COMPETITION COMMISSION

Aggregates, cement and ready-mix concrete market investigation

Aggregates price-concentration analysis and entry and exit analysis: first results

NON-CONFIDENTIAL

Contents

Section 1: Summary of results

Context

Context

- As part its local competitive assessment for aggregates, the Competition Commission (CC) has carried out an entry-and-exit analysis (EEA) and price-concentration analysis (PCA)
- We investigated whether there was any relationship between the prices paid for aggregates products and the extent of local competition
- The aim of this analysis was to assess whether, and how, the relationship between prices and the extent of competition varied by type of competitor, taking into account the size of plants and their proximity to the customer, and the identity of competitors

Purpose of the presentation

- In this slide pack we summarize the first results of EEA and PCA (along with descriptive statistics on the extent of local concentration) with the objective of providing the parties to the aggregates, cement and ready-mix concrete market investigation with an opportunity to comment on the analysis undertaken by the CC
- These first results are as of 7 January 2013, and we intend to finalize our analysis in the provisional findings report, taking into account comments received during the consultation

Our approach

- We examined the extent to which local competition impacts prices for primary aggregates using two approaches
  - An EEA examined whether openings and closures of aggregates plants near customer job-sites have had an effect on prices that customers pay, using a difference-in-differences model
  - A PCA examined the extent to which local competition impacts prices using a fixed effects panel model
- Data
  - We used transaction data, supplied by the parties, to analyse average delivered prices that customer job-site X paid for a specific type of primary aggregate from plant Y
  - Competition measures (CMs) captured the extent and composition of local competition around customers' job-sites
  - At this stage, we have carried out the analysis for [✂], [✂], and [✂], as they had supplied us the most reliable data on customer job-site locations in their transaction data
    - » [✂]
    - » [✂]

Summary: EEA results

- EEA examined whether entry and exit of primary aggregates plants have an effect on prices, and what that effect is
- We found little evidence of entry or exit of plants having an effect on prices on average
  - [✂]
  - [✂]
  - [✂]
- Our robustness checks using county-level analysis confirmed that price effects of aggregates plant entry and exit, where they are statistically significant, are small
- However, the average effects that we obtained may hide local or regional variability in competitive constraints, to the extent that they exist

Summary: PCA results (1)

- Purpose of the PCA—to test competitive constraints in local markets
  - Are prices higher in areas with fewer aggregates sites/competitors? Does the identity of competitors present in a local market impact the strength of competitive constraints? Does the size of the competitor and the proximity to the customer matter for the relationship between competition and prices?
  - Consider also whether, and how, other factors, such as quantity discounts and local demand and supply conditions, affect prices
- Mixed results, with some statistically significant price effects, which appear relatively small in magnitude (typically 1 to 2 per cent of price)
  - Significant negative (positive) price effects mean that increased local competition is associated with lower (higher) prices charged to customers; insignificant price effects mean that there is no statistically discernible effect of local competition on prices
  - Competition from other majors had sometimes negative and sometimes positive price effects, but they are often statistically insignificant
  - Competition from independent suppliers did not seem to constrain prices charged by the majors, as price effects tended to be positive and/or statistically insignificant

Summary: PCA results (2)

- Quantity discounts appear to be important in explaining variations in prices that customers pay
  - We found that larger customers pay lower prices
- When we included recycled aggregates in our PCA analysis, we found little evidence of local constraints on primary aggregates prices from recycled aggregates plants
- On their own PCA results indicate that, on average, the extent of local competition does not seem to have much impact on prices that customers pay
- But these are 'average effects', and may hide local or regional variability in competitive constraints, to the extent that they exist

Section 2: Local concentration in aggregates

Measuring local concentration in aggregates

- How concentrated are local aggregates markets? What is the makeup of local competition?
  - Here we focused on primary aggregates used in general construction
- Analysis of concentration in local areas around customer job-sites
  - We used circular areas around customer job-sites: 28 miles for job-sites located in non-urban areas and 20 miles for job-sites located in urban areas (straight-line distances)
    - » Our analysis of 80 per cent catchment areas used as basis for defining these radial distances
  - Plant and fascia counts
  - Aggregates volume share of the largest supplier (C1 concentration ratio), and the combined share of the largest four suppliers (C4 concentration ratio)
  - Combined share of the five majors
  - We used 2011 data on aggregates plants and sales/production in Great Britain, and use customer job-site data from [✂], [✂], and [✂] for delivered sales in 2011
    - » Analysis limited to these three suppliers due to data constraints

Summary of results on local concentration

- Practically all customer job-sites of the three majors analysed have more than 5 plants and competitors to choose from within 80 per cent catchment areas
  - Nearly 100 per cent of customers have more than 5 plants within 20 or 28 miles
  - Over 90 per cent of customers have more than 5 supplier fascias within 20 or 28 miles
- However, in terms of shares of aggregates volumes, we found relatively high concentration levels, particularly in some areas
  - In the catchment areas around 9 per cent of job sites, the largest firm had a market share of more than 50 per cent (C1 concentration ratio)
  - the four largest firms collectively had a market share of more than 90 per cent around 18 per cent of job sites (C4 concentration ratio)
- Majors' combined share tends to be relatively large, as most independents' plants are smaller if compared to majors' plants
  - In the catchment areas around 45 per cent of job-sites the majors collectively held a market share of 75 per cent or more
  - In the catchment areas around 8 per cent of job sites, the majors collectively held a market share of 90 per cent or more

