings after each match means that those completed more recently have greater weight, i.e., constant gain updating. Alternative measures of time-varying team strengths would include UEFA coefficients, league positions and other metrics of recent form. We prefer Elo ratings as they take into account form over different competitions, being functions of who beat who and when, throughout the history of association football, regardless of the match

⁵Elo ratings, originally proposed by [Elo \(1978\)](#) for chess players, are commonly used to estimate the relative strengths of football teams, both in practical applications (e.g., <https://www.eloratings.net/>) and in academic research (e.g., [Hvattum & Arntzen, 2010](#)). See either of these sources for the mathematical details.

formats. The ratings will be useful control variables in the regression model, described in the next section. For the analysis, however, the focus is on relatively recent data, from the beginning of the 2015/16 season to the COVID-19 induced football shutdown in March 2020.

The dataset used is summarised in Table 1. In each of the five top leagues over this period, it represents between 24 and 29 teams, which translate into between 496 and 709 distinct fixtures (or matchups) of specific home and away teams. The number of matches covered varies from 1,447 in France to 1,808 in England. All matches that were played behind closed doors are excluded, i.e., in approximately empty stadiums, for whatever reason, including a few occurring toward the end of the sample period due to COVID-19, mostly in Italy. Spectators were not allowed to attend these games so it would not make any sense to include them in the analysis. Over the studied period, there was substantial variation in attendances in all five of the countries. Germany and England had the highest attendances on average, and these were also the two countries where matches were more likely to sell out in advance, with an implied excess demand (Cox, 2018). The variance of match attendances is highest in Spain. Stadium capacities rarely bind in Spain, Italy or French domestic football over this period.

Information on the numbers of daily confirmed cases from COVID-19 and related deaths was collected from ‘Our World in Data’ (ourworldindata.org/coronavirus-source-data). Figure 1 summarises these data, showing the pace of the outbreak in the five major European countries studied here and worldwide. These numbers relate to what had been recorded and published by midnight before the day listed. Hence they were public information by the time football matches kicked off on that same day, as well as being the most recent major news on the state of the outbreak available to spectators before they decided whether to go to a match.

3 Estimation

The relationship between the COVID-19 outbreak and football match attendances is estimated using a two-step strategy, applied individually to each country. This two-step approach is chosen to produce the most conservative standard errors, given that the COVID-19 information does not vary over the matches played in a country on the same day (see Donald & Lang, 2007 or Angrist & Pischke, 2009). It is also transparent with an unbalanced longitudinal dataset; home-team-away-team pairs, i.e., fixtures, occur infrequently and on different match days throughout the period. Variation over time in adjusted match day average attendances is used to identify the outbreak’s impacts on implied spectator demand.

In the first step, the following model is separately estimated for each country using least squares:

$$\ln(\text{Attendance}_{it}) = \alpha_i + \phi_{H(it)} + \beta_1 \text{HomeElo}_{it} + \beta_2 \text{AwayElo}_{it} + d_t + \varepsilon_{it} , \quad (1)$$

where i denotes the identity of the home and away team pair, i.e., Real Madrid C.F. playing at home against FC Barcelona, and t is the match day. Regressing the natural logarithm of the attendance in matches (1000s) on fixed effects for the identity of the fixture, α_i , addresses both the different typical stadium attendances of home teams, but also that some matchups generally attract more fans, such as when local rivals play one another. It is also possible that a home team has higher or lower attendances from one season to the next, perhaps because it is playing in a different stadium or has become more or less popular. Home-team-season fixed effects are included in Equation (1) to address this, $\phi_{H(it)}$, where $h = H(it)$ indicates the particular home team season. These two sets of effects may also partially address the role of the competitive intensity of matches (Kringstad & Gerrard, 2004, 2005), which has been shown to affect stadium attendance demand (e.g., Andreff & Scelles, 2015; Bond & Addesa, 2020; Valenti et al., 2020). The regression model also includes controls for the time-varying Elo ratings of the home and away teams, with corresponding coefficients β_1 and β_2 . Fans are likely to prefer watching their teams within any given season when they are doing well, either at home or away. d_t are match-day fixed effects, which provide measures of the average daily attendance at elite-level football in each country, adjusting for the nature of the matches that took place on the day through the fixture and home-team-season fixed effects, and the Elo ratings. The remaining heterogeneity in attendances is in the residual term, ε_{it} .

