Appendix to Crematoria: evidence on competition between crematoria – Econometric entry analysis

Introduction

1. We have conducted a Performance Concentration Analysis (PCA) to test how crematoria volumes and fees respond to the entry of another crematorium within their local area. In doing so, we estimate the effect of entry on an incumbent crematorium's volume and standard cremation fee, and assess whether local authority and private incumbents' responses to entry differ.

2. This appendix describes the data, sets out the methodology used and its strengths and limitations, reports the results (these are summarised in the main body of the paper) and covers an extension of the main analysis.

Data

3. We based our analysis on the following data for each year from 2007[1] to 2018 from:

    (a) the Cremation Society's annual survey of crematoria – each crematorium's volume and standard cremation fee (referred to as 'fee' throughout this appendix);[2] and

    (b) the Institute of Cemetery and Crematorium Management (ICCM) – year of crematorium's entry, operator and postcode.

4. We used the postcode data to estimate the drive times at normal speed[3] between crematoria within 60 minutes of each other. This data is then used to calculate the number of alternative crematoria for each crematorium and year within the following drive time bands: 0-10, 10-20, 20-30 and 30+ minutes.

5. There are two main caveats for the data used in this analysis:

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[1] Using data from 2007 enables the estimation of the effect of entry from 2008 onwards.
[2] In the working paper Crematoria: outcomes we note in paragraphs 11 and 12 that there are differences in Cremation Society fee data and that collected by Dignity/Trajectory, but that we do not consider this to be material in most cases. Though the Cremation Society fees may be lower, in some instances compared to the Dignity/Trajectory collected fees, it could be assumed that entry will have proportionally the same impact on both sets of fees. If this was the case, then this data error would have limited effect on the results of this analysis.
[3] If using cortege drive times, the drive time bands would be expanded by the 5/3 factor used to calculate cortege drive time from normal drive time. For reference a 30 minutes cortege drive time is equivalent to an 18 minutes normal drive time.

(a) first, there are no exits in the data set, only entries. So, this analysis does not estimate the effect of exits on volumes or fees; and

(b) second, almost all entrants are private crematoria.[4] As such, this analysis does not distinguish between entrant type. However, as almost all entries were by private providers, the results may approximate the effect of a private entrant. Therefore, if the effect from a local authority entrant was significantly different to the effect from a private entrant, then the results of this analysis could not be applied to instances of local authority entry.

6.   Table 1 below, shows the number of entries experienced by incumbents during the time period covered by the data set, split by drive time band and type of incumbent (local authority or private crematorium). A crematorium may enter in a location within multiple incumbent crematoria drive time bands, particularly in drive time bands which are further away. Table 1 shows that this is the case. For example, incumbent crematoria experienced 78 entry events within a 20-30 minute drive time during the relevant period (with 48 events experienced by local authority crematoria and 30 by private crematoria).

7.   The representativeness and the reliability of the estimated impacts of entry on volumes and fees depend on the number of observations available: the higher the number of entries experienced by incumbents, the more robust our results are likely to be. Only two crematoria (both local authority crematoria) experienced entry within the 0-10 minute drive time band and only seven private crematoria experienced entry within the 10-20 minute drive time band. The small number of observations in these drive time bands is likely to affect the robustness of the corresponding results (noted with a "†" in Table 2 and Table 3, and described further in paragraph 18 below).

Table 1: Number of entries experienced by incumbent type within each drive time band, 2008 – 2018

		Incumbent Type	
Drive time band (min)	All	Local authority	Private
0-10	2	2	0
10-20	35	28	7
20-30	78	48	30
30+	549	366	183

Source: CMA analysis.

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[4] 46 instances of entry took place from 2008 to 2018, of which 44 were private crematoria entry. This analysis excludes the 3 replacements between 2008 and 2018 as these events do not change the number of crematoria in the area.

Econometric model

8.   Our econometric model allows us to estimate the average effect of one additional crematorium on an incumbent's volume or fee. This is done through a fixed effects approach. This technique enables us to control for factors which, to a large extent, are constant over time, for example local factors such as crematorium chapel size. More specifically, our specification captures the relationship between changes in the volume or fee generated at each crematorium and the variation (due to entry) in the number of crematoria within each drive time band.[5] We estimate the following reduced form regression:

$$\log(Y_{it}) = \sum_d \beta_d N_{d,it} + \delta_i + \delta_t + \varepsilon_{it}$$

Where Y_{it} is either the volume or fee for crematorium i in year t; $N_{d,it}$ is the number of crematoria within drive time band d of crematorium i in year t; δ_i and δ_t are crematorium and year fixed effects respectively; and ε_{it} is the error term.