Plant counts

Table shows the proportion of customer job-sites with a given number of primary aggregates plants within 80 per cent catchment areas in 2011

- For example, 98 per cent of customer job-sites that the three majors sold and delivered aggregates to in 2011 had more than 5 plants within 20/28 mile radius
- Plants include quarries, depots, and marine wharves

Plant count	[✂]	[✂]	[✂]	All
Up to 1 plant				0.0%
2 plants				0.2%
3 plants				0.4%
4 plants				0.5%
5 plants				0.9%
More than 5 plants				98.0%

Fascia counts

Table shows the proportion of customer job-sites with a given number of distinct primary aggregates suppliers within 80 per cent catchment areas

- For example, 94 per cent of customer job-sites that the three majors sold and delivered aggregates to in 2011 had more than 5 supplier fascias within 20/28 mile radius
- Each independent fascia here is accounted for separately

Fascia count	[✂]	[✂]	[✂]	All
1 producer				0.0%
2 producers				0.4%
3 producers				1.1%
4 producers				1.9%
5 producers				2.7%
More than 5 producers				93.8%

Concentration ratios

Table shows the proportion of customer job-sites with a given concentration ratio within 80 per cent catchment areas

- C1 measure the market share of the largest supplier, and C4 measures the combined share for the four largest suppliers
- Concentration ratios are measured in terms of primary aggregates sales/production volumes in 2011
- For example, for 55 per cent of customer job-sites the combined share of the four largest suppliers within 20/28 miles was between 75 and 90 per cent
- Although most customers have a choice of many supplier fascia (see the previous slide), C1 implies that for around 85 per cent of job-sites a single supplier has a share of more than 25 per cent

Concentration ratio	Concentration ratio range	[✂]	[✂]	[✂]	All
C1	Up to 25%				15.2%
	25% to 50%				75.6%
	50% to 75%				8.4%
	75% to 90%				0.8%
	More than 90%				0.1%
C4	Up to 50%				0.0%
	50% to 75%				26.8%
	75% to 90%				55.4%
	More than 90%				17.7%

Combined shares of the five majors

Table shows the proportion of customer job-sites with a given combined majors' share of aggregates volumes within 80 per cent catchment areas

- Shares are measured in terms of primary aggregates sales/production volumes in 2011
- For example, for 37 per cent of customer job-sites the combined share of the five majors within 20/28 mile radius was between 75 and 90 per cent
- Around 45 per cent of all job-sites have majors accounting for more than 75 per cent of primary construction aggregates volumes
- Although most job-sites have many plants and suppliers to choose from, independents' aggregates plants are on average smaller than majors' plants, therefore we get the result that majors have a large share of aggregates volumes in local markets

Combined share of majors	[✂]	[✂]	[✂]	All
Up to 50%				11.0%
50% to 75%				44.2%
75% to 90%				36.8%
More than 90%				8.1%

Recycled aggregates plant counts

Table shows the proportion of customer job-sites with a given number of recycled aggregates plants within 80 per cent catchment areas in 2011

- For example, 88 per cent of customer job-sites that the three majors sold and delivered primary aggregates to in 2011 had more than 5 plants within 20/28 mile radius
- However, the data that we use does not capture all the possible sources of supply of recycled aggregates, therefore these figures are likely to underestimate the availability of recycled aggregates
- Most recycled aggregates plants are small, with half of recycled aggregates plants in our data producing less than 50 kt per year

Plant count	[✂]	[✂]	[✂]	All
Up to 1 plant				2.4%
2 plants				1.9%
3 plants				2.8%
4 plants				2.4%
5 plants				2.9%
More than 5 plants				87.7%

Section 3: Entry and exit analysis

1. Descriptive statistics: entry and exit in aggregates, 2008 to 2011
2. Description of the econometric model
3. Results: job-site analysis and county-level analysis

Number of entry and exit events in Great Britain

Table shows the number of entry and exit of primary aggregates plants in GB from 2008 to 2011

- We used plant list data submitted by the five majors and a number of mid-tier independents, and BDS data to identify plants of the rest of the independent suppliers

	Party	2008	2009	2010	2011	Total
ENTRY	[✂]					
	[✂]					
	[✂]					
	[✂]					
	[✂]					
	[✂]					
	Total	**49**	**41**	**44**	**36**	**170**
	[✂]					
EXIT	[✂]					
	[✂]					
	[✂]					
	[✂]					
	[✂]					
	[✂]					
	Total	**64**	**83**	**70**	**65**	**282**
	[✂]					