In the second step, the point estimates of d_t from the first step are used to estimate the following using least squares:

$$\Delta \widehat{d}_t = \gamma + \lambda_1 \text{NewDomestic}_t + \lambda_2 \text{NewWorldwide}_t + \phi' \mathbf{D}_t + \zeta_t , \quad (2)$$

where $\Delta \widehat{d}_t$ gives the day-to-day change in the adjusted average log attendance within a country. The coefficients λ_1 and λ_2 provide estimates of the log point change (approximate percentage change or semi-elasticity) in stadium attendances due to the additional daily domestic and worldwide confirmed cases (or deaths) of COVID-19, announced by midnight on the day prior to a match taking place. Day of the week fixed effects are added to the model in \mathbf{D}_t , to account for the general pattern of match-day attendances from, for example, Saturday to Sunday (see Goller & Krumer, 2020 for a description of how spectator demand for football varies throughout the week and how this can matter for match outcomes).

To adjust the average daily attendances, the estimation period chosen for the first step is the beginning of the 2015/16 season to the last matches played with spectators before the outbreak-induced shutdown in each country, at the beginning of March 2020. Importantly, this was before any major suppression measures were implemented by the national governments. The last rounds of league matches with spectators in all five countries were played before the nationwide lockdown in Italy on 10th March. Home and away team pairs that only appeared once in the sample period are excluded from the first step (e.g., all of Sheffield United’s fixtures in the English Premier League are excluded, as they were promoted in 2019 and had not played in the previous four seasons of the top league). In the second step, only the match-day fixed effect point estimates from the beginning of the 2019/20 season in August are used, i.e., $\hat{d}_{t \geq 1Aug2020}$, to cover the period of the global outbreak and to address the general pattern of attendances over weekdays. It is preferable to estimate the second step in first differences, with the daily change on the left-hand side and the number of new confirmed cases (deaths) over the previous day on the right-hand side, to address potentially spurious estimates if the time series are integrated. Exploiting this day-to-day variation in match-day attendances and the COVID-19 outbreak, while being more robust, reduces the sample size in the second step to just 42-49 consecutive two-day periods in each of the five countries. The second step is estimated using ordinary least squares as there is no significant evidence of heteroskedasticity.⁶

4 Results

Figure 2 displays for each country the point estimates of the adjusted average daily match attendances from the first-step regressions of Equation (1), \hat{d}_t , shown from January 2020. In the top-left, there appears to be no downward trend in match-day attendances in England after the first domestic COVID-19 case was confirmed in late January. There was a sharp drop in attendances on Saturday 15th February, but at this point there were only 9 confirmed cases in the UK, though this was only a few days after the World Health Organisation had officially named the virus. There was another marked drop in match-day attendances between 7th and 9th March, during the final round of fixtures played before lockdown was imposed. This was just after the first COVID-19 death was confirmed in the UK on 6th March, with two further deaths on 8th March. The patterns in France since January were more mixed, with more variance in the adjusted match-day attendances than in England. However, there appears to have been a slight downward trend in attendances from the middle of February to the end of the last match played in March. Germany also displays a lot of day-to-day variation, with no discernible trend

⁶A modified Breusch-Pagan test, where the squared residuals from the second step, Equation (2), are regressed on the inverse of the number of matches per match day, returns non-significant coefficient estimates for all countries (p -value > 0.1). Regardless, when estimated using weighted least squares, with the number of matches per match day as weights, all our main results are qualitatively unchanged (results available on request).

over the period of the outbreak, although there was a sharp drop in adjusted attendances on the final match day with fans present on 8th March. Italy also saw a substantial drop in adjusted attendances on its final match day in this period. There is a prevalent positive match-day spike in Figure 2 for Italy on 5th February. This was an outlier due to an unusually well-attended midweek game between SS Lazio and Hellas Verona F.C., possibly due to the home team being in Serie A title contention, with the potential of moving into second position and just two points behind the leaders with a win. However, it does not affect our second-step regression model estimates as there were no matches in Italy on either the day before or after. Finally, there is some suggestion of a downward trend in adjusted stadium attendances in Spain throughout February, but nothing else is especially distinctive in the bottom panel of Figure 2.

