

STRATHCLYDE

DISCUSSION PAPERS IN ECONOMICS



DOMESTIC VIOLENCE AND FOOTBALL IN GLASGOW: ARE REFERENCE POINTS RELEVANT?

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No. 13-01

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Domestic Violence and Football in Glasgow: Are Reference Points Relevant?*

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December 19, 2012

Abstract

Much research suggests that sporting events can trigger domestic violence with recent evidence suggesting that pre-match expectations (which can be interpreted as reference points) play an especially important role in this relationship. In particular, unexpectedly disappointing results have been associated with large increases in domestic violence. This paper contributes to this literature using a new data set containing every domestic violence incident in Glasgow over a period of more than eight years. We find that Old Firm matches, where Glasgow rivals Celtic and Rangers play, are associated with large increases in domestic violence (regardless of the timing or the outcome of the match). Non-Old Firm matches tend to have little impact on domestic violence. Furthermore, we find little evidence for the importance of reference points. Matches with disappointing outcomes, relative to pre-match expectations, are found to be associated with unusual increases in domestic violence only in a very limited set of matches.

Key words: domestic abuse; Scottish football; Old Firm; reference points; loss aversion.

JEL classification: D03; J12.

1 Introduction

It is clear that there is a link between professional sport and spectator violence. The most visible and notorious example of this is displayed in the behaviour of

*We would like to thank Deborah Barton, Bob Hamilton and Martin Smith from Strathclyde Police and Lilian Liesveld and Mhairi McGowan from ASSIST (Advocacy, Support, Safety, Information Services Together) Glasgow, without the support of whom and provision of data this research would not have been possible. We would also like to thank Rodney Strachan for his valuable comments.

the football hooligan (see [Burford \(1991\)](#)). The heyday of football hooliganism was at its peak in the 1970's and 1980's, although it still persists at a significant level throughout the world today. While hooliganism represents a major social problem, it is to a large extent easy to understand within the context of the sporting contests that provide its platform. Competition between teams creates spectator rivalry that spills over into violent conflict. In recent times, an arguably more perplexing manifestation of violence related to professional sport has been highlighted and has been attracting attention from the media, public policy makers and academics. This is the relationship between domestic violence and professional sport. It is more perplexing than hooliganism in that the violence is not committed in public against rival fans as an extension of the on field rivalry. Rather, the violence is committed behind closed doors against spouses and partners.

Perhaps the most high profile example of the link between domestic violence and football is in Glasgow and relates to the intense traditional rivalry between the 'Old Firm' of Celtic and Rangers. After an Old Firm match on Sunday September 18, 2011, domestic violence incidents in Glasgow more than doubled compared to a football free Sunday. This huge spike received widespread media attention which also drew attention to the fact that domestic violence incidents are always substantially higher when Celtic play Rangers.¹ In March 2011, the Scottish Government, the police and the Scottish football community formed the Joint Action Group (JAG) to '*protect the good reputation of Scottish football and to contribute positively to efforts to tackle wider social issues – in particular alcohol misuse, violence and bigotry.*' Tackling domestic violence/abuse was a centrally stated objective of the JAG report.² At its simplest, it seems that attendance at a football match, watching the match in the pub, or indeed watching the match at home, acts as an emotional cue that results in an increased likelihood of domestic violence taking place. In this paper we remain agnostic about the psychological mechanism through which football causes domestic violence, but instead focus on the relationship between the particular characteristics of football matches and variation in the level of domestic violence.³

Academic attention towards domestic violence and professional sport has come in the form of [Card and Dahl \(2011\)](#). They conduct a study for the US and consider the link between domestic violence and American football. What

¹See 'Domestic abuse incidents double after Old Firm match', *Daily Record*, September 19, 2011; 'Domestic abuse incidents double after Old Firm game', *The Telegraph*, September 20, 2011; 'Warning over huge rise in Old Firm domestic abuse', *The Herald*, September 20, 2011.

²See <http://www.scotland.gov.uk/Resource/Doc/925/0123798.pdf> for the Joint Action Group Progress Report, December 2011.

³For a discussion of the psychological mechanisms that lead to domestic violence, see [Finkel \(2007\)](#) who distinguishes clearly between impelling and inhibiting mechanisms.

distinguishes this study as economics rather than sociology? The relationship between their study and economic theory is that they provide evidence for the existence of a rationally expected reference point. The literature on reference points emerged from the explosion in behavioural economics following [Kahneman and Tversky \(1979\)](#)'s presentation of prospect theory. A key aspect of this theory is loss aversion. Losses matter more than the same sized gains around a reference point. [Kőszegi and Rabin \(2006\)](#) develop this theory so that it is applicable to situations where the reference point is not clearly defined by a status quo. Rather, it is defined with regard to rational expectations. [Card and Dahl \(2011\)](#) investigated whether domestic violence in cities in the US was associated with the features of the outcome of (American) football games involving the 'home' team. Their hypothesis was that fans form expectations of their team's performance in a game that can be proxied by the pre-game betting odds, and evaluate the outcome of the game relative to those expectations. Whilst they find that there is no increase in domestic violence associated with expected losses (or indeed a decrease in domestic violence associated with expected wins) when a team loses unexpectedly there is around a 10% increase in domestic violence (but no associated reduction in domestic violence for unexpected wins). This suggests that experiencing a loss relative to expectations provides fans with an emotional cue that causes them to commit greater than average levels of domestic violence. The effect is larger the more salient the game. Salience is defined as games where the team in question is still in playoff contention, is playing a traditional rival or the game is controversial in terms of sacks, penalties or turnovers.⁴

There is a growing body of convincing evidence that decision makers exhibit loss aversion: the reduction in utility from a loss relative to a reference point is larger than the gain in utility from an equivalent-sized gain. A well-documented example of loss aversion is the endowment effect in which the payment required to sell an item is larger than the willingness to pay (see, for instance, [Kahneman et. al. \(1980\)](#), [Kahneman et. al. \(1991\)](#) and [List \(2004\)](#)). Other recent applications consider auctions ([Rosenkranz and Schmidt 2007](#)), the housing market ([Genesove and Meyer 2001](#)) and labour supply (following the work of [Camerer et. al. \(1997\)](#)). Thinking of a decision maker's total utility as being a weighted average of 'consumption utility' and 'gain-loss utility', the evidence in favour of loss aversion suggests that the gain-loss component has significant weight in total utility. Loss aversion, however, is not a ubiquitous phenomenon: in some decision-making environments loss aversion may not be exhibited (see, for example, [Novemsky and Kahneman \(2005\)](#), [List \(2004\)](#) and [Tversky and Kahneman](#)

⁴Earlier work on American football and violence by [Gantz et. al. \(2006\)](#) and [Rees and Schnepel \(2009\)](#) does not investigate the potential role of reference points.

(1991)). In their study of the labour supply decisions of New York city cab drivers, Crawford and Meng (2011) found that whether behaviour consistent with loss aversion around an expected earnings reference point will be observed depends on whether or not a target level of hours has already been reached (see also Farber (2008), Farber (2005) and Camerer et. al. (1997)). It is not inconceivable in general that the manifestation of loss aversion, i.e. the weight with which gain-loss utility enters the total utility equation, might be dependent on the *context* of the decision making environment.

In a paper highly relevant to the study conducted here, evidence for a relationship between professional sport and reference points is found in Priks (2010) study of unruly fan behaviour (in the form of throwing objects on to the pitch) in Sweden. He uses league positions as a reference point and finds that the unfulfilled expectation of a good performance leads to a significant increase in object throwing rather than bad performance *per se*. Card and Dahl (2011) likewise find an unambiguous relationship between upset losses and increased levels of domestic violence. These works suggest that the total utility of fans in these leagues is heavily influenced by gain-loss utility. In contrast, for matches involving Celtic and Rangers in the Scottish Premier League we find very little evidence that supports the dependence of preferences on a reference point. We do not question the notion that fans form expectations and judge outcomes relative to those expectations, but we hypothesise that the weight with which gain-loss utility enters total utility depends on the context of the environment, and in the Scottish Premier League in which there is an intense local rivalry this weight is very low. Card and Dahl (2011)'s conclusion that upset losses are associated with spikes in domestic violence was specific to American football, but our analysis and hypothesis suggest that such conclusions should be applied to different sporting contexts with caution.

A way to organise how we might think about the relationship between domestic violence and football matches is to split the aspects of the match into three parts; (1) the existence of the match; (2) the context of the match and (3) what happens during the match. The existence of the match is likely to matter more if the competing teams are traditional rivals. The context of the match can refer to a number of factors such as; the day of the week it is played; whether it is played during a public holiday; the time the match kicks off; whether the match matters in terms of determining important league outcomes and whether the match is broadcast live on television. What happens during the match could refer to whether the match is controversial in terms of, for example, red cards, dubious refereeing decisions, big swings in result during the second half compared to the first half and crucially, given the Card and Dahl (2011) study, whether the outcome of the match was unexpected.

The study we have conducted here follows the approach of [Card and Dahl \(2011\)](#) very closely. Data was supplied by Strathclyde police for all domestic violence incidents in Glasgow from January 1st 2003 until 5th October 2011. This can also be disaggregated into police subdivisions within Glasgow. This is potentially useful because it may allow us to more closely identify areas which are more likely to be Celtic or Rangers strongholds. The historical pre-match odds for the matches involving the two teams are freely available on the web and we can classify whether the subsequent results deviated from the rationally expected reference point. We control for key factors (to be discussed later) and our key finding is that the traditional rivalry between the two teams is the main explanatory variable for domestic violence with regard to its relationship to football. We find very limited evidence for loss aversion with a rationally expected reference point. The exception to this is in ‘important’ games at the very end of the season where the league title is still up for grabs, but the effect is lost if we extend the definition of importance to include games further back into the season. In contrast, [Card and Dahl \(2011\)](#) found evidence of an upset loss effect in all games where the team is still in playoff contention, which accounts for 68% of the games in their sample (but not in games where the team is no longer in playoff contention). It is also unclear whether winning or losing (against each other) makes any difference to the act of engaging in domestic violence. Violence increases in response to Old Firm matches across all subdivisions regardless of the result. This relates to a finding in [Card and Dahl \(2011\)](#) which they admit does not conform to reference point theory. They find that in games between traditional rivals there is a marginally significant increase in violence following an upset win.