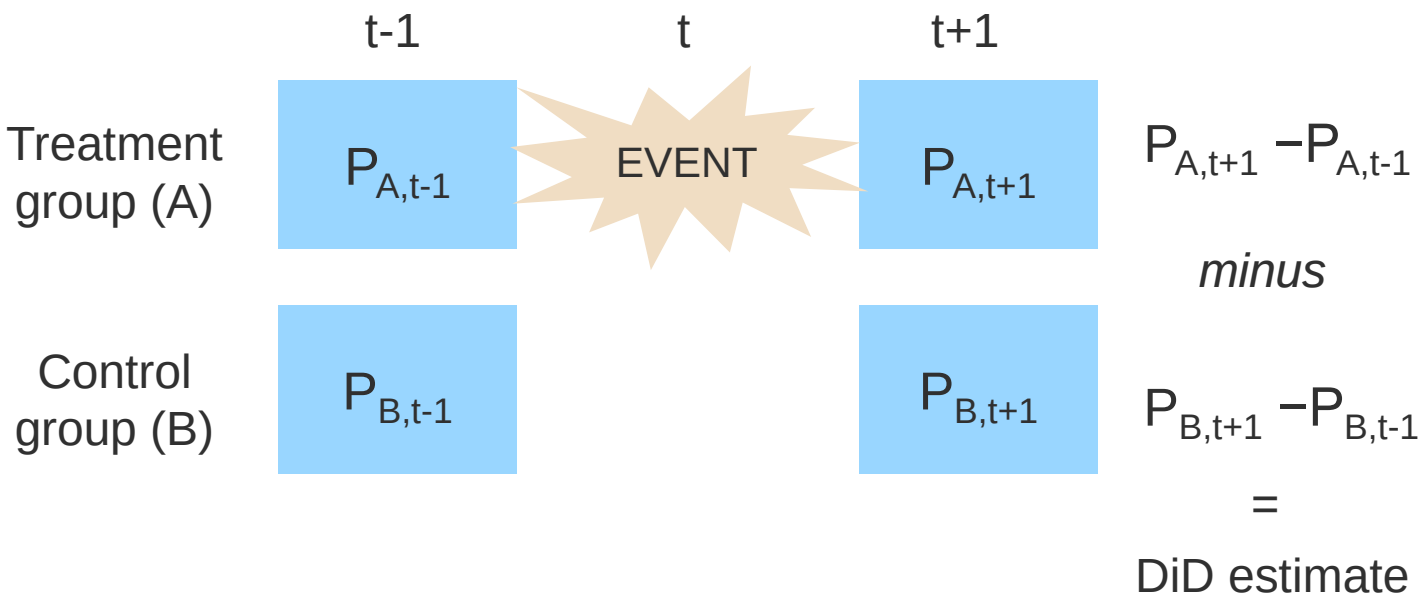
Purpose of the EEA

- EEA examines whether entry and exit of primary aggregates plants have had an effect on prices that customers pay for aggregates, and what that effect is
  - In a competitive market, all else equal, one would expect entry to put pressure on prices to fall, and exit to reduce the competitive constraints and lead to increases in prices
- The impact on prices could be expected to differ depending on the strength of the constraint posed by the entering or exiting competitor site
  - Entry/exit of sites owned by the majors vs independents
  - Proximity of the entering/exiting site to the customer job-site
- Caveat: we do plant counts, rather than fascia counts, so our explanatory variables do not necessarily capture reduction/increase in competition in terms of fascia

EEA—a difference-in-differences approach

Difference-in-differences (DiD) approach allows to measure change in price due to an event, such as entry or exit of a competitor near a job-site

- Time differencing captures change in prices due to trends over time
- Compare change in prices between job-sites that had an entry or exit event nearby and job-sites that did not
- Control for factors that potentially could affect price changes over time differently at different jobsites



EEA—The econometric model

Treatment and control group job-sites

- Treatment group: at least one entry/exit event in year t
- Control group: no entry/exit events in year t

Dependent variable

- Change in price (Δp_t) – subtract average price in year preceding the entry/exit event (p_{t-1}) from average price in the year following the event (p_{t+1})
  - Specification in terms of change in log delivered prices; prices are calculated by aggregates plant, customer job-site, and product category

Explanatory variables

- Number of entry and exit events (in terms of plant count) in year t, in groups 'majors', 'independents', 'own', and by inner and outer distance band (d.b.)—see Appendix for details on the dataset
  - In order to capture potential additional price effects in more concentrated areas, we included a dummy for exit events that resulted in 5 or fewer plants in year t+1, and a dummy for entry into areas with 5 or fewer plants
- Controls for changes in local demand or supply conditions (population, unemployment, wage rate), controls for customer size (indicator variables for customer size quintiles in t+1 and t-1), year and product category dummies

EEA results—job-site level DiD regressions (1)

Table shows regression coefficients for plant entry and exit event counts in the regressions on 2-year change in log of delivered prices

- Explanatory variables are number of plants entering/exiting within a particular distance band (d.b.)
- For example, a coefficient of '0.01' means that average effect of entry/exit of a plant is a price increase by 1%

Explanatory variable category	Explanatory variables	[✂]	[✂]	[✂]
ENTRY	No of majors' plants, inner d.b.			
	No of majors' plants, outer d.b.			
	No of independents' plants, inner d.b.			
	No of independents' plants, outer d.b.			
	No of own plants, inner d.b.			
	No of own plants, outer d.b.			
	Dummy for entry in areas (inner d.b.) with 5 or fewer plants			
EXIT	No of majors' plants, inner d.b.			
	No of majors' plants, outer d.b.			
	No of independents' plants, inner d.b.			
	No of independents' plants, outer d.b.			
	No of own plants, inner d.b.			
	No of own plants, outer d.b.			
	Dummy for areas (inner d.b.) with 5 or fewer plants post-exit			
No of observations				
R-squared				

Statistical significance level p-values: * 10%, ** 5%, *** 1%.