Going further than a descriptive analysis of patterns in adjusted match-day attendances, Table 2 shows in separate columns the second-step estimation results of Equation (2) for each of the five countries, beginning with confirmed new domestic and worldwide COVID-19 cases as the explanatory variables. In Italy (column IV), where the virus outbreak was initially more severe, attendances reduced by 13 log points (14%; p -value < 0.01) for each additional 100 domestic cases announced the day before. In England and Germany (columns I & III), attendances also had a negative 4 log point (5%; p -value < 0.05) and 11 log point (11%; p -value < 0.01) response to 100 new domestic cases, respectively. The equivalent responses in France and Spain were insignificant from zero (columns II & V). The lack of a response to the initial stages of the outbreak in these countries is somewhat puzzling. It is plausible, though impossible to confirm, that Spanish and French football fans responded to the domestic outbreak by anticipating that matches would soon be played behind closed doors, as was happening in Italy by the final round of league matches in those countries. As Figure 1 shows, these two countries were closer behind Italy than England and Germany in terms of how the outbreak was progressing. Only in France was there a statistically significant response to the number of new worldwide cases being confirmed on the previous day, with an attendance increase of 4 log points (4%; p -value < 0.05) for every additional 1,000 cases, partially offsetting the negative but insignificant effect of domestic cases. This stand-out result is hard to reconcile with any theory of risk-taking behaviour, and may be driven by something coincidental in the nature of the matches occurring toward the end of the sample period in France, which the first-step regression model did not account for. One potential explanation is that the competitive intensity of Ligue 1 at this time was driving increased spectator demand. By the time the French 2019/20 season was cancelled in March due to Covid-19, the nine teams in positions 5-13 were separated by just four points, with only ten rounds of matches remaining. This explanation would be consistent with Scelles et al. (2016), who found that French stadium

attendances are particularly sensitive to the potential prize of qualifying for the UEFA Europa League in positions 4-6.⁷

Table 3 shows an equivalent set of results to Table 2, using the numbers of COVID-19 related deaths on the previous day instead of confirmed cases as the explanatory variable in Equation (2). Again, only in France (column II) was there a significant match-day attendance response to the number of new worldwide deaths from the virus announced on the previous day. Germany had not experienced any domestic deaths from the virus by the last football match with spectators. The numbers of daily deaths from the virus were small and not yet consistent in England, France and Spain by the time their football seasons were halted, and there was no significant effects of these small numbers on stadium attendances in these two countries. In Italy (column IV), an additional domestic death confirmed the day before was associated with a substantial and significant 5 log point (p -value < 0.01) reduction in match-day attendances. In England and Germany, stadiums frequently sell out, implying excess demand. This makes it difficult to infer the true extent of the implied overall demand response to the COVID-19 outbreak from the estimates here. But sell outs are rare in Italy. Therefore, it is more reasonable to view the estimates from Serie A as capturing something of the true extent to which fans were deterred from going to the stadiums by negative news about the domestic virus outbreak.

