Analysing the Impacts of Football Matches on Domestic Abuse Incidents; A Case Study for the Strathclyde Police Area

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Abstract: This report presents results from an analysis conducted with the specific objective of identifying the possible effects of Scottish Premier League games on domestic abuse incidents within the Strathclyde Police area.

This analysis was performed principally to measure the extent and significance of long-held beliefs that there exists a positive relationship between domestic abuse incidents and football matches. The second factor that motivated this study was the need to investigate the potential presence of persistence or long term memory in terms of responses of domestic abuse incidents to football matches.

The events included in the analysis were matches played by Celtic, Kilmarnock, Motherwell and Rangers between 1st April 2004 and 6th April 2009. Results suggest that a statistically significant positive relationship does indeed exist between domestic abuse incidents and football matches albeit varying in magnitude between Divisions. For example, while in A Division the overall effects of matches involving the above four teams where found to increase the number of domestic abuse incidents by 5.6%, G Division shows an increase of 23%; effects in other Divisions ranged from 9.4% to 16.7% increases. Of equal importance was also the finding that the persistence of an incident was identified as almost non-existent in all but, on average, 2.5% of incidents that continue into the following day.

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Data

Data for domestic abuse incidents were collected from the Force's Vulnerable Persons database and represented the number of incidents at daily frequency over the period April 1st, 2004 to April 6th 2009. These were further distributed by Divisions given the prior expectation that abuse patterns might differ between areas within the Force area.

Football events data were obtained to cover all league, league cup, Scottish cup and Scotland games. Games, dates and results were collected from relevant websites (SPL, SFA, UEFA etc…).

Team/match selection was based on those teams that played in the Scottish Premier League and originated from the Strathclyde area. Over the sample period, initial teams included were Celtic, Hamilton, Kilmarnock, Motherwell, Rangers and St Mirren.

In order to contextualise the above data-sets, two discreet variables were constructed. These represented weekends and festive/bank holidays periods (FBH) where the former covered Friday, Saturday and Sunday while the latter accounted for Valentine (2 days), Easter (4 days), May day weekend (3 days), May Spring weekend (4 days), September weekend (4 days), Christmas, (24, 25 and 26 December) and New Year (31 December, 1 and 2 January).

A third discreet variable was further constructed representing events where two Strathclyde teams would meet on match day. The hypothesis to be tested was as to whether the propensity of domestic abuse incidents to increase by a greater margin when a Strathclyde team played a team from outside Strathclyde or indeed when the game was against a team from within the area.

Methodology.

The analytical methodology consisted of estimating the unknown parameters of a system of equations where variations in the dependent variables (level of domestic abuse incidents) could be explained by variations in the explanatory variables namely, games between teams from the Strathclyde area, games played by the teams listed in

the above Data section, weekends and festive/bank holiday periods. Equations were specified for each Division since, intuitively, it could not be assumed that the population in all eight Divisions will support identical football teams nor that incidents of domestic abuse occur at the same rate or indeed are influence by football events.

Equations' functional form further included a variable that represented a one-day lag of domestic abuse incidents in order to account for the autoregressive nature of this particular type of incidents (ie where the count of incidents for a particular day is partly a function of the count on the previous day). Applying econometric univariate tests on Divisional incident variables revealed that an autoregressive pattern was indeed present specifically over weekends and FBH periods. Thus, removing this effect ensured a greater validity of the parameters describing the effects of football games.

Resulting effects were expressed as elasticities where the latter is a measure of the responsiveness of domestic abuse incidents to a unit increase in the performance of teams included in the model, weekends and (FBH) periods.
With respect to the timing of the games (ie a 12 noon or 15:00 kick-off), this effect was not modelled given the assumption that the timing of games was implemented more for the purpose of avoiding disturbances inside stadia rather than more general breaches of public order away from football grounds.