EEA results—job-site level DiD regressions (2)

- Coefficients on entry and exit explanatory variables indicate that entry or exit of primary aggregates plants have little or no impact on prices
  - Where we see statistically significant effect on prices, it appears relatively small, and sometimes counter-intuitive (for example, an entry of a plant nearby a job-site is associated with price increases)
  - [✂]
  - [✂]
  - [✂]
  - [✂]
- For brevity, we have not reported regression coefficients on the other explanatory variables; they are mostly statistically insignificant

County-level EEA as a robustness check

Job-site level analysis

- Our baseline DiD model is estimated using job-site level data, and includes only those job-sites that have purchased a particular type of aggregate from the same aggregates plant for three consecutive years
- Thus our sample is likely to exclude, for example, customers that may have switched or infrequent buyers

County-level analysis

- We performed county-level analysis in order to test whether results could be affected by the sample selection issue of the job-site level analysis
- By examining prices and entry and exit events on the basis of county averages, we did not have to restrict our analysis to job-sites that had aggregates purchases for three consecutive years
- County-level DiD: we calculated county-level averages of the explanatory variables (eg, average number of entry events around customer-jobsites in a given county), and performed a difference-in-differences analysis on change in log of average delivered prices in a county (with averages calculated separately for each product category and customer size quintile)
- County-level fixed effects: we calculated county-level average prices, plant counts, and other explanatory variables used in our PCA, and carried out a panel data analysis with county fixed effects
- The results of these analyses did not alter our main findings from the EEA analysis

EEA results—county-level DiD regressions

Table shows regression coefficients for average number of plant entry and exit events in the regressions on 2-year change in log of delivered prices

- For example, a coefficient of '0.01' means that average effect of entry/exit of a plant is a price increase by 1 per cent
- The dependent variable is change in log of average delivered price, where the average is calculated across all job-sites in a county

Explanatory variable category	Explanatory variables	[✂]	[✂]	[✂]
ENTRY	No of majors' plants, inner d.b.			
	No of majors' plants, outer d.b.			
	No of independents' plants, inner d.b.			
	No of independents' plants, outer d.b.			
	No of own plants, inner d.b.			
	No of own plants, outer d.b.			
EXIT	No of majors' plants, inner d.b.			
	No of majors' plants, outer d.b.			
	No of independents' plants, inner d.b.			
	No of independents' plants, outer d.b.			
	No of own plants, inner d.b.			
	No of own plants, outer d.b.			
No of observations				
R-squared				

Statistical significance level p-values: * 10%, ** 5%, *** 1%.

EEA results—county-level fixed effect regressions

Table shows regression coefficients for plant counts in the regressions on log of (county) average delivered prices

- For example, a coefficient of '–0.01' means that counties with higher average plant count by one plant tend to have prices lower by 1 per cent
- There are some positive statistically significant coefficients, indicating there is a positive relationship between prices and average competitor plant counts in a county, but the effects are relatively small (up to 1 per cent)

Explanatory variables	[✂]	[✂]	[✂]
No of small *other majors*' plants, inner d.b.			
No of large *other majors*' plants, inner d.b.			
No of small *other majors*' plants, outer d.b.			
No of large *other majors*' plants, outer d.b.			
No of small *independents*' plants, inner d.b.			
No of large *independents*' plants, inner d.b.			
No of small *independents*' plants, outer d.b.			
No of large *independents*' plants, outer d.b.			
No of small *own* plants, inner d.b.			
No of large *own* plants, inner d.b.			
No of small *own* plants, outer d.b.			
No of large *own* plants, outer d.b.			
No of observations			
R-squared			

Statistical significance level p-values: * 10%, ** 5%, *** 1%.

Section 4: Price concentration analysis

1. Description of the econometric model
2. Results

PCA—The econometric model

At each plant *j*, in each year *t*, at each job-site *i* (and, in some specifications, for each product category):

$$P_{ijt} = CHARACS_{ijt}\ \alpha + DIST_{ij}\ \beta + CM_{ijt}\ \delta + PLANTFE_{jt}\ \gamma + \varepsilon_{ijt}$$

- CHARACS control for characteristics that may vary across job-sites and over time, such as local construction activity, size of a customer, etc
- DIST measure distance from plant *j* to job-site *i*
- CM is competition measures, parameter δ will capture the competition effects
- PLANTFE is time-varying plant-specific 'fixed effects' which are not captured by other variables
- these 'fixed effects' will absorb such effects as the plant's production costs and alleviate endogeneity problem* concerns
- ε_{ijt} : a random error capturing all the things that affect prices at job site *i* in period *t* but which we cannot measure

*In the context of PCA, endogeneity problem arises if both price and competition measures are affected by some unobserved third factor, such as plant costs. Failing to take account of these unobserved factors would lead to the relationship between prices and competition measures being incorrectly estimated.