As a caveat, if some of the attendance data used here reflect the number of tickets sold for matches rather than the seats actually filled on the day, which is likely, then the estimated responses to the outbreak here could be upper bounds.⁸ In other words, it is plausible that fans could have increasingly chosen not to use their advance purchased tickets during the outbreak, including season tickets, and that is not captured here. For example, the estimated negative attendance response in Germany from 100 new domestic cases was 11 log points (Table 2, column III). However, Schreyer et al. (2019) described how up to one in ten tickets sold in the German Bundesliga went unused in recent seasons. Further, fans in this league responded to the perceived increased risk to their safety after the major terrorist attack in Paris on 13th November, 2015, with increased no-show behaviour in the following weeks (Frevel & Schreyer, 2020). The German attendance data used here are more likely to reflect tickets sold rather than actual attendances than for the other countries.⁹ This suggests that there could have been a

⁷Teams only qualify for the UEFA Europa League by finishing in positions 5 and 6 if the winners of the two domestic cup competitions finished in the top four positions. There was a high likelihood in February and March of the 2019/20 season, that the dominant league leaders Paris Saint Germain F.C. would go on to win the two domestic cup competitions, which subsequently happened.

⁸The over-reporting of football stadium attendances has been widely in the media. (e.g., Ian Thomson in the Guardian, September 2017, “Football clubs should stop exaggerating their attendance figures”; <https://www.theguardian.com/football/2017/sep/28/football-clubs-leagues-attendance-figures-arsenal-celtic-mls>).

⁹The data used here from Germany frequently report round attendance numbers that reflect stadium capacities, such as 75,000 for Bayern Munich in practically every home game, and this tendency is more frequent than in the data from other countries.

more significant spectator demand response in Germany to the COVID-19 outbreak if it were possible to account fully for the numbers of people attending matches rather than the numbers of tickets sold.

5 Policy implications

The focus of this study has been on the impacts of COVID-19 on spectator demand for football. But the reality is that the reverse relationship is equally pertinent: what impact does professional football and live spectator sport have on the spread of the virus? Social distancing measures saw the end of fans in many stadiums in Western Europe from March 2020, as the pandemic was brought under control. There is some historical evidence that major sports events can have significant public health impacts. There is indicative evidence of heightened influenza infection rates from the 2002 Winter Olympics (Gundlapalli et al., 2006) and the 2006 FIFA World Cup (Schenkel et al., 2006). Even more convincing evidence was found by studying the annual National Football League Super Bowl. Using a differences-in-differences approach, Stoecker et al. (2016) found that cities in the United States which were represented in the Super Bowl had an 18% increase in influenza deaths. Nonetheless, part of understanding when to allow fans back into sports stadiums is knowing how far demand will be reduced by any ongoing risk of infection. In other words, if fans were allowed back tomorrow, will few enough actually turn up and congregate such that social distancing in the stadium, concourses and surroundings is practical?

The results here cast a shadow over the possibility that spectator sport will rebound even when social distancing measures are eased by governments. One argument is that there will be a pent-up demand effect, that could offset or even override the negative effects from any ongoing risk of COVID-19 infection. Two of the most sustained attendance increases in the history of English football came after the suspensions brought about by each World War (e.g., Dobson & Goddard, 1995). But this is a tentative parallel at best, as the results here show that in the initial stages of the European COVID-19 outbreak there were already substantial negative demand responses, suggestively because of the implied risk of infection, even when the significance of the disease and its implications were both being played down by politicians.¹⁰

¹⁰For example, the UK Prime Minister boasted of continuing to shake hands on 3rd March 2020 and was observed doing so on 9th March 2020; see The Guardian, 5th May 2020: <https://www.theguardian.com/politics/2020/may/05/boris-johnson-boasted-of-shaking-hands-on-day-sage-warned-not-to>

The elite European football clubs represented in this study are likely to survive the outbreak financially, given their access to substantial funds besides match-day gate receipts.¹¹ But professional football below that level still largely relies on getting the fans in on match days. By forensically studying the 2018/19 accounts of professional football clubs in England and Wales, [Szymanski \(2020\)](#) has found that the majority of these firms were already on the verge of insolvency before the loss of revenues and write-down of assets, i.e., player valuations, due to COVID-19.¹² Our results here imply that clubs will likely face substantial ongoing losses even after they can fully re-open their stadiums, since spectator demand will be decreased so long as there is a continued risk of becoming infected at matches.