Results

Results confirmed the original hypothesis by identifying a statistically significant relationship between football events and domestic abuse incidents. While the measure of this relationship, given as the percentage of variation explained, differs across Divisions (lowest 8.6%, A Division; highest 26.3%, B Division), the variation in number domestic abuse explained by football events across the Strathclyde was estimated to be 18.7%.

Turning to the effect of individual football teams, the first observation was that the model reported the effects of Hamilton and St Mirren as being statistically insignificant. While these findings do not infer a complete absence of effect on

domestic abuse from these two teams, the confidence with which one could deduce that an effect does exist was statistically too insignificant to be included[1]. As such, both teams were therefore excluded from the model. Causal effects of the remaining teams (Celtic, Kilmarnock, Motherwell and Rangers) on total numbers of domestic abuse incidents distributed by Division are reported in Tables 2 and 4 as well as effects caused by the occurrence of FBH and weekend periods.

It is worth noting in the first instance figures reporting the movements in and daily average number of incidents over the sample period for weekends and match days. In all Divisions, it can be observed that the percentage movement over the selected days is positive ranging from a 37% increase in G Division to 73% in L Division while the Force average is 50% (Table 1). With respect to daily averages, a minimum figure of 2.26 total incidents is reported for A Division while a high of 14.77 total incidents is recorded in B Division against a Force average of 9.74 incidents. Considering daily averages and percentage changes jointly, the two sets of data are found to be negatively correlated by a factor of 0.61; that is to say that where the daily average decreases, the percentage change figure increases. This inverse relationship suggests that in Divisions where the daily average is lower that the Force average, the percentage change is likely to be much larger than where the daily average exceeds the Force average. Where however the inverse is observed, it may be an indication that domestic abuse incidents occur following a more regular pattern through the week and at a level higher than those Divisions with a low daily average figure.

[1] Conventionally, for an effect to be said significant, parameters must show a 95% confidence level. In the case of Hamilton and St Mirren, confidence levels were 16 and 11 percent respectively.

Table 1 – Force Average Effects on all Domestic Abuse Incidents.

	FORCE Averages			
Increases from:	WMDs	Daily	Elasticity	Proportion
Celtic			3.23%	13.20%
Kilmarnock			0.13%	0.52%
Motherwell			0.56%	2.29%
Rangers			10.31%	42.18%
Derby			2.54%	10.40%
Weekends			6.93%	28.34%
F&BH			0.75%	3.07%
Observed	50.37%	9.74		
Football Games			14.22%	58.19%
Total			21.91%	

NB: see Table 2 notes.

The exception is A Division where neither the daily average nor the percentage change exceeds the Force average. This may be explained in part by a low residential population density within the Division although a significantly large transient population resides in the Division specifically during weekends and FBH periods. This is supported by the magnitude of the weekends elasticity (responsiveness factor) for A Division which is found to be higher than in the other 7 Divisions. Furthermore, Table 1 shows that the proportion of the estimated increases in domestic abuse due to weekends is significantly higher than in other Divisions (57.55%). In the case of A Division, it is therefore fair to say that weekends have greater effects on the number of domestic abuse incidents than either football events or FBHs.

Turning to the issue of how domestic abuse numbers are affected by football matches, results show that the extent of these effects differs quite markedly between Divisions, ranging between 5.61% in A Division and 22.98% in G Division in terms of responsiveness against a Force average of 14.22%.

A pattern that however seems to repeat itself across all Divisions is the ranking of individual teams' effects based on the magnitude of their respective influence on domestic abuse incidents. The ranking (in ascending order) is Kilmarnock, Motherwell, Celtic and Rangers of which the largest effect is found to be in G Division as per prior expectation and accounting for marginally under 57% of the total estimated effects. It can nevertheless be observed that the gap between the two consistently dominant teams, Rangers and Celtic, varies across Divisions. For example, in L Division, the difference in domestic abuse incidents' responsiveness is

calculated at 2.28% while in G Division, the gap between the two teams rises to 14.83%. This differential may therefore give indications of the relative importance placed on football teams in the various geographical locations of the Force area and go some way , albeit probably small, towards explaining an underlying population separability.