PCA specifications and robustness checks

Our PCA model

- As a baseline specification, we included all products in the regressions, with dummies for product categories
  - Plant and fascia count competition measures (CMs)
- Further analysis by product category
  - Allow for a possibility that competitive constraints vary across products

Robustness checks

- Robustness checks on our specification produce similar results as the baseline specifications (Appendix B reports results for competition measures)
  - Categorize plants into four size quartiles, allowing to test the extent to which size of the competitor is related to the strength of competitive constraints
  - Exclude small plants when doing the fascia counts (similar as above)
  - Exclude largest 10 customers from the analysis, on the basis that prices for large customers may be negotiated nationally
  - Separate plant count CMs for high and low concentration areas

PCA headline results

Fascia count PCA

- Presence of other majors appears to have no statistically significant or relatively small (<1%) impact on prices
- Presence of independents appears to have little or no statistically significant negative effect on prices
- Customer size variables are important in explaining variation in prices
  - We see statistically significant discounts to larger customers
  - Other explanatory variables, such as local population count, appear relevant in explaining variation in prices —for example, while not always statistically significant, population count increase by 1 per cent in the inner distance band is associated with around 1 per cent lower prices

Plant count PCA

- Increased number of other majors' plants is associated with statistically insignificant or relatively small (<1%) positive price effects
- Increased number of small independents' plants is associated with a small positive effect on prices (<1%)
- For brevity, we do not report regression coefficients on other variables—we observe similar effects as described above also in other specifications

Further results—see Appendix B

- Analysis by product category show statistically insignificant or relatively small positive and negative price effects, although results differ across suppliers and products
- Results with 4 competitor plant size categories indicate that the number of independents' plants in the largest size quartile tend to have negative effect on prices, which is sometimes statistically significant
- Price effects of an additional competitors' plant, where they are statistically significant, are similar in high and low concentration areas, and they are relatively small and positive

PCA using fascia counts—results for CMs

Table shows PCA regression coefficients for competitor fascia indicators in the regressions on log of delivered prices

- For example, a coefficient of –0.01 indicates that, on average, presence of a given fascia near supplier X's customer job-site is associated with 1 per cent lower prices paid by that customer to supplier X

Explanatory variables	[✂]	[✂]	[✂]
Aggregate Industries, inner d.b.			
Aggregate Industries, outer d.b.			
Cemex, inner d.b.			
Cemex, outer d.b.			
Hanson, inner d.b.			
Hanson, outer d.b.			
Lafarge, inner d.b.			
Lafarge, outer d.b.			
Tarmac, inner d.b.			
Tarmac, outer d.b.			
Independents, inner d.b.			
Independents, outer d.b.			

Statistical significance level p-values: * 10%, ** 5%, *** 1%.

PCA using fascia counts—results for customer size

Table shows regression coefficients on selected customer size explanatory variables

- For example, 5th quintile indicates customers accounting for the top 20 per cent of revenues in each year
- We see statistically significant discounts to larger customers (if compared to 1st size quintile customers), although this is not the case for all years and all size quintiles (note that table below shows only results for the 4th and the 5th size quintiles and omits the results for other size quintiles)
- Top ranking customers also tend to receive discounts (results not shown)
  - Majors' top ranking customers include other majors

Explanatory variables	[✂]	[✂]	[✂]
4th size quintile, 2007			
4th size quintile, 2008			
4th size quintile, 2009			
4th size quintile, 2010			
4th size quintile, 2011			
5th size quintile, 2007			
5th size quintile, 2008			
5th size quintile, 2009			
5th size quintile, 2010			
5th size quintile, 2011			

Statistical significance p-values: * 10%, ** 5%, *** 1%.

PCA using fascia counts—results for other variables

Table shows regression coefficients on selected explanatory variables, and statistics on the model

- Significant positive coefficient on the distance variable reflects the effect of transport cost on delivered prices
- Larger population in the inner d.b. tends to be associated with lower prices, but larger population in the outer d.b.—with higher prices (we get similar results when using local construction output instead of population—the two measures are highly correlated)
- Cash sales attract a premium of around [✂] per cent of price per tonne

Explanatory variables	[✂]	[✂]	[✂]
Distance (miles)			
Distance squared/1000			
Log of population ('000), inner d.b.			
Log of population ('000), outer d.b.			
Average wages, inner d.b.			
Average wages, outer d.b.			
Average unemployment rate, inner d.b.			
Average unemployment rate, outer d.b.			
Dummy for cash sales			
No of observations			
R-squared			

Statistical significance p-values: * 10%, ** 5%, *** 1%.

PCA results for all products – plant counts

Table shows PCA regression coefficients for primary aggregates plant counts in the regressions on log of delivered prices

- For example, a coefficient of –0.01 indicates that, on average, an additional primary aggregates plant is associated with 1 per cent lower prices

Explanatory variables	[✂]	[✂]	[✂]
No of small *other majors*' plants, inner d.b.			
No of large *other majors*' plants, inner d.b.			
No of small *other majors*' plants, outer d.b.			
No of large *other majors*' plants, outer d.b.			
No of small *independents*' plants, inner d.b.			
No of large *independents*' plants, inner d.b.			
No of small *independents*' plants, outer d.b.			
No of large *independents*' plants, outer d.b.			
No of small *own* plants, inner d.b.			
No of large *own* plants, inner d.b.			
No of small *own* plants, outer d.b.			
No of large *own* plants, outer d.b.			
No of observations			
R-squared			

Statistical significance p-values: * 10%, ** 5%, *** 1%.