Given the suggested reluctance of fans to return to football stadiums when social distancing measures are relaxed, clubs may have to become especially flexible and agile with dynamic ticket pricing to begin with, until they understand how their customer base has altered, learning from the studies of when this has been applied by sports organisations in the past (e.g., [Shapiro & Drayer, 2012, 2014](#), and specifically for football, [Kemper & Breuer, 2016](#). See also [Soebbing, 2019](#), for a survey on the economics of sports ticket pricing). [Kemper & Breuer \(2016\)](#) showed that ticket prices for home fixtures at Derby County F.C., a team in the second tier of English football, systematically increased over time from a base starting price as the stadium filled up to a matchday. This suggests that football fans are myopic. With potentially restricted stadium capacities when crowds are allowed back into stadiums post COVID-19, clubs could look to exploit the tendency of their fans to buy tickets late by significantly increasing prices in the days leading up to matches.

In a world with social distancing and people who are concerned about the risks of catching or passing on COVID-19, teams could also look toward group ‘friends and family’ ticketing. If the restrictions imposed by authorities involve minimum distances between numbers of households in public spaces, then group price discounts may increase revenue by filling a greater proportion of seats. We found little evidence on the extent to which elite football clubs already apply family discounts, but [Clowes & Clements \(2003\)](#) found that they were rare over two decades ago in the English Premier League, suggesting that clubs saw little added value in them. COVID-19 may change this.

With reduced capacities, some clubs will have to decide who among their supporters should be offered seats first. For two reasons, it is clear that they should prefer longstanding season

¹¹ See the Deloitte Football Money League 2020 report for estimates of the dependence of top European football clubs on gate receipts and related revenues;

<https://www2.deloitte.com/bg/en/pages/finance/articles/football-money-league-2020.html>

¹² This research was presented at the Reading Online Sport Economics Seminars (ROSES) on 17 April 2020. See here for a public recording:

https://www.youtube.com/watch?time_continue=4006&v=viPqe93rW2c&feature=emb_logo

ticket holders. First, clubs should want to protect the loyalty of these customers (see [Schreyer et al., 2018](#), for evidence on the determinants of stadium attendance by season ticket holders). Second, these supporters are likely to have higher willingness to pay (e.g., [Simmons, 1996](#)), and thus clubs could generate greater revenues from this group.

Besides matchday ticketing strategies, clubs may have to find more innovative ways of raising revenue with their stadiums. For example, one particularly innovative club in England has erected a screen on its pitch to show new and classic films as a drive-in cinema - though the groundsman was probably not too pleased about it.¹³

It is likely that if the present structures of professional football are to survive, then some degree of consolidation will be required in response to the crisis caused by COVID-19. [Szymanski \(2020\)](#) notes that this is particularly the case since much of football club debt is owed to other clubs. He suggests that consolidation should involve assigning all future broadcast rights to a collective fund, from which those unable to collect unpaid debts can make claims, including delayed transfer fees and player wages. In other words, the only way to save the professional football pyramid today is to leverage the future value of football after COVID-19.

6 Concluding remarks

This paper provides an analysis of the initial impact of COVID-19 on the demand for attending elite-level football matches. There were negative impacts on revealed spectator demand in Italy, England and Germany during the initial outbreak in Europe, though only in response to the domestic outbreaks rather than the emerging worldwide picture. In France and Spain, there was no statistically significant response to the respective domestic outbreaks. There were significant positive effects of global cases and deaths in France, though we speculate that this was driven by the coincident demand effects of how competitive the Ligue 1 season was in February and March 2020.

Turning to future research, the nature of the reporting of the virus, and of football, affords a more thorough regional demand and response analysis to the outbreak, that may even guide policy makers in managing suppression measures going forward. But applying these results too far beyond the initial outbreak period would be speculative because, if nothing else, a pent-up demand effect might be expected once football matches and other public events resume. It would also be interesting to compare results from football to other frequent and major sports events in Europe over the same period, such as basketball games. A similar analysis of

¹³BBC Sport, 22nd May 2020: <https://www.bbc.co.uk/sport/football/52680375>

the H1N1 ‘Swine Flu’ outbreak of 2009 in Europe may also demonstrate how general these responses are, though that outbreak was substantially less lethal. Finally, more detailed data might allow a comparison of whether these patterns are driven by season-ticket holder no shows or more casual fans staying away from the stadiums, with potentially different management implications in either case. Though such data are difficult to come by, recent studies of German professional football have shown that making such a distinction can reveal novel patterns in fan behaviour (Schreyer & Däuper, 2018; Schreyer et al., 2016, 2019).