One message that can be taken from this paper is that the relationship between professional sport and violence found by [Card and Dahl \(2011\)](#) is perhaps not easily extended to other sports settings in different locations within the world. This is not surprising if one considers sports such as rugby union where spectator violence is virtually non-existent; but it does seem surprising in the context of the Old Firm where violence has been a persistent problem and of such recent concern that it triggered the JAG mentioned earlier. Our initial expectation was that we would find significant increases in domestic violence in response to unexpected losses. We can only speculate as to why we find such limited evidence for a reference point effect for domestic violence and football in Glasgow. One story might be that the traditional rivalry to which [Card and Dahl \(2011\)](#) refer in the context of American football is small compared to that between Celtic and Rangers. It is not unreasonable to argue that it is the most intense sporting rivalry in the world (see the opening chapter in [Wilson \(2012\)](#) where he compares the Old Firm to other famous football rivalries). It combines

the rivalry of a city derby alongside a sectarian divide between Celtic identified with Catholicism and support for Irish Nationalism and Rangers identified with Protestantism and support for Ulster Unionism. This combination of city, religious and political rivalry provides for an intensified emotional cocktail. Perhaps in the case of this Glasgow rivalry, the emotional salience surrounding this fixture is so intense (reflected in domestic violence), that the negative emotions that [Card and Dahl \(2011\)](#) find for unexpected defeats in the case of American football (reflected in domestic violence) are negligible (or at least, insufficient to trigger domestic violence) in the case of unexpected defeats for the Old Firm. The emotional investment manifest in the deeply ugly expression of domestic violence is reserved almost exclusively for the matches played against each other.

In 2012, following a tax dispute with Her Majesty's Revenue and Customs (HMRC) Rangers became insolvent and entered administration. Subsequently, after a failure to reach agreement with creditors, the club was forced to relaunch and begin life in the fourth league tier of Scottish football. Assuming there is no change to the way the leagues are structured in Scotland, it will take Rangers at least three years to return to the Scottish Premier League (SPL) and regular league fixtures against Celtic. One message to emerge from this paper is that we should expect to see a major fall in domestic violence incidents in Glasgow due to the absence of the Old Firm fixtures, so long as the two clubs do not transfer the intensity of this traditional rivalry to another club. Given the deep history of the Old Firm rivalry this would seem very unlikely. The predicted reduction in domestic violence is a side-benefit of the very costly demise of Rangers. From a policy perspective, policy-makers and agencies have potentially three years to think about approaches to eliminate the link between Old Firm matches and domestic violence. Given the positive effect to Scottish football and the economy ([Allen et. al. 2007](#)) of Old Firm matches, ideally a way can be found to help minimize domestic violence as a scar upon these matches.

2 Data

Our data on domestic violence was obtained from Strathclyde Police which is responsible for the region of Strathclyde, populated by some 2.3 million inhabitants, covering an area of 13,624 km² and containing the city of Glasgow with a population of approximately 600,000.⁵ The data contains, for each of Strathclyde Police force's 30 subdivisions⁶ the number of incidents of domestic violence recorded on each day between 1st January 2003 and 5th October 2011

⁵These details came from http://en.wikipedia.org/wiki/Strathclyde_Police and <http://en.wikipedia.org/wiki/Glasgow>, accessed 14/11/2012.

⁶Details on the subdivisions of Strathclyde Police can be found in Appendix A.

(a total of 3200 days). Our data is thus a panel with 30 police subdivisions and 3200 days. *All* incidents of domestic violence recorded by Strathclyde Police are included in the data, whether the incident resulted in a crime being committed or not and whether or not the perpetrator was male.⁷ So that we are able to associate domestic violence incidents in the early hours of the morning with events that took place the day before we constructed the data so that a day in our sample period runs from 12noon on the day in question until 11.59am the following day.

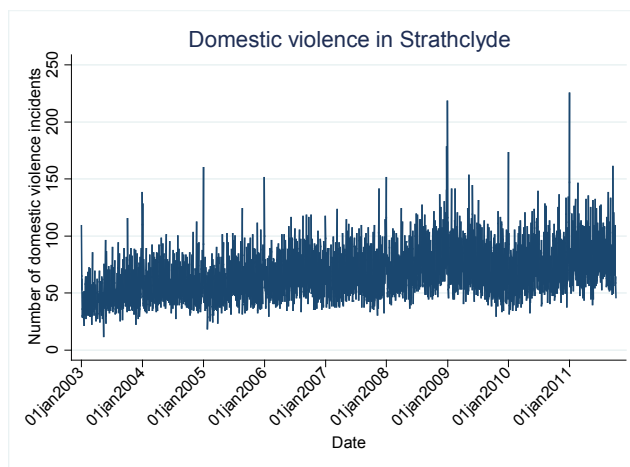


Figure 1: Domestic violence in Strathclyde as a whole.

Figure 1 plots the data on domestic violence in Strathclyde as a whole over the sample period (aggregated across subdivisions), and Table 1 presents the summary statistics for the data for various types of days in the sample period. As is evident, there is a general upward trend in the number of domestic violence incidents reported,⁸ and there is considerable variation in the number of incidents of domestic violence across days of the week with a greater number of domestic violence incidents on average at the weekend, as one would expect. There is also a sharp rise in domestic violence around Christmas and New Year. In Table 1 we also include the level of domestic violence when Celtic and/or Rangers are engaged in football matches. These summary statistics tell us two things: a) the fact that domestic violence incidents increase on days when Celtic or Rangers play suggests the need for further investigation of the source of this

⁷The data include occasional incidents that were recorded as occurring somewhere other than in the home. However, since the incident reported is domestic violence (not general assault) we expect these incidents to occur in the vicinity of the home and will, in particular, not taint the pattern of domestic violence between police sub-divisions.

⁸This may be due to increased awareness or better reporting methods and not necessarily due to an increase in the number of incidents.

increase; and b) when investigating this it is important to control for year, day of the week and Christmas holiday effects.⁹

	No. Obs.	Mean	Standard Deviation	Min	Max
All days	3200	64.46	22.0	12	225
Mid-week	1829	53.06	13.76	12	218
Friday	457	81.20	17.96	34	225
Saturday	457	93.49	19.00	46	178
Sunday	457	64.34	17.80	23	161
Xmas/NY	91	90.32	34.82	45	225
2003	365	48.70	16.63	12	138
2004	366	56.25	17.19	28	160
2005	365	57.58	18.04	19	151
2006	365	63.64	18.61	30	118
2007	365	64.10	19.83	31	151
2008	366	72.48	22.05	37	218
2009	365	71.35	23.00	30	173
2010	365	69.94	22.99	32	225
2011	278	79.81	22.82	40	161
Celtic plays	328	79.98	24.18	35	178
Rangers plays	329	81.61	24.92	35	178

Table 1: Summary statistics for the number of domestic violence incidents in Strathclyde as a whole. ‘Mid-week’ incorporates Monday through Thursday inclusive. The Xmas and New Year holiday is defined as 24th December to 3rd January inclusive. Note that our sample finishes part way through 2011.

We collected data on all Scottish Premier League (‘SPL’) football matches that involved either Celtic or Rangers during the sample period¹⁰ from the information that is freely available on the Web.¹¹ Each year the SPL season runs from August to May. There are 12 teams in the league. The league has an unusual structure in that the year is divided into two parts. In the first part, each team plays each other 3 times. In the second, the league splits into upper and lower sections consisting of 6 teams in each. Teams then proceed to play one further game against each team in their section. This provides a total of 38 games in a league season. There are no playoffs in the SPL. Teams receive 3 points for a win, 1 point for a draw and no points if they lose, and the team that accumulates the most points after 38 matches wins the league. There is relegation from the SPL each season and this explains why there are 18 teams in the data set.

For each season all matches that took place in the season are listed along with several details of the match: the ‘home’ and ‘away’ teams, the half-time and full-time results and some information about the match (such as the number

⁹Initial examination of the data suggested that Monday through Thursday have similar levels of domestic violence and, hence, can be grouped into one mid-week category. Furthermore, after controlling for the Christmas holiday period there is no evidence of monthly effects which are, therefore, not included.

¹⁰We restrict our attention to league matches and do not include any Cup fixtures in our data.

¹¹We used the website <http://www.football-data.co.uk> to collate this data.

of fouls and the number of ‘bookings’). In our sample, Celtic played 328 games and Rangers played 329 games.¹² 35 of these are the Old Firm matches where Celtic and Rangers play each other. Of the Old Firm matches in the sample, Celtic won 17, Rangers won 13 and there was a draw on 5 occasions. Of the other matches played, Celtic won 222, drew 43 and lost 28, and Rangers won 213, drew 53 and lost 28.

The two teams under consideration are generally the dominant teams in the SPL; this is reflected both in the fact that either Celtic or Rangers won the league in all years in our sample, and in the betting odds. Information on pre-match betting odds offered by a number of bookmakers for a home win, a draw, and an away win is included in the football data. The betting odds are available for around 10 bookmakers for most of the sample,¹³ and from the quoted decimal odds we calculate the average (across all available bookmakers) pre-match probability that Celtic and Rangers will win each match they play during the sample period. Figures 2 and 3 plot the probability of winning for Celtic and Rangers respectively for each match against each of the 18 teams in the SPL.¹⁴ The probability of each team winning the matches they are engaged in suggest that when Celtic and Rangers play each other (Celtic is team 2 and Rangers is team 16) the match is invariably predicted to be close, and when they play other teams there is a mixture of matches where the outcome is predicted to be close or the team is predicted to win.