A salient point that has to be noted at this stage is that while, by virtue of how the discreet variables that represented football teams' performance and their subsequent effects on domestic abuse numbers were formulated, the more immediate inference was that as a team's performance increases in terms of successes, domestic abuse numbers increase. This may however not always be the case in that one cannot dismiss adverse reactions to successes from opposing teams as a causality for domestic abuse. Essentially, perfect separability of information indicating as to which individuals react to which team depending on that team's performance and whether a positive or negative reaction is recorded could not be modelled due to lack of socio-demographic/cultural information on both victims and accused.

Considering the effects from matches involving two Strathclyde teams, result Tables report the effects of the 'derby' impact. It is observed that at Divisional level, lowest and highest values are found in the same Division for both total number of incidents and incidents involving repeat accused. With respect to the former, the effect is found to be 1.22% in A Division while B Division shows a value of 4.61% against a Force average of 2.54%. The magnitude of the extremes for repeat accused incidents in A and B Divisions stand at 1.07% and 5.23 respectively while the Force average is 2.62%.

Given the above observations that in some Divisions the increase in the number of domestic abuse incidents is not as pronounced as either in other Divisions or indeed as would have been expected, it was felt that further probing of the data averred itself necessary. In view of the previously observed gap between observed marginal increases and daily average numbers of incidents resulting in varying levels of responsiveness in domestic abuse such that it was inferred that where the responsiveness is lower than expected, there may be the presence of a greater continuity in incident occurrences throughout the week, a second model was estimated where the variables to be explained were those representing incidents which involved repeat offenders. The model was estimation along the same criteria as for

total number of incidents. Results, shown in Table 3 for Force averages and Table 4 for Divisions.

From Table 3, it can be observed that with respect to percentage increases in incidents and daily average incidents are reported to be lower under repeat accused. This is as expected since from the raw data, 90.5% of total incidents over the sample period involved a repeat offender (rising to 91.9% during WMDs periods).

In terms of overall estimated effects (football games, weekends and FBHs), causal percentage increase in repeat offender incidents at Force level was found to be higher (22.12%) than for total incidents (21.91%).

Table 3 – Force Average Effects on Repeat Accused Domestic Abuse Incidents.

	FORCE Averages			
Increases:	WMDs	Daily	Elasticity	Proportion
Celtic			3.62%	14.63%
Kilmarnock			0.12%	0.48%
Motherwell			0.53%	2.15%
Rangers			9.90%	40.02%
Derby			2.62%	10.60%
Weekends			7.10%	28.71%
F&BH			0.85%	3.42%
Observed	48.72%	8.96		
Football Games			14.17%	57.27%
Total			22.12%	

Turning to the effects of football games, it can be observed that overall, the increase in domestic abuse incident involving a repeat offender is only marginally lower than when all incidents are considered. However, when looking at individual teams, results show that while the effect of Celtic's performance increases repeat offenders incidents by a higher margin than it does total incidents, Rangers' performance tends to increase such incidents by a lower margin than it does total incidents. It is therefore fair to infer that, at Force level, Celtic's performance tends to impact more on repeat incidents than Rangers does. This, however, also infer that Ranger's performance tends to generate more first time-reported incidents regardless of whether it really was a first-time incident or whether it is cases of repeat incidents never before reported.

Considering repeat incidents at Divisional level, summarised raw data show that in all Divisions, the daily average is as expected, lower than for total incident although only marginally. With respect to percentage changes over WMD periods, repeat incidents show increases ranging from 33.9% in B Division to 59% in Q Division.