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TABLE 1: Summary statistics over football matches, 2015/16-2019/20

	Mean	St. Dev.	Min.	Median	Max.
English Premier League					
Attendance (1000s)	37.5	16.4	10.0	32.0	83.2
Home Elo rating	1153	124	855	1129	1548
Away Elo rating	1147	121	871	1119	1552
<i>N</i> of (home) teams			29		
<i>N</i> of home-away team pairs			709		
<i>N</i> of matches			1,808		
French Ligue 1					
Attendance (1000s)	22.0	12.8	1.1	17.6	65.4
Home Elo rating	1115	109	847	1102	1465
Away Elo rating	1110	106	858	1090	1436
<i>N</i> of (home) teams			27		
<i>N</i> of home-away team pairs			642		
<i>N</i> of matches			1,791		
German Bundesliga					
Attendance (1000s)	42.9	17.7	13.2	41.5	81.4
Home Elo rating	1087	105	867	1075	1432
Away Elo rating	1083	103	824	1068	1400
<i>N</i> of (home) teams			24		
<i>N</i> of home-away team pairs			496		
<i>N</i> of matches			1,447		
Italian Serie A					
Attendance (1000s)	24.2	14.2	0.5	19.8	79.2
Home Elo rating	1140	125	829	1114	1498
Away Elo rating	1138	126	857	1110	1470
<i>N</i> of (home) teams			28		
<i>N</i> of home-away team pairs			661		
<i>N</i> of matches			1,768		
Spanish La Liga					
Attendance (1000s)	27.6	19.3	3.3	19.9	99.2
Home Elo rating	1143	119	897	1123	1471
Away Elo rating	1142	121	896	1119	1476
<i>N</i> of (home) teams			27		
<i>N</i> of home-away team pairs			648		
<i>N</i> of matches			1,787		

Notes.- statistics are calculated over all matches in the top domestic leagues of England, France, Germany, Italy, and Spain since the beginning of the 2015/16 season. Excludes matches with no spectators, i.e., played 'behind closed doors'. Source.- worldfootball.net; accessed 14 March 2020.

TABLE 2: Second step regression model estimates: effects of the previous day's COVID-19 new confirmed cases on log stadium attendances in elite-level European football, 1st January to 9th March 2020

	England (I)	France (II)	Germany (III)	Italy (IV)	Spain (V)
Dependent variable: day-to-day change in adjusted log stadium attendance[†]					
New domestic cases (100s)	-0.045** (0.021)	-0.062 (0.076)	-0.108*** (0.050)	-0.132*** (0.045)	0.083 (0.111)
New worldwide cases (1000s)	0.001 (0.001)	0.042** (0.018)	0.005 (0.011)	-0.003 (0.005)	-0.009 (0.029)
Day of the week fixed effects	Yes	Yes	Yes	Yes	Yes
N of consecutive match days	45	49	43	42	49

[†] Point estimates of daily fixed effects from the first-step regression models as per Equation (1), with log match attendance as the dependent variable and controls for the Elo ratings of both the home and away teams, as well as home & away team pair (fixture) and home-team-season fixed effects. First step estimated over matches since the beginning of the 2015/16 season. First-step Ns: England, 1,567; France, 1,638 ; Germany, 1,337; Italy, 1,558; Spain, 1,650. Excludes games played behind closed doors.

***, **, * indicate significance from zero at 1% and 5% levels, respectively, two-sided tests, robust standard errors are displayed in parentheses.