Plant count summary statistics

Table shows averages for plant count CMs in our PCA samples

Explanatory variables	[✂]	[✂]	[✂]
No of small *other majors*' plants, inner d.b.			
No of large *other majors*' plants, inner d.b.			
No of small *other majors*' plants, outer d.b.			
No of large *other majors*' plants, outer d.b.			
No of small *independents*' plants, inner d.b.			
No of large *independents*' plants, inner d.b.			
No of small *independents*' plants, outer d.b.			
No of large *independents*' plants, outer d.b.			
No of small *own* plants, inner d.b.			
No of large *own* plants, inner d.b.			
No of small *own* plants, outer d.b.			
No of large *own* plants, outer d.b.			
No of observations			

Section 5: PCA including recycled aggregates

1. Description of the econometric model
2. Results

Summary (1)

- Using PCA analysis, we test local competitive constraints from recycled aggregates
  - Does a larger number of recycled aggregates plants near customers' job-sites impact prices that customers pay for primary aggregates? Does the strength of these local competitive constraints, if any, differ by product category?
- Most of the recycled aggregates plants are operated by independent suppliers
  - In 2011, the five majors had an estimated share of [0–20] per cent of recycled aggregates volumes
  - Most customers have a choice of a number of recycled aggregates plants within their 80 per cent catchment areas (ie 20 or 28 miles)
  - Recycled aggregates plants tend to be small if compared to primary aggregates plants: around half of plants produce up to 50 kt a year
  - Recycled aggregates plants tend to be located in urban areas
- We found little evidence that the number of recycled aggregates plants locally have an effect on primary aggregates prices for any of the products analysed
  - While there are some statistically significant price effects from additional recycled aggregates plants near job-sites, they are small in magnitude, and often positive (ie, more recycled aggregates plants are associated with higher prices on average)

Summary (2)

- [✂]
  - [✂]
- [✂]
  - [✂]
- [✂]
  - [✂]
- Regression results on other explanatory variables (customer size, local population count, etc) were broadly similar to those in the primary aggregates PCA regressions

Our approach

- Same econometric PCA model as for primary aggregates
  - Panel data model with year and plant fixed effects
  - Average delivered price for primary aggregates as the dependent variable
    - » Prices paid by a given job-site for a particular aggregates product from a given aggregates plant, for [✂], [✂] and [✂] customer job-sites
  - Two years of data (2010 and 2011)
  - Perform analysis separately by product category, in order to allow for differences across products in the strength of local competitive constraints from recycled aggregates
- CMs include recycled aggregate plant counts
  - Count the number of recycled aggregates plants near each jobsite, by operator (Major vs Independent), size of the plant (where 'large' plants are recycled aggregates plants producing or selling more than 35 kt recycled aggregates a year on average), and distance band (inner and outer distance bands)
  - As for the primary aggregates PCA, we included primary aggregates plant count CMs, but aggregated them across distance bands and size categories
- Other explanatory variables for prices—as for the primary aggregates PCA
  - Controls for local demand and supply conditions (population, wages, unemployment rate), customer size (sales revenue quintiles and indicators for top 10 ranking customers), delivery distance, indicator for cash sales

Data on recycled aggregates plants

- For independents, we used data on recycled aggregates plants received from BDS
  - BDS collected data on static (ie fixed) recycled aggregates plants that recycle demolition and construction waste for reuse as an aggregate
  - Data available for 2010 and 2011
  - Location and production volume ranges
  - But: BDS data unlikely to capture all the supply sources of recycled aggregates
- For the five majors, we used data supplied by the parties
- In total, 567 sites in 2011
- Median production volume: below 50 kt a year

[✂]

[✂] PCA results—CMs, including recycled

Table shows regression coefficients on delivered prices for competition measures

- For example, a coefficient of –0.15 indicates that an additional plant near a customer job-site is associated with prices for a given aggregate category being lower by £0.15 per tonne on average
- There are a few statistically significant price effects of recycled aggregates CMs for some products, but these are relatively small (typically <0.10 £/tonne) and some are counter-intuitive (ie positive—implying more recycled aggregates plants near a job-site are associated with higher prices)

Explanatory variables	CR—Sub-base	CR—Fill	CR—Graded	SG—Gravel	SG—Coarse Sand
No of *other majors*' primary aggregates plants	[✂]	[✂]	[✂]	[✂]	[✂]
No of *independents*' primary aggregates plants					
No of *own* primary aggregates plants					
No of majors' small recycled agg plants, inner d.b.					
No of majors' large recycled agg plants, inner d.b.					
No of majors' small recycled agg plants, outer d.b.					
No of majors' large recycled agg plants, outer d.b.					
No of independents' small recycled agg plants, inner d.b.					
No of independents' large recycled agg plants, inner d.b.					
No of independents' small recycled agg plants, outer d.b.					
No of independents' large recycled agg plants, outer d.b.					

Statistical significance level p-values: * 10%, ** 5%, *** 1%.