3 Econometric Methods

We have a panel data set where observations on our dependent variable (number of domestic violence incidents) differ across time and subdivision. However, our explanatory variables (e.g. results of football matches, day of week dummies, etc.) do not vary across subdivisions. This fact means that a regression model using data for Strathclyde as a whole will be equivalent to a fixed effects panel data model (and virtually equivalent to random effects panel data models) using data at the subdivision level. Accordingly, our main results use count data regression models where the dependent variable is the number of domestic violence incidents in Strathclyde as a whole. In a subsequent section, we present some results for a mixed effects model using data at the subdivision level. The mixed effects model allows for coefficients to vary across subdivisions, which will allow

¹²Our sample period starts and stops during the season.

¹³Some bookmakers are not quoted for later dates in the sample, but there are others that only appear later in the sample.

¹⁴We have coded the teams that play or have played in the SPL in the sample period as 1=Aberdeen, 2=Celtic, 3=Dundee, 4=Dundee United, 5=Dunfermline, 6=Falkirk, 7=Gretna, 8=Hamilton, 9=Hearts, 10=Hibernian, 11=Inverness [C], 12=Kilmarnock, 13=Livingstone, 14=Motherwell, 15=Partick, 16=Rangers, 17=St Johnstone, 18=St Mirren.

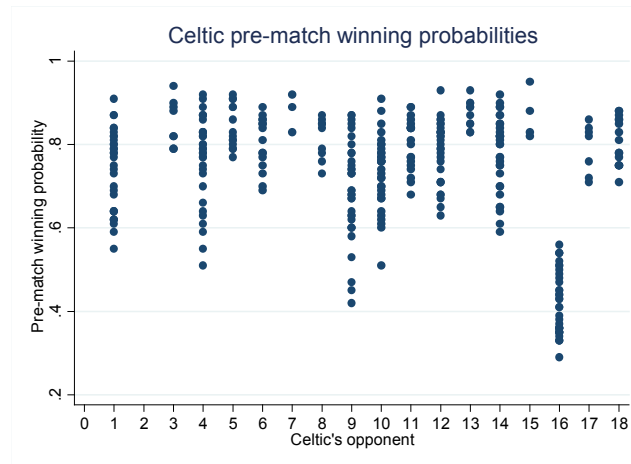


Figure 2: Pre-match average probability of Celtic winning.

us to identify differential effects across the Strathclyde region resulting from the features of matches in which Celtic and Rangers are engaged. Since we have count data we use Poisson versions of each model.¹⁵ As noted below (see also Appendix B), results using a negative binomial model are virtually the same as Poisson results using aggregate data.

4 Factors to Explain Levels of Domestic Violence

In the context of football and domestic violence it is hypothesised that fans engaging with a football match involving their preferred team receive an emotional cue which, whilst unrelated, influences their subsequent decision of whether to engage in domestic violence. The presence of this emotional cue is determined by whether a football match involving the fan’s preferred team takes place or not; its strength may depend on a number of factors related to the context of the match and what happens in the match. We turn next to discuss the explanatory variables we use to identify games and distinguish between different types of game that might provide stronger emotional cues and so contribute to explaining the level of domestic violence.

We classify each day in our sample as falling into one of the four categories: neither Celtic or Rangers play; only Celtic plays; only Rangers plays; both Rangers and Celtic play. We further delineate the latter category into those

¹⁵We use Stata’s `poisson` and `xtmepoisson` commands. Relevant formulae are provided on page 405 of Stata’s Longitudinal/Panel Data Reference Manual (Release 12).

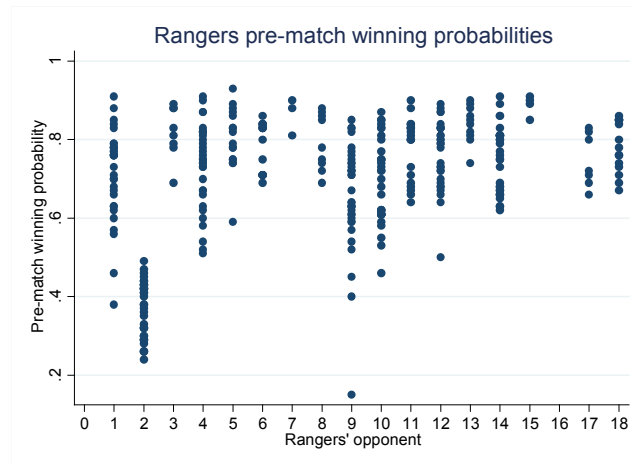


Figure 3: Pre-match average probability of Rangers winning.

days where Celtic and Rangers both play but do not play each other (`candr`), and those days where there is an Old Firm match and they do (`oldfirm`). The explanatory variables listed in Table 2 are used in the analysis to distinguish between types of days. This allows the effect associated with the traditional Old Firm rivalry to be identified after controlling for any effect that arises from both teams being engaged in football matches on the same day, as well as identifying any change in domestic violence associated with either Celtic or Rangers playing when the other team does not.

Variable	No match	Only Celtic	Only Rangers	Celtic & Rangers	Old Firm
<code>conly</code>	0	1	0	0	0
<code>ronly</code>	0	0	1	0	0
<code>candr</code>	0	0	0	1	1
<code>candr</code>	0	0	0	1	0
<code>oldfirm</code>	0	0	0	0	1

Table 2: Variables that identify different types of match day.

Two potentially important factors in explaining levels of domestic violence are whether the match is played ‘at home’ and whether the match is televised. All Old Firm matches take place in Glasgow either at Celtic Park or at Ibrox (Rangers’ home stadium), but other matches might be played either at the home ground or elsewhere in Scotland.¹⁶ To control for Celtic and Rangers playing at home in non-Old Firm matches we define the variables `c(r)home` that take the

¹⁶Since there are other teams based within the region, ‘away’ games may be within Strathclyde. We do not take special account of the fact that Partick (a less competitive team that was not part of the SPL for some of the sample due to relegation) is also based in the city of Glasgow.

value 1 if Celtic (Rangers) are playing at home in a *non*-Old Firm match (and are zero otherwise). During the sample period 49% of Celtic’s matches were played at Celtic Park, and 50% of Rangers’s matches were played at Ibrox.

If football matches are not televised live then the fan base engaged with football is potentially reduced and one might expect the level of domestic violence associated with non-televised matches to be lower.¹⁷ While all Old Firm matches are televised, the same is not true of other league matches. To account for this we define the variables $c(r)tv$ that take the value 1 if Celtic (Rangers) play a non-Old Firm match that is televised (and is zero otherwise).¹⁸ Some 55% of non-Old Firm Celtic matches in the sample are televised whilst the same statistic for Rangers is 51%.

As identified by Card and Dahl (2011), three factors of a match might make it ‘emotionally charged’, or salient, and therefore provide a stronger emotional cue for fans that may result in an increased level of domestic violence: whether the match itself is important in terms of the team winning the tournament they are contesting; whether the match is against a ‘traditional rival’; and whether the actual play in the match is particularly heated. We introduce similar classes of variables to attempt to understand whether emotionally charged matches are associated with a higher level of domestic violence in Strathclyde.

Card and Dahl (2011) used a measure of ‘playoff contention’ to distinguish between those games where a team no longer has the chance to win the league, and those where there is at least a mathematical possibility of winning the league. If applied to Celtic and Rangers in the SPL (the strongest teams in the league) this would include all but the very few matches at the end of some seasons where the winner of the league has already been decided. A more appropriate definition of ‘salience’ in this regard emerges from a distinct feature of the SPL: there is a natural break point in each season where the league is split and the teams in each half of the league play the remaining 5 matches against each other. If the team is in the top half of the league at this point (which is the case for both Celtic and Rangers for every season in our sample) and the points difference between the leader and the second highest team is no larger than 10, the game is classed as ‘important’. Whilst this measure limits the number of matches that fall in to this category of salience, we believe that it accurately reflects salience for these teams in the SPL. The variables $c(r)imp$ take the value

¹⁷Note, however, that in the UK there are ‘football roundup’ programmes broadcast on television, and matches may be aired on radio.

¹⁸The SPL website www.scotpremier.com has a record of all matches televised live from the 2008-09 season on. For earlier years, a comprehensive web search was undertaken to ascertain whether matches were televised live or not. We believe the combination of these data sources has provided us with a reliable measure of which matches are televised and which are not. Whilst we cannot rule out some errors we are confident that if there are any they are very few, and do not cause a systematic bias.

1 if Celtic (Rangers) play a non-Old Firm match and it is ‘important’: 7.5% of Celtic’s matches and 7.1% Rangers’ matches are important. `oldfirm_imp` takes the value 1 if an Old Firm match is important for either Celtic or Rangers, which is true of 14% of Old Firm matches.¹⁹

Another feature that may cause a match to be salient in the eyes of fans is when their team plays against a traditional rival. The Old Firm is perhaps the leading example in the world of such a traditional rivalry, and naturally we control for matches where Celtic and Rangers play each other, as previously discussed. In the SPL there are only a few other traditional rivalries that involve Celtic or Rangers that we might want to account for: when Celtic play Hearts and Rangers play Hibernian, and when either team plays Aberdeen.²⁰ To account for these matches we define the variables `c(r)vstr` that take the value 1 if Celtic (Rangers) plays Hearts (Hibernian) or Aberdeen, and is otherwise zero. In our sample 19.8% of Celtic’s matches and 19.1% of Rangers’ matches are against a traditional rival.