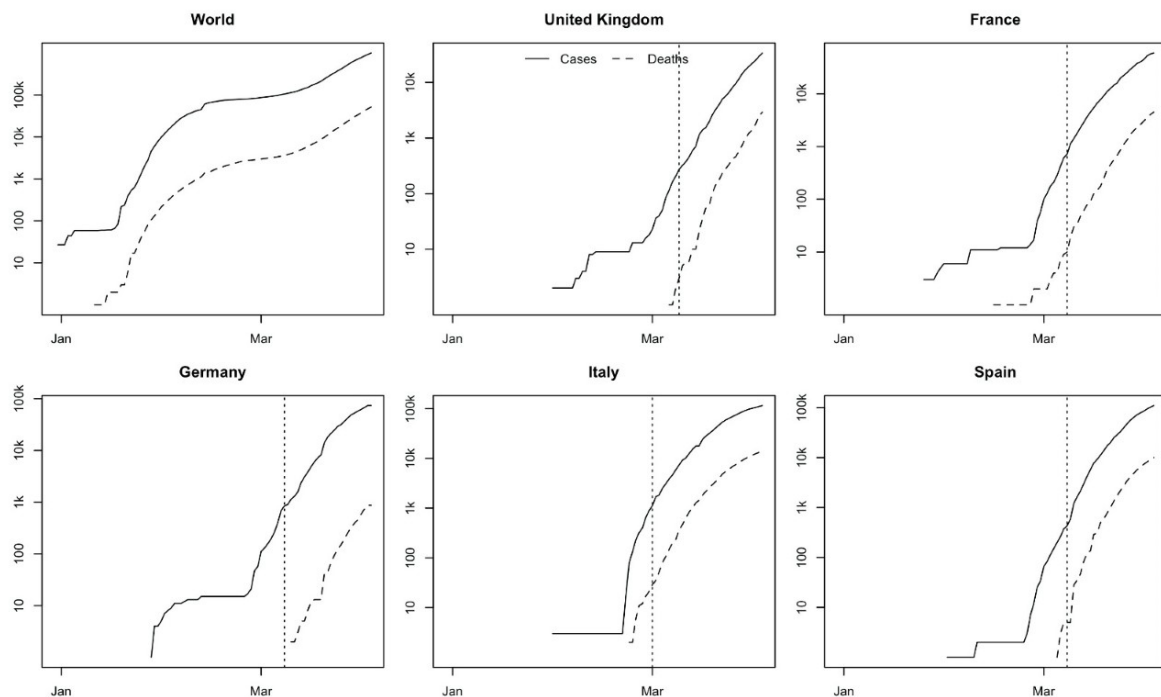
TABLE 3: Second step regression model estimates: effects of the previous day's COVID-19 new **deaths** on log stadium attendances in elite-level European football, 1st January to 9th March 2020

	England (I)	France (II)	Germany (III)	Italy (IV)	Spain (V)
<i>Dependent variable: day-to-day change in adjusted log stadium attendance</i> [†]					
New domestic deaths	-0.018 (0.018)	0.002 (0.026)		-0.051 ^{***} (0.006)	0.017 (0.036)
New worldwide deaths (100s)	-6×10^{-5} (0.018)	0.114 ^{***} (0.048)	0.021 (0.029)	0.046 (0.073)	0.028 (0.062)
Day of the week fixed effects	Yes	Yes	Yes	Yes	Yes
N of consecutive match days	45	49	43	42	49

[†] See Table 2.