Appendix A:
Description of the data used in the PCA/EEA

Data (1)

- Transaction data received from the parties
  - We analysed sales of 7 most significant product categories (three sand and gravel, four crushed rock), which cover the majority of sales of aggregates by the parties: Gravel, Coarse Sand, Fine Sand, Sub-base, Fills, Dust and Coarse Graded Crushed Rock
    - For brevity, we do not report results for Fine Sand and Dust in the PCA regressions by product (these two product categories have relatively smaller sample sizes)
  - External delivered orders only, as parties did not hold comprehensive data on locations of customers that collected the aggregates
  - Annual average delivered price for each product category, plant and jobsite
    - Delivered price includes haulage cost
- At this stage, we have carried out the analysis for [✂], [✂], and [✂], as they had supplied us the most reliable data on customer job-site locations in their transaction data
  - Customer location data in terms of geo-coordinates (eastings and northings) required in order to calculate 'local' variables—ie, competition measures around customer job-sites, local population count, unemployment rate, etc

Data (2)

- CMs based on plant lists submitted by the parties and on BDS data for the independents
- Other explanatory variables for prices
  - Controls for local demand and supply conditions—population, construction output, wages, unemployment rate
    - Totals or averages within a certain straight-line distance from each job-site, based on ONS data
    - We used population count in the final specifications—construction output data from ONS is less robust, but it is highly correlated with population count data
  - Controls for customer size in order to take account of quantity discounts
    - Top 10 ranking customers by sales revenue in the period from 2007 to 2011
    - Divide customers into sales revenue quintiles for each year

Competition measures (1)

CMs aim to capture the degree of local competition. We used two different measures: plant count and fascia count. For EEA, CMs were measured as change in plant counts.

Fascia count—the identity of competing suppliers

- Testing the competition effects of different suppliers, irrespective of the number and size of their plants
- For each year, a dummy variable indicating whether a particular aggregates producer had a plant within a certain distance from a job-site
  - Treat all independents as a single fascia

Plant count*—number of aggregates plants

- Testing the competition effects from different plants of the same group of suppliers
  - Distinguish between own, other majors', and independents' plants
  - For example, what is the effect on prices job-site *i* pays for material from plant *j* of a given major of an additional other majors' plant nearby job-site *i*
- We counted all primary aggregates plants for each year, irrespective of whether they produced sand and gravel (SG) or crushed rock (CR)
  - As a sensitivity, we also did separate SG and CR plant counts, and used those when carrying out analysis by product category

* Plants include quarries, wharves and depots.

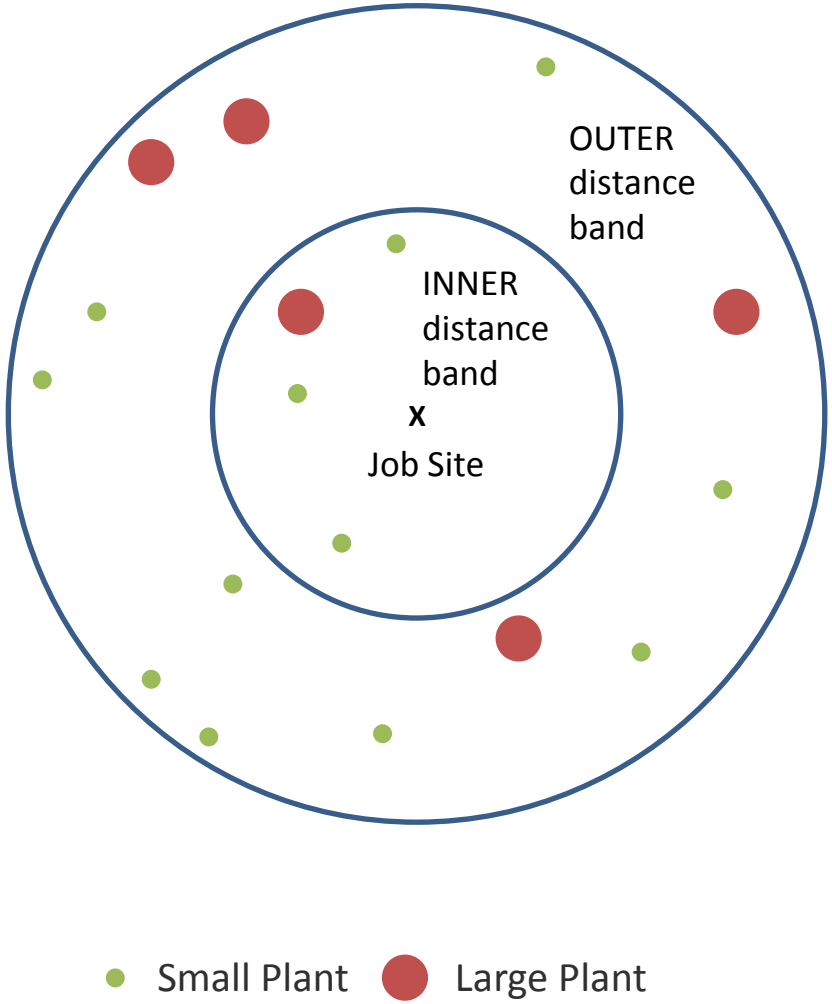
Competition measures (2)

Two distance bands (d.b.), based on our catchment area analysis

- Inner d.b.
  - 10 miles for urban job-sites
  - 14 miles for non-urban job-sites
- Outer d.b.
  - 10–20 miles for urban job-sites
  - 14–28 miles for non-urban job-sites
- Given the importance of transport costs, allow for a possibility that plants/suppliers located closer to the customer job-site exert a stronger constraint than those located further away

For plant count CMs, two aggregates plant sizes, based on annual average sales/production volumes

- Size thresholds vary by type of aggregate
  - Eg, 91 Kt a year for primary aggregates plants
  - Allow for a possibility that the strength of local competitive constraints differ by size of plant