A slightly less well-defined but potentially important feature that might make a game salient is whether the play in the match was particularly controversial. To get a handle on this we introduce the variables `c(r)ref` that take the value 1 when Celtic (Rangers) play a non-Old Firm match and either the number of bookings (red and yellow cards) or the number of fouls is larger than the average of all such games, and is otherwise zero. `oldfirm_ref` is a similar measure for Old Firm matches.

The outcome of football matches may also influence the strength of the emotional cue that fans receive. Moreover, as [Card and Dahl \(2011\)](#) explained in their study, loss aversion – where a loss relative to a reference point incurs a greater reduction in utility than the increase in utility from an equivalent-sized gain – which is a very well-documented feature of decision making, may play a

¹⁹In the season completed in 2004, 2006 and 2007 Celtic led the league by more than 10 points after the split. Rangers led by more than 10 points after the split in 2010. These seasons are not salient in terms of the importance of the remaining matches in the season. In 2003, 2005, 2008, 2009 and 2011 the league was extremely competitive until the end of the season. The 5 matches in each of these 5 seasons are defined as salient.

²⁰Although the link is not as tight as in Glasgow for Celtic and Rangers, in Edinburgh, Hibernian and Hearts are often associated with Catholicism and Protestantism respectively. Thus we label Celtic versus Hearts and Rangers versus Hibernian as matches with a ‘traditional’ sectarian element. The rivalry that both members of the Old Firm have with Aberdeen stems from the 1980’s when under the management of Alex Ferguson the dominance of the Old Firm was broken. Aberdeen won the league in 1984 and 1985, the last time a team outside the Old Firm managed to do so. Aberdeen also won the European Cup Winner’s Cup in 1983. This has been the only Scottish winner of a European competition since Celtic won the European Cup in 1967. Given the success of Dundee United in the 1980’s (league winners in 1982 and European Cup semi-finalists in 1983) a case could be made for also including them as a traditional rival. We accept that our definition of traditional rivalry outside the Old Firm is to a large extent a subjective judgement; in particular linking the Edinburgh clubs to religious (or Irish) identity is somewhat controversial. Some would argue that there is only one traditional rivalry for Celtic and Rangers and that is the match played against each other.

role in explaining levels of domestic violence. If fans are loss averse then losses relative to a reference point, that loom larger than gains, will generate a stronger negative emotional cue and might therefore have some power in explaining levels of domestic violence.

To determine whether simple match outcomes matter in explaining the level of domestic violence we define the variables `c(r)win/draw/lose` that take the value 1 if Celtic (Rangers) play a non-Old Firm match and win/draw/lose (note that draws are not uncommon in ‘soccer’, in contrast to American football). In addition, we define the variables `oldfirm_draw/close/rlose` to identify Old Firm matches that result in a draw/Celtic losing/Rangers losing. A sensible hypothesis is that losses provide a negative emotional cue to fans that might result in higher level of domestic violence. Note that a conclusion of a significant positive effect on domestic violence from losses but no significant effect from draws or wins (or a significant negative effect) is consistent with loss aversion where the reference point is defined as the game being expected to result in a draw. This could be justified if all fans had expectations that every game is going to be close; whilst this might be true of Old Firm games, Figures 2 and 3 reveal a different picture for non-Old Firm games. Card and Dahl (2011) hypothesise that fans may form expectations about their team’s performance in a match and evaluate the outcome of the match relative to those expectations. Using pre-match betting odds as a proxy for fans’ expectations, they define an ‘upset loss’ as a game where the team was predicted to win (the pre-game point spread is less than -4) and then lost. To investigate this issue in the SPL we categorise match outcomes relative to the pre-game probability of winning, the construction of which was discussed in Section 2. To clearly define what is expected and unexpected we follow Card and Dahl (2011) who take pre-game betting odds as a proxy for expectations and postulate (somewhat arbitrarily but we believe sensibly given the observed pre-match betting odds) that if the pre-match winning probability is at least as large as 70% ($q \geq 0.7$) then the team is expected to win, if $0.7 < q < 0.25$ the game is expected to be ‘tight’ and if $q < 0.25$ then the team is expected to lose. This definition leads to a variable that is consistent with reality in the SPL which is that all Old Firm games are expected to be tight. Both Celtic and Rangers are strong teams in the SPL and two patterns are apparent from the pre-match probabilities of winning plotted in Figures 2 and 3: a) neither team could be classed as ever being expected to lose; and b) for Old Firm games the prediction is always that the game will be tight. As a result of a) there will never be ‘upset wins’ in our data (where a team is expected to lose but wins) and b) suggests that nothing ‘unexpected’ will happen in an Old Firm game. For non-Old Firm matches we classify the outcome of the match in relation to the pre-match winning probability (q) as

one of the categories detailed in Table 3, for which we define indicator variables for both Celtic and Rangers.

Prob. win	Lose	Draw	Win
$q \geq 0.7$	favlose	favdraw	favwin
$q < 0.7$	tightlose	tightdraw	tightwin

Table 3: Match outcomes relative to pre-game expectations.

5 Results and Discussion

In this section we report the results of our attempts to try to explain the level of domestic violence in Strathclyde as a whole using various features of football matches discussed in Section 4. Our empirical results are presented in Tables 4 and 5. Table 4 presents the first set of empirical results investigating whether the presence, context and outcome of football matches involving Celtic and Rangers can explain levels of domestic violence. Table 5 goes on to investigate whether levels of domestic violence can be explained by match outcomes when evaluated relative to expectations.²¹

All the explanatory variables we use are dummy variables; the coefficients should thus be interpreted as the change in the log of the average number of domestic violence incidents as a result of the indicator variable taking the value 1, or (approximately) the percentage change in the average level of domestic violence on days that have the characteristics of the indicator variable compared to days that do not.

In all of the regressions reported in this paper we control for year (2003 is the omitted dummy variable), day of the week (Saturday is the omitted variable) and the Christmas and New Year holiday period (using the variables detailed in Table 1) which are all strongly significant in each regression. Of note is the observation that the coefficient for `xmas_ny` which identifies days between 24th December to 3rd January inclusive is consistently around 0.33, signifying a 33% increase in domestic violence during the holiday season.

In model (A1) we regress the total number of domestic violence in Strathclyde on the basic match indicator variables, and find a strong significant effect

²¹Our data is over-dispersed (the mean is 65.4 whilst the variance is 485.5) so whilst coefficients estimated by Poisson regression methods will be unbiased the standard errors may be biased downwards, so we report robust standard errors that inflate the standard errors by a factor given by the ratio of the variance to the mean. We also estimated each model using negative binomial regression methods, which yields results that are almost identical to our reported results using Poisson regression (estimates of these models can be found in Appendix B).

	(A1)	(A2)	(A3)	(A4)	(A5)	(A6)
conly	-0.00659 (0.0125)	-0.00409 (0.0134)	-0.0717* (0.0408)	-0.0547 (0.0369)	-0.0657* (0.0378)	
ronly	-0.00578 (0.0132)	-0.00452 (0.0146)	-0.0467 (0.0302)	-0.0411 (0.0295)	-0.0355 (0.0305)	
candr	0.134*** (0.0208)					
candr \neg		0.0539*** (0.0197)	-0.0578 (0.0473)	-0.0255 (0.0465)	-0.0262 (0.0502)	
oldfirm		0.357*** (0.0343)	0.359*** (0.0348)	0.343*** (0.0388)	0.387*** (0.0710)	
cvstr		-0.00213 (0.0223)	-0.000442 (0.0217)	-0.00549 (0.0210)	-0.00845 (0.0213)	-0.00631 (0.0216)
rvstr		-0.00273 (0.0223)	-0.00414 (0.0216)	-0.00568 (0.0206)	-0.00471 (0.0209)	-0.00728 (0.0210)
chome			0.0447 (0.0359)	0.0253 (0.0334)	0.0277 (0.0336)	0.0208 (0.0339)
rhome			0.0278 (0.0298)	0.0195 (0.0295)	0.0188 (0.0296)	0.0184 (0.0291)
ctv			0.0850** (0.0361)	0.0567* (0.0339)	0.0560 (0.0344)	0.0591* (0.0344)
rtv			0.0578** (0.0291)	0.0384 (0.0293)	0.0384 (0.0294)	0.0464 (0.0289)
cimp				0.0906** (0.0418)	0.0894** (0.0425)	0.0823* (0.0444)
rimp				0.0846* (0.0483)	0.0841* (0.0486)	0.0771 (0.0504)
oldfirm_imp				0.101 (0.0655)	0.126* (0.0685)	0.106 (0.0685)
cref					0.0174 (0.0195)	
rref					-0.0133 (0.0211)	
oldfirm_ref					-0.0687 (0.0822)	
oldfirm_draw						0.388*** (0.112)
oldfirm_close						0.410*** (0.0537)
oldfirm_rlose						0.285*** (0.0464)
cwin						-0.0254 (0.0376)
cdraw						-0.0469 (0.0399)
close						-0.0323 (0.0514)
rwin						-0.0256 (0.0280)
rdraw						0.000181 (0.0366)
rlose						-0.0253 (0.0381)
intercept	4.223*** (0.0144)	4.229*** (0.0141)	4.233*** (0.0142)	4.232*** (0.0142)	4.233*** (0.0142)	4.230*** (0.0143)
N	3200	3200	3200	3200	3200	3200

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: The effect on domestic violence in Strathclyde resulting from football matches involving Celtic and Rangers.

when both Celtic and Rangers play. However, when the Old Firm and other traditional rivalries are accounted for in model (A2) it is clear that the overwhelming majority of the effect resulting from both teams playing on the same day can be attributed to Old Firm matches: with this specification, the average level of domestic violence in Strathclyde increases by some 36% on days when there is an Old Firm match, which is of the same order of magnitude as the Christmas holiday effect alluded to above. Other traditional rivalries, however, make very little difference. Model (A3) includes our context variables (identifying games that are played at home and those that are televised); model (A4) includes the effect of games that are ‘important’; and model (A5) includes the effect of matches involving a greater than average number of fouls or bookings.