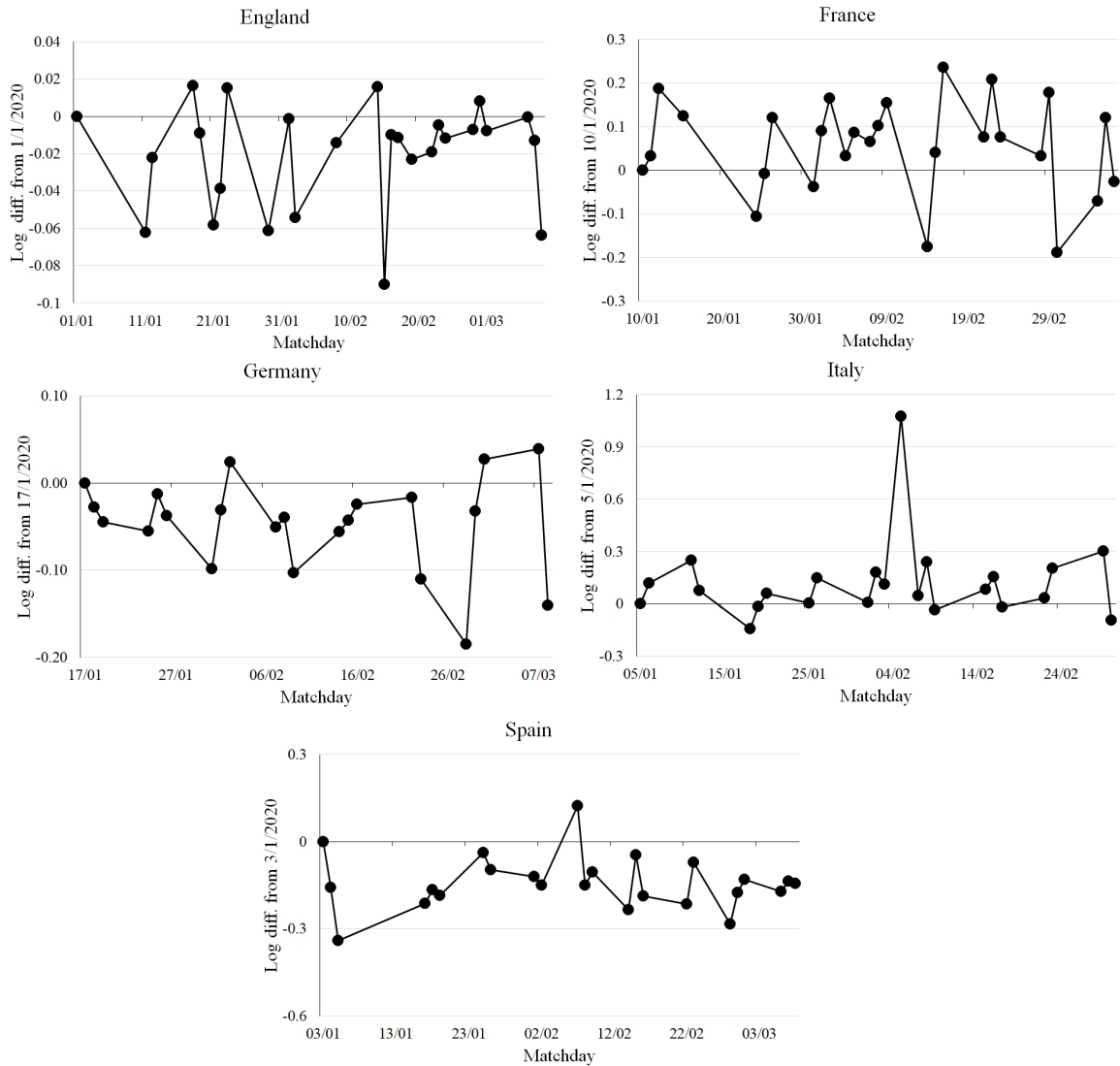
***, **, *, indicate significance from zero at 1% and 5% levels, respectively, two-sided tests, robust standard errors are displayed in parentheses.

FIGURE 1: Total numbers of confirmed cases and deaths from COVID-19, January to April 2020



Source.- ourworldindata.org/coronavirus-source-data; accessed 3 April 2020, vertical dashed lines denote the final football match played in front of spectators in the top league of each respective country (1st March in Italy, 8th March in France, Germany and Spain and 9th March in England).

FIGURE 2: Adjusted average daily attendances in top football leagues, February to March 2020



Source.- author calculations using data from worldfootball.net. Figures give the point estimates of \hat{d}_t from the first-step regression of Equation (1). Interpretation: the log difference in adjusted daily match-day attendances from the first date shown.