Appendix B: Further results

[✂] PCA results, fascia counts

Table shows regression coefficients on delivered prices in levels (£/tonne) for five product categories

- For example, 'Competing major A, inner d.b.' is an indicator that at least one Competing major A SG or CR plant operating in the inner distance band around the job-site (we count SG plants/fascia when analysing SG product prices, and CR plants/fascia when analysing CR products)
- [✂]

Explanatory variables	CR—Sub-base	CR—Fill	CR—Graded	SG—Gravel	SG – Coarse Sand
Competing major A, inner d.b.	[✂]	[✂]	[✂]	[✂]	[✂]
Competing major A, outer d.b.					
Competing major B, inner d.b.					
Competing major B, outer d.b.					
Competing major C, inner d.b.					
Competing major C, outer d.b.					
Competing major D, inner d.b.					
Competing major D, outer d.b.					
Independents, inner d.b.					
Independents, outer d.b.					
No of observations					
R-squared					

Statistical significance p-values: * 10%, ** 5%, *** 1%.

[✂] PCA results using plant counts

Table shows regression coefficients on delivered prices in levels (£/tonne) for five product categories

- Plant counts include SG plants when analysing SG products, and CR plants when analysing CR product prices
- [✂]

Explanatory variables	CR—Sub-base	CR—Fill	CR—Graded	SG—Gravel	SG – Coarse Sand
No of small *other majors*' plants, inner d.b.	[✂]	[✂]	[✂]	[✂]	[✂]
No of large *other majors*' plants, inner d.b.					
No of small *other majors*' plants, outer d.b.					
No of large *other majors*' plants, outer d.b.					
No of small *independents*' plants, inner d.b.					
No of large *independents*' plants, inner d.b.					
No of small *independents*' plants, outer d.b.					
No of large *independents*' plants, outer d.b.					
No of small *own* plants, inner d.b.					
No of large *own* plants, inner d.b.					
No of small *own* plants, outer d.b.					
No of large *own* plants, outer d.b.					
No of observations					
R-squared					

Statistical significance p-values: * 10%, ** 5%, *** 1%.

[✂] PCA results using plant counts, with CMs based on plant size quartiles

- CMs are calculated for four size categories of primary aggregates plants (size quartiles), based on their average annual production/sales volume; plants are counted for the inner and the outer d.b. together
- Regressions are on delivered prices in levels (£/tonne)

Explanatory variables	CR—Sub-base	CR—Fill	CR—Graded	SG—Gravel	SG—Coarse Sand
No of 1st size quartile other majors' plants	[✂]	[✂]	[✂]	[✂]	[✂]
No of 2nd size quartile other majors' plants					
No of 3rd size quartile other majors' plants					
No of 4th size quartile other majors' plants					
No of 1st size quartile independents' plants					
No of 2nd size quartile independents' plants					
No of 3rd size quartile independents' plants					
No of 4th size quartile independents' plants					
No of 1st size quartile own plants					
No of 2nd size quartile own plants					
No of 3rd size quartile own plants					
No of 4th size quartile own plants					
No of observations					
R-squared					

Statistical significance p-values: * 10%, ** 5%, *** 1%.

[✂] PCA results using fascia counts, excluding bottom size quartile plants from CMs

- Fascia counts do not include a given fascia, if its plant(s) is (are) in the smallest size quartile
- Regressions are on delivered prices in levels (£/tonne)

Explanatory variables	CR—Sub-base	CR—Fill	CR—Graded	SG—Gravel	SG—Coarse Sand
Competing major A, inner d.b.	[✂]	[✂]	[✂]	[✂]	[✂]
Competing major A, outer d.b.					
Competing major B, inner d.b.					
Competing major B, outer d.b.					
Competing major C, inner d.b.					
Competing major C, outer d.b.					
Competing major D, inner d.b.					
Competing major D, outer d.b.					
Independents, inner d.b.					
Independents, outer d.b.					
No of observations					
R-squared					

Statistical significance p-values: * 10%, ** 5%, *** 1%.

PCA results using plant counts classified by high and low concentration areas

Table shows PCA regression coefficients for primary aggregates plant counts in the regressions on log of delivered prices, where we computed plant counts separately for high and low concentration areas

- High concentration areas are defined as inner or outer distance bands around customer's job-site with 5 or fewer plants
- Results indicate that price effects of an additional primary aggregates plant are greater in high concentration areas than in low concentration areas, and the effect of an additional competitors' plant, where statistically significant, is positive and small (<1%)

Explanatory variable category	Explanatory variable	[✂]	[✂]	[✂]
High concentration (up to 5 plants in the inner d.b.)	No of other majors' plants, inner d.b.			
	No of other majors' plants, outer d.b.			
	No of independents' plants, inner d.b.			
	No of independents' plants, outer d.b.			
	No of own plants, inner d.b.			
	No of own plants, outer d.b.			
Low concentration (up to 5 plants in the inner d.b.)	No of other majors' plants, inner d.b.			
	No of other majors' plants, outer d.b.			
	No of independents' plants, inner d.b.			
	No of independents' plants, outer d.b.			
	No of own plants, inner d.b.			
	No of own plants, outer d.b.			

Statistical significance p-values: * 10%, ** 5%, *** 1%.