Model (A2) suggests that there is a positive and significant effect when both Celtic and Rangers play, but not each other, which is not present on days when either Celtic or Rangers play. This effect, however, disappears in model (A3) which controls for whether the game is televised or not, in which there is a positive and significant effect of matches being televised. One might expect a ‘tv effect’ since it expands the base of fans that are engaged with football and therefore the pool of the population who will experience the hypothesised emotional cue resulting from the football match. However, this effect itself disappears in model (A4) which controls for match importance. This can be explained as follows: Celtic and Rangers are more likely to play matches on the same day after the split in the league; such matches are more likely to be televised than the average match; but their defining feature is that they are more likely to be important. Hence, controlling for the importance of the match is necessary so that spurious relationships are not identified: it would be easy to recommend from model (A2) that Celtic and Rangers’ matches should not be scheduled on the same day, but model (A4) suggests this is an incorrect recommendation.

Model (A5) controls for matches involving a greater than average number of fouls or bookings. None of these effects are significant, but the negative coefficients, particularly in Old Firm matches, suggest that this is perhaps not an appropriate measure of salience for soccer. The same conclusions hold if the variable is defined to identify only those matches where the number of fouls or bookings are at least one standard deviation larger than the mean of all such matches. Indeed, it is easy to conceive that bookings that are *not* made by the referee could equally make the game emotionally charged.

In terms of explaining domestic violence using match indicator and context variables model (A4) is our preferred specification, which demonstrates that there is a large and significant Old Firm effect that is augmented (but not significantly so) when the match is also important. However, when Rangers and

Celtic are engaged in matches against other teams in the SPL there is no significant effect on the level of domestic violence, even when the match is against a non-Old Firm traditional rival. Indeed, the negative signs on the coefficients of $c(r)$ only and $candr$, although not particularly significant, suggest that when fans engaged with such matches the incidence of domestic violence is actually *reduced*. Moreover, whether the team plays at home or away makes no difference to this conclusion. Whether the match is televised or not is mildly significant for Celtic (p-value=0.094) but not for Rangers (p-value=0.189). There is a positive and significant *additional* effect when Celtic and Rangers are engaged in matches against other teams that are important (9.1% and 8.5%, respectively) relative to non-important matches. However, the *overall* effect of important matches for Celtic and Rangers (which combines the coefficients on various explanatory variables) is often insignificant. For instance, the effect of when either Celtic or Rangers play, when both teams play but not each other and one of the teams plays an important match (p-values of 0.551 for Celtic and 0.458 for Rangers), and when both teams play but not each other and both matches are important (p-value=0.102), are insignificant even at the 10% level. However, for Celtic and Rangers non-Old Firm matches that are both important and televised there is a significant additional effect (p-values of 0.001 for Celtic and 0.013 for Rangers), and the overall effect on match days when either Celtic or Rangers play matches that are both televised and important is statistically significant (p-values of 0.026 when only Celtic play and 0.085 when only Rangers play).

Our main findings so far can be summarized as saying: it is not football in general that is associated with domestic violence, but Old Firm matches in particular, with the possible exception of non-Old Firm matches that are both important and are televised.

Model (A6) controls for the outcome of matches. The results of this model demonstrate that when Celtic and Rangers are engaged in non-Old Firm matches there is very little heterogeneity in the effect on domestic violence according to the outcome of the match. Win, lose or draw the effect is largely similar, and indeed insignificant. Given the similarity of the coefficient estimates for each team for each type of outcome, whether the match is important and/or televised has a similar effect to that discussed in model (A4). One notices from the estimated coefficients of model (A6) that there is heterogeneity in the Old Firm effect depending on the outcome of the match: it is highest at 41% when Celtic lose, which is similar to the effect of a draw, and lowest at 29% when Rangers lose. The increase in domestic violence associated with any Old Firm match is large, but it seems that this effect is amplified when the outcome is not in Celtic's favour. However, whilst the difference in the coefficients seems large, the p-value of the test of the similarity between the effect of Celtic losing

and Rangers losing is 0.065, suggesting a null hypothesis of the effect being the same cannot be rejected at the 5% level of significance.

We now turn to the question of whether reference points are important in triggering domestic violence. The results in table 5 investigate whether match outcomes relative to pre-match expectations (proxied by pre-match betting odds) have any power in explaining the level of domestic violence. Despite the fact that in model (A6) there was no discernible effect on domestic violence of non-Old Firm matches regardless of the outcome of those matches, it may be the case that for those matches that resulted in a loss and that loss was unexpected (an ‘upset’ loss) there is a significant effect on domestic violence, as discussed extensively in Card and Dahl (2011) and as found in their data. By classifying match outcomes relative to pre-match betting odds as described in Table 3 we can test whether this is the case in Strathclyde.

Model (B1) is the same as model (A6) of Table 4 except that explanatory variables which categorise match outcomes according to pre-game betting odds are included. The results of this model demonstrate a striking feature that stands in stark contrast to the findings of Card and Dahl (2011, Table IV, p 25). They found that, whilst outcomes that accord with expectations have no effect on domestic violence (whether they are wins or losses), there is a statistically significant 10% increase in the level of domestic violence in the team’s home city when that team plays a game that it loses when it was expected to win. Furthermore, they also found this effect to be significantly different from the effect of an upset win. This allowed them to conclude that, when outcomes are evaluated relative to a reference point that is formed by expectations, losses have a larger negative impact on the level of domestic violence than a gain (the effect of which is insignificant). We are not finding this. Our results would be consistent with this if the coefficients on either the `favlose` or `favdraw` variables for Celtic and Rangers are positive and significant, but they are negative and insignificant.²² We do not find any explanatory variable which reflects match outcomes relative to pre-match betting odds to be significant. Unexpected losses do not seem to trigger domestic violence in our data set.

The preceding result was based on all matches. That is, model (B1) includes explanatory variables which, e.g., reflect unexpected losses throughout the season. It is possible that unexpected losses only have an impact in salient

²²Since our data is over-dispersed we use robust standard errors in hypothesis testing. One fear is that using robust standard errors over-inflates the standard errors, in turn making p-values larger than they should be, favouring a conclusion of no significance. However, even when the data is over-dispersed coefficient estimates from Poisson regression are unbiased so any conclusion of significance with non-inflated standard errors would only allow us to deduce a *reduction* in domestic violence. Indeed, when the estimation is repeated using non-robust standard errors or using the negative binomial model our conclusions do not change.

	(B1)	(B2)	(B3)	(B4)	(B5)
	All matches	Importance	Extended importance	Traditional rival	Referee active
cfavwin	-0.0306 (0.0389)	-0.0197 (0.0375)	-0.0440 (0.0380)	-0.0166 (0.0380)	-0.0426 (0.0414)
ctightwin	-0.0240 (0.0422)	-0.00753 (0.0412)	-0.0414 (0.0409)	-0.0295 (0.0437)	-0.0491 (0.0708)
cfavdraw	-0.0570 (0.0463)	-0.0652 (0.0467)	-0.0864* (0.0477)	-0.0869* (0.0470)	-0.0788 (0.0603)
ctightdraw	-0.0406 (0.0451)	-0.0296 (0.0463)	-0.0479 (0.0539)	-0.0637 (0.0515)	-0.0696 (0.0938)
cfavlose	-0.0124 (0.0604)	-0.0415 (0.0590)	-0.0643 (0.0783)	-0.0169 (0.0691)	0.00471 (0.0985)
ctightlose	-0.0689 (0.0651)	-0.0575 (0.0639)	-0.0823 (0.0634)	0.00139 (0.0552)	-0.00111 (0.0726)
rfavwin	-0.0321 (0.0318)	-0.0377 (0.0315)	-0.0374 (0.0326)	-0.0352 (0.0317)	-0.0118 (0.0361)
rtightwin	-0.0215 (0.0316)	-0.0336 (0.0310)	-0.0492 (0.0343)	-0.0154 (0.0320)	-0.0250 (0.0356)
rfavdraw	-0.0133 (0.0463)	-0.0239 (0.0469)	-0.0273 (0.0520)	-0.00687 (0.0500)	-0.0224 (0.0626)
rtightdraw	0.0133 (0.0445)	0.0262 (0.0455)	0.0448 (0.0463)	-0.0145 (0.0509)	0.0255 (0.0645)
rfavlose	-0.0241 (0.0469)	-0.0315 (0.0466)	-0.0237 (0.0513)	-0.0402 (0.0512)	-0.0904** (0.0457)
rtightlose	-0.0252 (0.0487)	-0.0379 (0.0502)	-0.0415 (0.0510)	-0.0476 (0.0764)	-0.194 (0.142)
cfavwin_sal		0.0123 (0.0799)	-0.0190 (0.0479)	-0.0728* (0.0409)	-0.0261 (0.0418)
ctightwin_sal		-0.0165 (0.101)	-0.00162 (0.0648)	-0.00289 (0.0461)	-0.0270 (0.0447)
cfavdraw_sal		0.372*** (0.141)	0.0677 (0.143)	0.147** (0.0709)	-0.0445 (0.0524)
ctightdraw_sal		0.0184 (0.0349)	-0.0685 (0.0446)	-0.0146 (0.0464)	-0.0410 (0.0460)
cfavlose_sal		0.208 (0.128)	0.0357 (0.0832)	0.0215 (0.0891)	-0.0416 (0.0493)
ctightlose_sal		omitted	omitted	-0.132 (.)	-0.107 (0.0867)
rfavwin_sal		0.0189 (0.0736)	-0.0219 (0.0477)	-0.0346 (0.0458)	-0.0423 (0.0330)
rtightwin_sal		0.0400 (0.126)	0.0303 (0.0409)	-0.0759 (0.0466)	-0.00354 (0.0389)
rfavdraw_sal		0.240*** (0.0308)	0.0218 (0.0572)	-0.0423 (0.0625)	0.00168 (0.0507)
rtightdraw_sal		-0.0858** (0.0389)	-0.108 (0.0679)	0.0213 (0.0637)	0.0139 (0.0539)
rfavlose_sal		omitted	-0.133* (.)	0.0372 (0.0895)	0.0484 (0.0661)
rtightlose_sal		0.159** (0.0726)	0.160*** (0.0513)	-0.0250 (0.0381)	0.0158 (0.0434)
oldfirm_draw	0.388*** (0.112)	0.388*** (0.112)	0.388*** (0.112)	0.386*** (0.112)	0.388*** (0.112)
oldfirm_close	0.410*** (0.0536)	0.410*** (0.0537)	0.410*** (0.0536)	0.409*** (0.0535)	0.410*** (0.0537)
oldfirm_rlose	0.285*** (0.0464)	0.284*** (0.0464)	0.285*** (0.0464)	0.285*** (0.0463)	0.285*** (0.0465)
cvstr	-0.00549 (0.0222)	-0.00887 (0.0215)	-0.00751 (0.0216)		0.00278 (0.0235)
rvstr	-0.00812 (0.0218)	-0.00951 (0.0207)	-0.0125 (0.0221)		-0.0164 (0.0218)
chome	0.0251 (0.0352)	0.0187 (0.0351)	0.0359 (0.0352)	0.0199 (0.0349)	0.0283 (0.0362)
rhome	0.0252 (0.0331)	0.0312 (0.0328)	0.0330 (0.0337)	0.0252 (0.0332)	0.0210 (0.0333)
ctv	0.0634* (0.0349)	0.0557 (0.0341)	0.0775** (0.0337)	0.0573* (0.0342)	0.0671* (0.0367)
rtv	0.0457 (0.0286)	0.0507* (0.0285)	0.0619** (0.0285)	0.0502* (0.0291)	0.0402 (0.0286)
cimp	0.0775* (0.0441)			0.0736* (0.0421)	0.0757 (0.0464)
rimp	0.0771 (0.0507)			0.0651 (0.0486)	0.0770 (0.0511)
oldfirm_imp	0.105 (0.0685)	0.106 (0.0686)	0.105 (0.0685)	0.105 (0.0685)	0.106 (0.0687)
intercept	4.230*** (0.0143)	4.231*** (0.0143)	4.230*** (0.0144)	4.230*** (0.0143)	4.230*** (0.0143)
N	3200	3200	3200	3200	3200