Turning to effects caused by football games, it can be observed that as in the results for 'All Incidents', the two dominant teams (Rangers and Celtic) exhibit responsiveness factors (elasticity) significantly larger in magnitude than Kilmarnock or Motherwell. Note however that while the elasticities of the latters indicate only minimal levels of responsiveness, it nevertheless remains that these were statistically significant in explaining part of the variations in repeat accused incidents. Whilst reporting responsiveness factors of repeat accused incident, figures in Table 4 further enables a numerical extrapolation of first-time reported incidents.

Given the way in which the elaticities were computed, it is not possible to directly compare Table 2 with Table 4 and thus, elasticities must be applied to observed domestic abuse numbers. For example, assuming that Rangers played at Ibrox, on a Saturday which was also a bank holiday weekend and played against another team from the Strathclyde area. Such a game was played on 27/12/2008, against Celtic, which Rangers lost. Employing domestic abuse data from the previous day from G Division, each relevant elasticity is applied to the observed numbers, producing the net increase attributable to the football event in question and period of the year. Details, shown in Table 5, indicate that one of the observed 30 total incidents, 28 repeat accused incidents and 2 first-time reported incidents, 17, 16 and 1 incidents respectively were attributable to that particular match and period of the year.

Table 5 – Incidents Changes from Football and Year Period

	Total Incidents	Responsiveness Factors		Repeats accused	FTR
	13			13	
Rangers	2.396719	0.184363	0.149471	1.943129	
Weekend	0.678878	0.052221	0.057297	0.744858	
F&BH	0.131687	0.01013	0.010703	0.139144	
Derby	0.431213	0.03317	0.030143	0.391858	
Total	17			16	1
Increase	30.77%			23.08%	
Observed	30			28	2

Lastly, an attempt was made to identify whether incidents, specifically those generated as a results of the factors analysed, were transient in nature or rather would 'spill' into subsequent time periods. In order to ascertain the potential inter-temporal persistence of those effects found to have been significant, a method referred to as Impulse Response Function was applied. If indeed even mild persistence was to be present in the data, the outcome of such an analysis would indicate the number of incidents remaining at specific time periods from previous periods. Results demonstrated conclusively that 97.5% of incidents are in fact transient in that no inter-temporal continuity could be detected. It can therefore be concluded that, of those incidents affected by football games, these do not continue into the next time period.

Table 2 – Effects on all Domestic Abuse Incidents.

			A				B				G				K	
Increases:	WMDs	Daily	Elasticity	Proportion	WMDs	Daily	Elasticity	Proportion	WMDs	Daily	Elasticity	Proportion	WMDs	Daily	Elasticity	Proportion
Celtic			0.69%	4.26%			4.13%	12.50%			3.60%	11.07%			1.06%	4.61%
Kilmarnock			0.10%	0.61%			0.22%	0.66%			0.15%	0.46%			0.14%	0.60%
Motherwell			0.55%	3.39%			0.89%	2.68%			0.79%	2.43%			0.48%	2.08%
Rangers			4.28%	26.59%			16.05%	48.59%			18.44%	56.67%			11.37%	49.57%
Derby			1.22%	7.60%			4.61%	13.95%			3.32%	10.20%			2.09%	9.11%
Weekends			8.56%	53.17%			6.81%	20.61%			5.22%	16.05%			7.05%	30.74%
F&BH			0.70%	4.38%			0.33%	1.01%			1.01%	3.11%			0.75%	3.28%
Observed	43.96%	6.26			38.48%	14.77			37.02%	10.40			50.56%	8.62		
Football games			5.61%	34.85%			21.28%	64.43%			22.98%	70.64%			13.04%	56.86%
Total Estimated			16.09%				33.03%				32.53%				22.93%	