9.   For each drive time band, as set out in paragraph 4, the model estimates a coefficient (β_d) which approximates the average percentage change in the volume or fee at an incumbent crematorium following entry of an additional crematorium in the given drive time band.[6] If a coefficient is negative and significantly different from zero, it means that volume or fee decreases following the entry of an additional crematorium within the relevant drive time band.

10.   We estimate an additional specification of the econometric model to assess whether the impact on volumes or fees from entry is significantly different between local authority and private incumbent crematoria. This estimation is performed by adding an interaction term for each drive time band to the reduced form regression above. The interaction term is the number of

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[5] The variation is measured with respect to the average number of crematoria within each drive time band.
[6] Our analysis does not take account of the fact that in a few instances the entrant is operated by the same crematoria provider as the incumbent (that is, this type of entry does not change the fascia count). In particular, within a 10-20 minute drive time there is one incumbent crematorium (out of 35 entry experiences) where the entrant and incumbent are operated by the same provider, and within the 20-30 minute drive time band there are seven incumbent crematoria (out of 78 entry experiences) where the entrant and incumbent are operated by the same provider. Where entry occurs and an incumbent and entrant are operated by the same provider the entrant and incumbent are typically relatively far apart (and never closer than a 19.8 minute normal drive time), and typically face other, closer, rivals (in 6 out of the 8 instances there are at least two other closer crematoria to the incumbent than the entrant). This would likely weaken any pricing incentive the operator may have as a result of operating two crematoria in the same local area. In these instances of entry, the price changes at incumbent in the year of entry compared to other years between 2008-2018 does not appear materially different on average (we compared the CAGR in fees over the period 2008-2018 with the fee change between the year before entry and the year of entry and found that on average these differences are zero). As such, we do not expect entry by an operator who is also an incumbent in the same area to materially affect our analysis.

crematoria within each drive time band from the incumbent crematorium multiplied by a dummy variable for whether the incumbent crematorium is privately operated.

11.   Under the additional specification, for each drive time band, the coefficient β_d approximates the average percentage change in the volume or fee at an incumbent local authority crematorium following entry within the relevant drive time band. The coefficients to the interaction terms estimate the difference between private and local authority incumbent crematoria's average percentage change in volume or fee following entry within the relevant drive time band. This means that the estimated average effect of entry on incumbent private crematoria can be obtained as the sum of the two coefficients within the same drive time band.

12.   The estimated effect of entry on incumbent private crematoria is considered statistically different from the estimated effect on incumbent local authority crematoria[7] if the coefficient to the interaction term is statistically significant in Table 2 and Table 3.

Strengths and limitations

13.   The principal concern in a PCA is that the extent of local competition (that is, the number of crematoria in a local area) is driven by factors such as local costs and characteristics of demand that also affect crematorium performance, in this case, volume or fee. This would bias the results, as we would wrongly be conflating the impact of such factors on performance with that of local competition.[8] Whether this bias causes the model to under- or over-estimate the impact of competition depends on how these omitted factors affect performance.

14.   The fixed effects regression helps to address this concern, by holding constant all crematoria-specific and area-specific factors that do not vary over time.[9] Our econometric model also accounts for effects that change over time and are common to all crematoria through the year fixed effect (δ_t).[10]

15.   Even so, it is possible that there are local factors that vary over time that are correlated with both local competition and performance. Again, omitting these

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[7] That is, that the estimated change in volumes or fees after entry at private incumbents is different to the change at local authority incumbents.
[8] For example, not accounting for mortality rate may result in an upward bias. An area with a higher mortality rate may have more crematoria but these crematoria may also have higher volumes and/or fees. This introduces a positive relationship between volume and/or fee and the number of crematoria in an area, which confounds the competition effect.
[9] For example, crematorium chapel size.
[10] For example, national trends and general price inflation.

factors from the model would bias the results. For example, increases in local demand are likely to attract new entrants and also increase the volumes and/or fees at crematoria. This would cause a positive bias in the results, because entry would be wrongly associated with increases in volumes and/or fees.

16.   A positive bias means that negative numbers should be more negative and positive numbers should be smaller (or non-significant) compared with the estimated effect.[11] Therefore, although we can give more weight to statistically significant negative coefficients (ie once the bias is accounted for these coefficients would remain negative), we are more cautious in non-significant results or statistically significant positive results that are close to zero.[12]

17.   More generally, the interpretation of a non-significant result is that our estimation is not precise enough to capture a statistically significant effect. That is, non-significance in statistical terms is a lack of evidence, rather than being evidence of a lack of effect. Non-significance could be due to the following reasons:

   (a) New entrants genuinely do not compete with the incumbent, and so there is no evidence to be found.