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: The effects of match outcomes relative to expectations on domestic violence in Strathclyde

games. This issue is considered in [Card and Dahl \(2011, Table VI, p 30\)](#). They considered whether the upset loss effect persisted in both salient and non-salient games, where salience was defined in three ways: games where the team was still in playoff contention; games against traditional rivals; and games that are particularly frustrating for fans. Their findings are that “the overall rise in...[domestic violence incidents]...following an upset loss is driven entirely by losses in games that “matter” the most to fans”: coefficient estimates of the increase in domestic violence for upset losses in games that possess one of the salience characteristics are at least twice as large as in games that do not possess that characteristic. For our data this hypothesis is investigated in models (B2) to (B5). In these models matches are split into two types – those that possess the salience characteristic listed at the top of each column and those that do not – and are further characterised by the match outcome relative to pre-match expectations as in model (B1). The coefficient estimates reported in the first block of the table are for those matches that *do not* have the salience characteristic of the column, and the second block of estimates is for those matches that do. So, for example, column (B2) distinguishes between games that are ‘important’ and those that are not; the first set of parameter estimates are for matches that do not have the importance characteristic, and the second set of parameter estimates are for matches that are important. Note that the parameter estimates in the second block (post-scripted with `_sal`) give the total effect on domestic violence from a match that possesses that characteristic, rather than the *additional* effect over and above non-salient matches (which would be the case if we just ‘controlled’ for matches that have the salience characteristic in question).

Model (B2) distinguishes between those matches that are classed as non-important in the upper block and those matches that are important in the second block. As discussed in Section 4 our measure of match importance is purposefully restrictive to focus attention on those matches at the end of the season, where the title is still to play for, that are particularly salient for fans. The consequence is that there are few observations, and indeed two parameter estimates are omitted as there are no observations that fall into those categories. We found in model (A4) that matches that are important do have a significant effect on levels of domestic violence. The results of model (B2) suggest that in important games there is indeed an upset loss effect that is not present in games that do not have the importance characteristic: when Celtic are predicted to win and draw domestic violence increases by 37% (p-value 0.008) compared to a reduction of 6.5% in non-important games (p-value for a test of equality between the coefficients is 0.001); when they are predicted to win but lose domestic violence increases by 21% (although this is not statistically significant due to the large standard error resulting from very few observations of this

type – p-value=0.104). Similarly, when Rangers are predicted to win and draw domestic violence increases by some 24% which is strongly significant. This can be compared to an effect of -2% in non-important games (p-value for test of equality ≈ 0). In addition, when Rangers play an important game that is predicted to be tight and they lose there is a significant 16% effect on domestic violence (p-value=0.028) which is significantly different from the effect in non-important games (p-value for test of equality is 0.008). Of note is the realisation that in important games that the teams win, there is no significant effect on domestic violence. Moreover, the effect of expected draws has no significant effect in the case of Celtic, and in fact a significant negative 9% effect for Rangers (p-value=0.027). In conclusion, in those games that are classed as important, there seems to be a significant effect on the level of domestic violence of a disappointing outcome where the team loses when they are either expected to win or the game is expected to be tight (although our definition of importance means this conclusion is drawn from few observations). Moreover, there is a significant effect on domestic violence when a team draws, but only when they were expected to win; games that result in a draw but were expected to be tight have no significant effect on domestic violence levels. As such, in important matches we identify an ‘upset non-win’ effect, but it seems to be the act of losing that matters, rather than necessarily losing unexpectedly.

In model (B3) we expand the definition of importance to incorporate the last 10 matches of the season where the team has a mathematical possibility of winning the league. This expands the number of matches that are classed as important, but very interestingly changes the conclusion that there is an upset-loss effect: all coefficients, except in Rangers matches that are predicted to be tight but they go on to lose, are insignificant. The significant 16% effect of Rangers losing games which were expected to be tight is in fact based on a single match which took place on Thursday 22nd May 2008 when Rangers played away at Aberdeen (losing 2-0). On the same day Celtic played away to Dundee United and won 1-0 and the combination of these matches meant that Celtic won the league, which was previously undecided. This in itself makes this match particularly important, but this was at the end of a season during which Rangers also lost the UEFA Cup final in Manchester on 14th May. Following this loss there was extensive rioting in Manchester city centre where the match was televised on big screens. The average number of domestic violence incidents midweek in 2008 was 61.5 but following Rangers’ defeat on 22nd May 2008 there were 77 reported domestic violence incidents. Excepting this single match, extending the definition of importance means we cannot conclude an ‘upset non-win’ effect: there is some evidence that losses relative to expectations have a significant effect on the level of domestic violence in Strathclyde, but this is true

only in those particularly salient matches right at the end of the season where the title is still to play for.

Model (B4) distinguishes between matches against non-Old Firm traditional rivals and those against other teams. The parameter estimates in the first block are for explanatory variables relating to matches against non-rivals, those in the second block are for matches against traditional rivals. Here there is very little evidence of upset losses or non-wins having a significant effect on domestic violence in games against traditional rivals, the exception being that when Celtic are favourite and draw against a traditional rival there is, on average, a 15% increase in domestic violence which is significant (p-value=0.038) and significantly different from the effect of the same matches not against traditional rivals (p-value for test of equality is 0.001). This effect does not materialise for Rangers, and moreover when the teams are favourite to win but then *lose* in matches against traditional rivals there is no significant effect on domestic violence.

For completeness, model (B5) distinguishes between those games where the number of fouls or bookings was greater than average. We found in model (A5) that this measure of salience is perhaps not appropriate to the SPL and indeed the results of model (B4) confirm that in games that have this characteristic there is no upset loss or non-win effect.

The overall picture from our empirical results is that the dominant effect on domestic violence is associated with Old Firm matches: when an Old Firm match takes place the average level of domestic violence increases by some 28-41% depending on the outcome. Football matches that do not involve an Old Firm clash, are not salient, do not involve other traditional rivals and are not televised tend to be associated with a *reduction* in the average level of domestic violence. Match outcomes matter very little in explaining levels of domestic violence, and the same is true when outcomes are considered relative to expectations. Only in games that are particularly salient is there a significant effect that results from upset non-wins, but importance has to be defined very tightly in order to get this result.

6 Mixed effects

One potential drawback of our analysis stems from fans of the two teams under consideration being located in the same city. It may be the case, for example, that when Rangers suffer an upset loss Rangers fans suffer negative emotions causing an increase in domestic violence whilst Celtic fans enjoy positive emotions causing a reduction in domestic violence thereby not allowing us to identify

the effect on domestic violence from Rangers fans alone. There is an objection in principal to this drawback, which is that whilst negative outcomes have been found to be associated with increased levels of domestic violence, positive outcomes, even related to the fans own team, have not been found to be associated with a significant change in violence both domestic and otherwise (see [Card and Dahl \(2011\)](#) for domestic violence and [Priks \(2010\)](#) for hooliganism). Since we have data by subdivision and in some areas of Glasgow in particular and in Strathclyde more generally there are distinct districts where the overwhelming majority of football fans are either Celtic supporters or Rangers supporters, we can estimate a mixed effects model and by allowing some carefully chosen parameters to vary across subdivisions determine whether in those areas where domestic violence increases when there is bad news for Celtic (Rangers) it also reduces when there is bad news for Rangers (Celtic).