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	WMDs	Daily	Elasticity	Proportion	WMDs	Daily	Elasticity	Proportion	WMDs	Daily	Elasticity	Proportion	WMDs	Daily	Elasticity	Proportion
Celtic			3.28%	19.16%			5.15%	18.95%			3.44%	15.23%			4.48%	18.55%
Kilmarnock			0.10%	0.59%			0.16%	0.59%			0.08%	0.37%			0.06%	0.26%
Motherwell			0.40%	2.34%			0.78%	2.87%			0.29%	1.29%			0.31%	1.27%
Rangers			5.56%	32.49%			10.61%	39.09%			8.11%	35.93%			8.07%	33.42%
Derby			1.25%	7.30%			2.87%	10.59%			2.26%	9.99%			2.72%	11.25%
Weekends			5.90%	34.47%			6.75%	24.86%			7.58%	33.58%			7.56%	31.33%
F&BH			0.63%	3.66%			0.83%	3.04%			0.81%	3.60%			0.95%	3.92%
Observed	73.46%	6.32			54.22%	11.26			65.65%	8.12			39.62%	12.17		
Football games			9.35%	54.57%			16.70%	61.51%			11.93%	52.82%			12.91%	53.50%
Total			17.13%				27.15%				22.59%				24.14%	

NB:

1 – Observed average increase in domestic abuse incidents on match days and weekends from the previous day.

2 – Observed average number of incidents on match days and weekends.

3 – Estimated responsiveness factor by which domestic abuse incidents increase.

4 –Fraction of Estimated percentage effects accounted for by each football team, weekends and F&BHs.

F&BH represents festive days and bank holidays while WMD represents Weekends and festive/bank holiday periods.

Table 4 – Effects on Domestic Abuse Incidents Involving a Repeat Accused.

	A				B				G				K			
	WMDs	Daily	Elasticity	Proportion	WMDs	Daily	Elasticity	Proportion	WMDs	Daily	Elasticity	Proportion	WMDs	Daily	Elasticity	Proportion
Celtic			2.02%	14.95%			0.74%	2.48%			4.44%	14.80%			1.90%	8.54%
Kilmarnock			0.07%	0.54%			0.19%	0.65%			0.13%	0.43%			0.11%	0.47%
Motherwell			0.45%	3.35%			0.76%	2.55%			0.66%	2.21%			0.42%	1.90%
Rangers			3.27%	24.14%			15.10%	50.51%			14.95%	49.84%			9.31%	41.92%
Derby			1.07%	7.90%			5.23%	17.50%			3.01%	10.05%			1.92%	8.67%
Weekends			5.79%	42.78%			7.42%	24.83%			5.73%	19.10%			7.69%	34.62%
F&BH			0.86%	6.34%			0.44%	1.47%			1.07%	3.57%			0.86%	3.88%
Observed	50.25%	5.71			33.90%	13.60			40.74%	9.43			54.89%	7.85		
Football Games			5.81%	42.97%			16.79%	56.20%			20.18%	67.28%			11.73%	52.83%
Total			13.53%				29.88%				29.99%				22.21%	

	L		N		Q		U	
	Elasticity	Proportion	Elasticity	Proportion	Elasticity	Proportion	Elasticity	Proportion
Celtic	5.71%	25.03%	7.27%	22.94%	2.54%	11.13%	4.33%	17.32%
Kilmarnock	0.13%	0.57%	0.18%	0.58%	0.10%	0.43%	0.03%	0.11%
Motherwell	0.53%	2.34%	0.88%	2.78%	0.33%	1.45%	0.21%	0.85%
Rangers	7.58%	33.23%	11.78%	37.14%	8.44%	37.04%	8.80%	35.17%
Derby	1.60%	7.03%	3.34%	10.54%	2.52%	11.04%	2.28%	9.12%
Weekends	6.55%	28.74%	7.43%	23.43%	7.95%	34.88%	8.27%	33.06%
F&BH	0.70%	3.07%	0.82%	2.58%	0.92%	4.04%	1.09%	4.36%
Observed	57.30%	5.87	46.64%	10.54	58.89%	7.52	47.11%	11.19
Football Increase	13.95%	61.17%	20.12%	63.45%	11.41%	50.04%	13.38%	53.45%
Total	22.80%		31.71%		22.79%		25.03%	