   (b) The model is unable to detect any effect of entry due to a small number of these events over the period. In this case any effect of entry is dwarfed by other variation in the dataset, leading to imprecise results.

18.   We note that there are in fact a reasonable number of entry events across most drive time bands and both incumbent types over the period considered (as described in paragraphs 6 and 7). However, for the 0-10 minute drive time band and for private incumbents in the 10-20 minute drive time band, we have noted that there are relatively few entry events. The identification of the entry effects on performance relies on variation in the number of competing crematoria over time. Therefore, for these specified drive time bands, there may not be a sufficient number of events to robustly estimate the coefficients. In our interpretation of the results we therefore place less weight on coefficients that have a low number of entry events (noted with a "†" in Table 2 and Table 3).

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[11] We do not know the magnitude of the bias, nor the extent to which this bias will differ across local areas.
[12] A large statistically significant positive coefficient is more likely to remain positive and statistically significant, than a positive result which is close to zero, once the bias is accounted for.

Results

19.	Where we draw on specific results in the text below, we identify the relevant coefficient, and its statistical significance, from the tables in brackets. The asterisks indicate that the result is significantly different from zero with the following confidence levels: *90%, **95%, ***99%.

20.	Table 2 presents the results of the model and additional specification for volumes. The dependent variable is in logarithms, so the coefficients in the table (multiplied by 100) approximate the percentage change in volumes resulting from the entry of an additional crematorium within a given drive time band.

21.	Overall the results suggest that:

(a) Entry has a statistically significant impact on volumes and that this effect decreases the further away entry occurs. For example, column (1) shows that one additional crematorium within the 10-20 minute drive time band reduces an incumbent's volume by 20% (-0.203***). This effect decreases to approximately a 7% (-0.0673**) reduction when the additional crematorium is within the 20-30 minute drive time band. The effect on volumes from an additional crematorium in the 30+ minute drive time band is found to not be significantly different from 0 (-0.00823).

(b) For most drive time bands, at the 95% confidence level the effect of entry on volumes does not significantly differ by incumbent type. The exception is in the 30+ minute drive time band. Column (2)[13] shows that in this drive time band, a local authority's volume is reduced by approximately 2% (-0.0244***) whilst a private's volume increases by approximately 3% (-0.0244*** + 0.0586***). We would not expect entry to lead to increased volumes at incumbent crematoria, particularly those that are over 30-minutes normal drive time away.[14]

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[13] See paragraph 11 for a description of the interpretation of coefficients in the additional specification.
[14] See for example paragraph 16 of the working paper Crematoria: Background and Market Structure.

Table 2: Estimated percentage volume effect on incumbent crematorium from entry

Drive time band (min)	(1) Ln (volume)	(2) Ln (volume)
0-10	-0.306***†	
	(0.0838)	
10-20	-0.203***	
	(0.0337)	
20-30	-0.0673**	
	(0.0318)	
30+	-0.00823	
	(0.00782)	
Effect on local authority (LA):		
0-10		-0.288***†
		(0.0864)
10-20		-0.174***
		(0.0373)
20-30		-0.0965***
		(0.0226)
30+		-0.0244***
		(0.00783)
Effect on private:	*(difference to effect on LA)*	
0-10		*No instances*
		(0)
10-20		-0.118*†
		(0.0712)
20-30		0.0647
		(0.0804)
30+		0.0586***
		(0.0176)
Observations	3,209	3,209

Source: CMA analysis.
† denotes drive time bands in which a small number of incumbents experienced entry.
Note: Standard errors are reported in parenthesis. All standard errors are clustered at the crematoria level. Asterisks indicate that the result is significantly different from zero with the following confidence levels: *90%, **95%, ***99%.

22.   Table 3 presents the results of the model and additional specification for fees. The dependent variable is in logarithms, so the coefficients in the table (multiplied by 100) approximate the percentage change in fees resulting from the entry of an additional crematorium within a given drive time band.

23.   Overall the results suggest that:

(a) There is a limited impact of entry on the cremation fee charged by incumbents when not accounting for incumbent type and, when there is an impact, it is in a direction opposite to what we would expect from a competitive response (since we would expect the presence of more competitors to lead to lower fees). For example, Column (1) indicates that only entry in the 20-30 minute drive time band has a statistically significant effect on fee, where fees increase by around 2% (0.0206**) with one additional crematorium in the drive time band.