The mixed effects Poisson model involves grouping the explanatory variables into those with constant coefficients (Z_t) and those with coefficients which vary across subdivisions (W_t). If y_{it} is the number of domestic violence incidents in subdivision i on day t then Poisson panel data models assume:

$$\Pr(y_{it} = y | \alpha_i) = \frac{\exp(-\lambda_{it}) \lambda_{it}^y}{y!} \quad (1)$$

for $y = 0, 1, \dots$. The mean is given by:

$$\lambda_{it} = \exp(Z_t \beta + W_t \alpha_i). \quad (2)$$

The vector of varying coefficients, α_i has a multivariate Normal distribution with diagonal error covariance matrix. Note that mixed effects models can be difficult to estimate precisely when the dimensionality of α_i becomes too large. Accordingly, it is common to allow for only a few explanatory variables to have varying coefficients, a practice that we follow here. In particular, we re-estimate model (B1) but allow the coefficients for `oldfirm_close`, `oldfirm_rlose`, `cfavlose` and `rfavlose` to vary across subdivisions. These are the coefficients that we would expect to vary across subdivisions if there are distinct Rangers (Celtic) neighbourhoods.

In practice, we find very little evidence that coefficients are varying across subdivisions. The average coefficients estimates (i.e. β and the mean of α_i) are basically the same as those of model (B1), and so are not presented here. [Appendix C](#) gives estimates (and standard errors) of the deviation of each coefficient from the average in each of the 30 police subdivisions. For two of the variables with subdivision-varying coefficients (`oldfirm_close` and `rfavlose`) these deviations are essentially zero. For the remaining two variables (`oldfirm_rlose`,

`cfavlose`) there is more evidence that their impact varies across subdivision. However, even for these variables, almost all of the estimated deviations are less than one standard deviation from zero and none are more than two standard deviations from zero.

The drawback referred to at the beginning of this sub-section would manifest itself if the correlation between the coefficients on `cfavlose` and `rfavlose` or on `oldfirm_close` and `rfavlose`, or on `oldfirm_rlose` and `cfavlose` were strongly negative. These correlations would mean in subdivisions where domestic violence increases when Celtic fans receive bad news it reduces when Rangers fans receive bad news. The correlations between the point estimates (ignoring the fact that standard errors tend to be quite large) are given in Table 6. These correlations tend to be quite small and do not fit a pattern which would lead to countervailing Rangers and Celtic effects masking each other.

	oldfirm_close	oldfirm_rlose	cfavlose	rfavlose
oldfirm_close	1.0000			
oldfirm_rlose	0.3889	1.0000		
cfavlose	-0.3400	-0.2059	1.0000	
rfavlose	-0.2183	-0.2296	0.3952	1.0000

Table 6: Correlations across sub-divisions between random effects.

The fact that our results using a mixed effects model on subdivision level data do not indicate substantial variations in coefficients could be due to the scale of police subdivisions. That is, the average police subdivision contains about 75,000 inhabitants and this degree of spatial resolution may be too coarse to pick up effects associated with neighbourhoods of a particular sectarian hue. But, at least the findings of this section are suggestive that our results of Section 5 are not missing important effects due to regional variations within the Strathclyde region.

7 Conclusion

When investigating the effect of American football on levels of domestic violence in the US, [Card and Dahl \(2011\)](#) found that there is a significant positive effect on domestic violence in a team’s home city when that team suffers an upset loss. We investigate whether the same is true in the area surrounding Glasgow focussing on games that involve Celtic and Rangers. We find that there is a very large and significant effect on domestic violence associated with Old Firm matches of the same order of magnitude as the increase in domestic violence around Christmas and the New Year. We test for the effect of upset losses but find very little evidence to support the conclusion: we only find this evidence in

a very limited set of matches where the battle to win the league is particularly intense.

Our conclusion, therefore, is that the manifestation of loss aversion and the influence of losses in sport relative to expectations on the incidence of domestic violence very much depends on the context of the league. In the SPL where there is a strong traditional rivalry in the form of the Old Firm upset losses play very little role in explaining levels of domestic violence, which increase significantly on days when an Old Firm match is played. The hypothesis of [Card and Dahl \(2011\)](#) implies that there is a kink in the payoff function of fans at the expected outcome. Our hypothesis is that the angle of this kink is reduced by other salient features of the league. If there are other more dominant factors that fans care about then other matches don't feature so much in their emotions.

Between the 2011 and 2012 seasons Rangers went into administration and subsequently was required to leave the SPL and play in the third division. In the 2012 season, therefore, Celtic remain in the SPL but are playing without the presence of the traditional Old Firm rivalry. This provides a natural experiment, and we look forward in the next few years to revisiting this question to ascertain whether there is any change in the pattern of fans' behaviour subsequent to this important change to the league. From a public policy perspective there is also an opportunity to take stock of the effect of Old Firm matches on domestic violence and ask whether more could be done to help eliminate the link between the two given that Old Firm matches will no doubt be restored in the coming years when Rangers return to the SPL.

A Strathclyde Police subdivisions

Strathclyde Police is headquartered in Glasgow and covers an area of 13,624 km² and a population of some 2.3 million. It is divided into 8 divisions, and further delineated into 30 subdivisions, which are listed below:

A Glasgow Central and West

1. AB Glasgow City Centre
2. AC Anderston
3. AD Glasgow West End
4. AE Drumchapel

B Glasgow North East and East Dunbartonshire

5. BA Calton and East Centre

6. BC Springburn and Western Glasgow North East
7. BD Baillieston, Shettleston and Eastern Glasgow North East
8. BE Maryhill/Kelvin and Canal
9. BF East Dunbartonshire

G Glasgow South and East Renfrewshire

10. GA Govan and Craigton
11. GB Greater Pollok and Newlands/Auldburn
12. GC East Renfrewshire
13. GD Linn and Langside
14. GE Pollokshields East and Southside Central

K Renfrewshire and Inverclyde

15. KA Paisley
16. KB Johnstone and Renfrew
17. KC Inverclyde

L Argyll, Bute and West Dunbartonshire

18. LA Dumbarton, Helensborough and Clydebank
19. LB Argyll and Bute

N North Lanarkshire

20. NA Monklands
21. NC Cumbernauld and Kilsyth
22. ND Bellshill
23. NE Motherwell and Wishaw

Q South Lanarkshire

24. QA East Kilbride and Strathhaven
25. QB Hamilton Area
26. QC Clydesdale
27. QD Rutherglen and Cambuslang

U Ayrshire

28. UA North Ayrshire
29. UC East Ayrshire
30. UD South Ayrshire

B Negative binomial regressions

This section contains estimates of the models presented in Tables 4 and 5 using negative binomial regression methods.

	(A1nb)	(A2nb)	(A3nb)	(A4nb)	(A5nb)	(A6nb)
conly	-0.00488 (0.0124)	-0.00204 (0.0133)	-0.0702* (0.0385)	-0.0526 (0.0352)	-0.0625* (0.0362)	
ronly	-0.00457 (0.0132)	-0.00378 (0.0146)	-0.0460 (0.0299)	-0.0393 (0.0286)	-0.0351 (0.0296)	
candr	0.142*** (0.0211)					
candr↔		0.0596*** (0.0204)	-0.0527 (0.0452)	-0.0208 (0.0448)	-0.0230 (0.0484)	
oldfirm		0.366*** (0.0344)	0.369*** (0.0351)	0.354*** (0.0392)	0.401*** (0.0701)	
cvstr		-0.00360 (0.0225)	-0.00208 (0.0217)	-0.00694 (0.0210)	-0.00948 (0.0214)	-0.00771 (0.0216)
rvstr		0.000644 (0.0224)	-0.00129 (0.0216)	-0.00402 (0.0200)	-0.00320 (0.0203)	-0.00474 (0.0206)
chome			0.0437 (0.0340)	0.0244 (0.0321)	0.0266 (0.0323)	0.0205 (0.0324)
rhome			0.0253 (0.0297)	0.0160 (0.0285)	0.0155 (0.0285)	0.0176 (0.0282)
ctv			0.0847** (0.0343)	0.0561* (0.0329)	0.0557* (0.0333)	0.0572* (0.0330)
rtv			0.0599** (0.0288)	0.0384 (0.0279)	0.0387 (0.0281)	0.0463* (0.0274)
cimp				0.0895** (0.0421)	0.0884** (0.0427)	0.0841* (0.0452)
rimp				0.0981* (0.0508)	0.0978* (0.0510)	0.0929* (0.0530)
oldfirm_imp				0.0900 (0.0698)	0.117 (0.0731)	0.107 (0.0731)
cref					0.0153 (0.0191)	
rref					-0.0100 (0.0207)	
oldfirm_ref					-0.0736 (0.0824)	
oldfirm_draw						0.394*** (0.112)
oldfirm_close						0.425*** (0.0531)
oldfirm_rlose						0.291*** (0.0480)
cwin						-0.0241 (0.0357)
cdraw						-0.0415 (0.0379)
close						-0.0301 (0.0504)
rwin						-0.0257 (0.0271)
rdraw						0.00246 (0.0350)
rlose						-0.0270 (0.0383)
intercept	4.222*** (0.0140)	4.228*** (0.0138)	4.234*** (0.0139)	4.232*** (0.0139)	4.233*** (0.0139)	4.229*** (0.0139)
N	3200	3200	3200	3200	3200	3200

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	(B1nb)	(B2nb)	(B3nb)	(B4nb)	(B5nb)
	All matches	Importance	Extended importance	Traditional rival	Referee active
cfavwin	-0.0292 (0.0370)	-0.0208 (0.0363)	-0.0442 (0.0365)	-0.0173 (0.0369)	-0.0416 (0.0389)
ctightwin	-0.0201 (0.0405)	-0.00659 (0.0406)	-0.0410 (0.0396)	-0.0249 (0.0434)	-0.0459 (0.0706)
cfavdraw	-0.0517 (0.0441)	-0.0613 (0.0447)	-0.0796* (0.0453)	-0.0810* (0.0453)	-0.0691 (0.0592)
ctightdraw	-0.0325 (0.0440)	-0.0241 (0.0462)	-0.0400 (0.0537)	-0.0610 (0.0511)	-0.0623 (0.0924)
cfavlose	-0.0134 (0.0607)	-0.0429 (0.0613)	-0.0655 (0.0795)	-0.0270 (0.0699)	0.00391 (0.0982)
ctightlose	-0.0598 (0.0629)	-0.0515 (0.0623)	-0.0753 (0.0616)	0.00348 (0.0547)	0.000369 (0.0715)
rfavwin	-0.0308 (0.0310)	-0.0364 (0.0307)	-0.0369 (0.0324)	-0.0351 (0.0311)	-0.0140 (0.0358)
rtightwin	-0.0206 (0.0302)	-0.0328 (0.0295)	-0.0499 (0.0333)	-0.0181 (0.0310)	-0.0213 (0.0342)
rfavdraw	-0.00240 (0.0438)	-0.0140 (0.0446)	-0.0156 (0.0503)	0.00371 (0.0469)	-0.00916 (0.0586)
rtightdraw	0.00643 (0.0432)	0.0189 (0.0440)	0.0387 (0.0448)	-0.0169 (0.0502)	0.0173 (0.0641)
rfavlose	-0.0198 (0.0471)	-0.0275 (0.0468)	-0.0175 (0.0523)	-0.0382 (0.0517)	-0.0965** (0.0461)
rtightlose	-0.0330 (0.0502)	-0.0444 (0.0519)	-0.0476 (0.0530)	-0.0643 (0.0828)	-0.226 (0.156)
cfavwin_sal		0.0172 (0.0825)	-0.0140 (0.0480)	-0.0769* (0.0408)	-0.0255 (0.0397)
ctightwin_sal		-0.0190 (0.0982)	0.00309 (0.0638)	-0.00779 (0.0457)	-0.0250 (0.0427)
cfavdraw_sal		0.340** (0.150)	0.0482 (0.147)	0.132* (0.0703)	-0.0455 (0.0502)
ctightdraw_sal		0.0228 (0.0342)	-0.0644 (0.0444)	-0.00480 (0.0475)	-0.0343 (0.0436)
cfavlose_sal		0.213 (0.132)	0.0413 (0.0878)	0.0368 (0.0946)	-0.0456 (0.0467)
ctightlose_sal		omitted (.)	omitted (.)	-0.124 (0.0860)	-0.0984 (0.0755)
rfavwin_sal		0.0319 (0.0762)	-0.0127 (0.0475)	-0.0335 (0.0441)	-0.0370 (0.0323)
rtightwin_sal		0.0762 (0.136)	0.0387 (0.0407)	-0.0661 (0.0451)	-0.00510 (0.0377)
rfavdraw_sal		0.243*** (0.0293)	0.0322 (0.0589)	-0.0350 (0.0599)	0.00940 (0.0497)
rtightdraw_sal		-0.0826** (0.0391)	-0.105 (0.0702)	0.00925 (0.0597)	0.00992 (0.0513)
rfavlose_sal		omitted (.)	-0.132* (0.0678)	0.0510 (0.0864)	0.0521 (0.0635)
rtightlose_sal		0.151** (0.0747)	0.153*** (0.0521)	-0.0265 (0.0383)	0.00926 (0.0435)
oldfirm_draw	0.394*** (0.112)	0.394*** (0.112)	0.394*** (0.112)	0.393*** (0.112)	0.394*** (0.112)
oldfirm_close	0.425*** (0.0530)	0.425*** (0.0531)	0.425*** (0.0530)	0.424*** (0.0530)	0.425*** (0.0531)
oldfirm_rlose	0.291*** (0.0480)	0.290*** (0.0481)	0.291*** (0.0480)	0.290*** (0.0479)	0.290*** (0.0481)
cvstr	-0.00825 (0.0221)	-0.0107 (0.0217)	-0.00931 (0.0217)		0.000774 (0.0235)
rvstr	-0.00451 (0.0214)	-0.00601 (0.0201)	-0.00868 (0.0218)		-0.0132 (0.0211)
chome	0.0249 (0.0336)	0.0211 (0.0340)	0.0364 (0.0340)	0.0219 (0.0340)	0.0279 (0.0344)
rhome	0.0214 (0.0321)	0.0284 (0.0315)	0.0300 (0.0331)	0.0221 (0.0320)	0.0178 (0.0323)
ctv	0.0606* (0.0336)	0.0549* (0.0333)	0.0757** (0.0326)	0.0564* (0.0335)	0.0644* (0.0351)
rtv	0.0459* (0.0271)	0.0507* (0.0269)	0.0620** (0.0277)	0.0518* (0.0276)	0.0400 (0.0273)
cimp	0.0799* (0.0451)			0.0774* (0.0440)	0.0780* (0.0470)
rimp	0.0941* (0.0530)			0.0816 (0.0519)	0.0939* (0.0536)
oldfirm_imp	0.107 (0.0731)	0.107 (0.0733)	0.106 (0.0731)	0.107 (0.0731)	0.107 (0.0733)
intercept	4.230*** (0.0140)	4.231*** (0.0140)	4.230*** (0.0140)	4.230*** (0.0140)	4.230*** (0.0140)
N	3200	3200	3200	3200	3200

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

C Mixed effects model

Subdivision-specific estimates of difference from the average coefficient using the mixed effects model.

subdivision	oldfirm_close		oldfirm_rlose		cfavlose		rfavlose	
	est	se	est	se	est	se	est	se
Average	.4098667	.0265469	.2791021	.0318814	-.0183021	.0429036	-.0241429	.0379596
1	-3.51e-10	.0000178	.0145717	.0886246	-.0095377	.0894032	4.19e-11	3.16e-06
2	4.80e-10	.0000178	-.0409088	.0907704	-.0320484	.0906564	3.11e-11	3.16e-06
3	-2.25e-09	.0000178	.0137195	.0829717	-.0188492	.0857157	-8.82e-11	3.16e-06
4	-5.77e-10	.0000178	-.0761421	.0756436	-.0839154	.0802242	1.04e-12	3.16e-06
5	1.16e-09	.0000178	.0026258	.075548	-.0258421	.0803736	-5.05e-11	3.16e-06
6	-2.27e-09	.0000178	.0157724	.0774168	-.0346071	.0819714	7.07e-11	3.16e-06
7	2.82e-10	.0000178	.0409148	.0703918	.0416579	.0760176	-3.17e-11	3.16e-06
8	2.57e-09	.0000178	-.0749129	.077453	.0480438	.0802122	8.06e-11	3.16e-06
9	1.11e-09	.0000178	.0966942	.0815901	-.0189568	.0854004	-1.77e-11	3.16e-06
10	-6.59e-11	.0000178	.0363059	.0763423	-.0023609	.0810696	-5.81e-11	3.16e-06
11	-1.93e-09	.0000178	.0295256	.0794474	-.0098541	.08332	7.16e-11	3.16e-06
12	1.71e-09	.0000178	.0022421	.0855686	-.0097254	.0873371	-2.17e-11	3.16e-06
13	-9.01e-10	.0000178	-.0970828	.0815881	.05686	.0831927	3.59e-11	3.16e-06
14	-5.82e-13	.0000178	-.0736117	.0794008	.0474526	.0817793	-4.90e-11	3.16e-06
15	-1.43e-09	.0000178	-.0805147	.0751176	-.0256493	.079118	-5.56e-11	3.16e-06
16	-2.48e-09	.0000178	.0571618	.0777625	.0284044	.0820093	-2.77e-11	3.16e-06
17	1.25e-09	.0000178	.023115	.0776008	.0039263	.081798	7.74e-11	3.16e-06
18	-3.34e-09	.0000178	-.0254234	.0696729	-.0142166	.0752988	-8.06e-11	3.16e-06
19	5.59e-10	.0000178	-.0348854	.0840499	-.053969	.086357	-7.09e-12	3.16e-06
20	5.03e-09	.0000178	.1320052	.0703782	-.041735	.0781926	-8.76e-11	3.16e-06
21	-1.46e-09	.0000178	.0287002	.0801809	-.0467895	.0841426	3.75e-11	3.16e-06
22	-1.73e-09	.0000178	-.0463458	.0822698	.0236056	.0844319	-6.21e-12	3.16e-06
23	2.93e-10	.0000178	.0501145	.0737266	.0964271	.0781128	6.91e-11	3.16e-06
24	3.13e-09	.0000178	.0334464	.0827286	-.0120527	.0856436	-1.92e-11	3.16e-06
25	2.92e-09	.0000178	.0095051	.074862	-.0304066	.0799846	3.68e-12	3.16e-06
26	-1.77e-09	.0000178	.0174798	.0854602	.0438677	.0870294	3.86e-11	3.16e-06
27	1.61e-09	.0000178	.0043046	.081856	-.009639	.0848042	1.68e-11	3.16e-06
28	4.31e-09	.0000178	.0711645	.0675177	-.0654568	.0755525	-7.93e-11	3.16e-06
29	-2.76e-09	.0000178	-.0932648	.0744157	.0716652	.0772259	4.76e-11	3.16e-06
30	-3.12e-09	.0000178	-.0073519	.0730897	.1064985	.076761	5.66e-11	3.16e-06

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