(b) When accounting for incumbent type, the effect of entry on fee is different between local authority and private incumbent crematoria. Column (2)

shows that across all drive time bands the impact of entry on a local authority crematorium's fee is not statistically significant. However, the entry effect on a private crematorium's fee is statistically significant, although the direction of the effect is opposite to what we would expect from a competitive response. Private incumbent crematoria fees increase by approximately 7% (0.0689**) with one additional crematorium within 10-20 minutes' drive time,[15] with this effect reducing the further away entry occurs – entry within 20-30 and 30+ minutes increases the fee by around 5% (0.0482**) and 2% (0.0202**) respectively.

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[15] We note that this finding is based on a small number of observations, see paragraph 7. However, if excluding this result, the finding remains that the size of the fee increase reduces as distance to the entrant increases.

Table 3: Estimated percentage fee effect on incumbent crematorium from entry

Drive time band (min)	(1) Ln (fee)	(2) Ln (fee)
0-10	0.0443†	
	(0.0494)	
10-20	0.00188	
	(0.0160)	
20-30	0.0206**	
	(0.0104)	
30+	-0.00193	
	(0.00440)	
Effect on local authority (LA):		
0-10		0.0507†
		(0.0483)
10-20		-0.00479
		(0.0174)
20-30		-0.000615
		(0.0120)
30+		-0.00759
		(0.00495)
Effect on private:	*(difference to effect on LA)*	
0-10		*No instances*
		(0)
10-20		0.0689**†
		(0.0289)
20-30		0.0482**
		(0.0198)
30+		0.0202***
		(0.00746)
Observations	3,184	3,184

Source: CMA analysis.
† denotes drive time bands in which a small number of incumbents experienced entry.
Note: Standard errors are reported in parenthesis. All standard errors are clustered at the crematoria level. Asterisks indicate that the result is significantly different from zero with the following confidence levels: *90%, **95%, ***99%.

Extension

24. In this section we explore how incumbent crematoria slot lengths are affected by entry through an equivalent version of the model, and additional specification, as set out from paragraph 8.

25. We gathered data on slot lengths from the Cremation Society's annual survey of crematoria. Due to changes in the way that the Cremation Society gathered data in relation to slot length, consistent slot length data is available from 2012 onwards. Where this data was either missing or appeared incorrect (eg slot lengths were stated as being very short) we confirmed the data with individual crematoria.

26. Having fewer years of data, compared to the main analysis, reduces the robustness of the results for this extension as the analysis uses fewer entry events and thus have fewer observations. Additionally, using fewer years of data means the coefficients reported below are not directly comparable to the results of the main analysis.

Slot length as a performance variable

27. This extension uses slot length as a performance variable, replacing volume or fee in the fixed effects model and additional specification, as set out from paragraph 8. This version of the model assesses whether incumbent crematoria slot lengths are affected by entry.

28. Table 4 presents the results of the second extension. The dependent variable is in logarithms, so the coefficients in the table (multiplied by 100) approximate the percentage change in slot length resulting from the entry of an additional crematorium within a given drive time band.

29. The results suggest that overall entry does not have a statistically significant impact on slot length.

30. Entry in the 0-10 minute drive time band was found to be significant, for example in column (1) one additional crematorium within the 0-10 minute drive time band reduces an incumbent's slot length by 7% (-0.0743***). However, as noted in paragraph 7, the small number of observations in this drive time band is likely to affect the robustness of this result.

Table 4: Estimated percentage slot length effect on incumbent crematorium from entry

Drive time band (min)	(1) Ln (slot length)	(2) Ln (slot length)
0-10	-0.0743***†	
	(0.00963)	
10-20	0.0697	
	(0.0507)	
20-30	0.00818	
	(0.0256)	
30+	-0.00529	
	(0.00987)	
Effect on local authority (LA):		
0-10		-0.0676***†
		(0.0112)
10-20		0.0529
		(0.0555)
20-30		-0.00697
		(0.0262)
30+		-0.0142
		(0.0113)
Effect on private:	*(difference to effect on LA)*	
0-10		No instances
		(0)
10-20		0.0991†
		(0.105)
20-30		0.0312
		(0.0512)
30+		0.0274*
		(0.0164)
Observations	1,912	1,912

Source: CMA analysis.
† denotes drive time bands in which a small number of incumbents experienced entry.
Note: Standard errors are reported in parenthesis. All standard errors are clustered at the crematoria level. Asterisks indicate that the result is significantly different from zero with the following confidence levels: *90%, **95%, ***99%.