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An Empirical Analysis of Countervailing Power in Business-to-Business Bargaining

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Abstract Pricing schemes in business-to-business (B2B) relationships reflect price discrimination and bargaining over rents. Bargaining outcomes are determined by upstream market power and countervailing buyer power downstream. This paper uses a panel of B2B transactions in the UK brick market to study B2B transaction prices. The empirical analysis identifies three effects on prices: nonlinear volume and freight absorption effects; countervailing power effects that arise from buyers' local commercial significance; and competition effects that are due to the buyers' local potential suppliers. And it shows that small buyers benefit more from competition than do large buyers because they are not constrained by the suppliers' capacity.

Keywords Countervailing power · Bargaining · Price discrimination · Transaction data

JEL Classification D43 · L11 · L12 · L14 · L42 · C23 · C78

1 Introduction

Since the early work of Galbraith (1952, 1954), countervailing power—or buyer power—has been an element of competition analysis. Competition authorities that investigate business-to-business (B2B) dealings treat it as a factor that can mitigate upstream market power. Prices in B2B relationships are complex. They may reflect

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countervailing power if the contracting counterparties bargain over rents, and they may also reflect nonlinearities, which possibly are due to some degree of price discrimination.

This paper exploits a panel data set of the UK brick industry that comprises all transactions over the period 2001–2006 between the four main UK brick manufacturers and their customers. It studies the effects of countervailing power and price discrimination on "ex-works" brick prices at the transaction level. Customers in the brick market are heterogeneous, in terms of their size, geographic spread and position in the construction industry supply chain. While related structural work (Beckert et al. 2016) focusses on one specific customer segment, this study uses the entire data set of transactions with all customers and embeds the heterogeneity of buyer-seller relationships in a reduced-form empirical model of prices.

The empirical approach to model transaction prices that is advocated in this paper exploits the full richness of the data. It is neither limited to a market segment that is defined by a subset of buyers, nor by the restrictions that are imposed by a structural model. It can serve practitioners as an initial screen: to test an antitrust market definition and to provide an indicative competitive assessment for an entire market.

The empirical model builds on existing theoretical results from the bilateral bargaining (Horn and Wolinsky 1988; Inderst and Wey 2003; Stole and Zwiebel 1996) and nonlinear pricing and price discrimination literatures (Katz 1987; Stigler 1949; Thisse and Vives 1988). Because transportation costs are significant in this high weight-to-value industry, features of local demand and supply play an important role. The model distinguishes the effect of countervailing power—which results from the buyer's local bargaining weight vis-à-vis the selected manufacturer—from that of the buyer's local outside options. The latter depend on the set of manufacturers with whom a buyer has established transactional relationships and from which the buyer selects the local supplier for a transaction.

The empirical analysis shows, first, that prices exhibit nonlinear volume discounts and 'freight absorption' effects. Second, it also shows that buyers with larger local commercial significance—in terms of the volume of bricks that they buy locally—have countervailing power, at least locally: Through their local commercial significance they enjoy higher bargaining weights and receive lower ex-works prices, relative to locally smaller buyers. And third, it shows that buyers that have established supply relations with more manufacturers that are local to the delivery site benefit from the ensuing competition and pay lower prices. Surprisingly, it reveals that small buyers benefit more from competition because, unlike large buyers, they are not constrained by the capacity of the supplier so that they have more supplier options. Finally, it shows that the effect from competition among established manufacturers dominates the local commercial significance effect. This is important for competition assessment because the former is under the buyer's control, while the latter is not.

The paper proceeds as follows: Sect. 2 reviews the literatures on countervailing power and bargaining, price discrimination, and competition analysis practice on which this study draws. Section 3 describes the industry background and the data that are used. Section 4 lays out the empirical approach for the data analysis, and Sect. 5 reports estimation results. Section 6 concludes.

2 Related Literatures

2.1 Countervailing Power and Bargaining in Vertical Relations

Despite its growing importance and policy relevance, the academic literature on buyer and countervailing power is still relatively sparse. Galbraith (1954) defines countervailing power as "neutralization of one position of power by another" in vertical relationships in which both parties—upstream and downstream—have some market power. In such business-to-business relationships, the transacting parties are typically not anonymous, and they bargain or negotiate with each other.

The theoretical cooperative bargaining literature—which typically assumes bilateral bargaining in bilateral oligopolies (Inderst and Wey 2003; Stole and Zwiebel 1996)—fits this setting. This theory literature emphasises "endogenous" sources of bargaining power such as firm size[1] and surplus shape effects that are explored empirically in a setting with upstream monopoly by Chipty and Snyder (1999)[2]; or differences in outside options (Katz 1987; Inderst and Valletti 2009).

The empirical structural bargaining literature typically stipulates non-cooperative bargaining models. Crawford and Yurukoglu (2012), Draganska et al. (2010), Gowrisankaran et al. (2014), and Grennan (2013) use a specific bargaining model, the "Nash-in-Nash" bargaining solution proposed in Horn and Wolinsky (1988). Beckert et al. (2016) employ a non-cooperative bargaining equilibrium concept that possesses the pairwise proof property (McAfee and Schwartz 1994).

Such structural bargaining models are plausible when upstream and downstream firms are relatively homogeneous and can reasonably be assumed to adhere to a common model of bilateral interaction. In the context of the UK brick industry that is considered in this study, buyers are heterogeneous along various dimensions—in terms of their "type" or role in the construction supply chain, size, geographic spread, and business organisation—as will be detailed in a subsequent section of the paper. As a consequence, it is unlikely that a common structural model of buyer-manufacturer relationship applies to this industry.[3]

This paper therefore proceeds in a nonstructural approach. Nonstructural approaches to countervailing power analysis have been employed by Giulietti

[1] Snyder (1996) provides an explanation for discounts that are granted to large buyers, in the context of an infinitely repeated game with upstream competition vis-à-vis a single downstream buyer; there, buyer size makes a seller's deviation—in the form of discounts—from upstream collusion profitable relative to possible punishment. Smith and Thanassoulis (2008) demonstrate how upstream competition can endow large buyers with market power by inducing supplier-level volume uncertainty. See also Inderst and Mazzarotto (2006) for a survey of theoretical buyer power results and policy implications.

[2] Chipty and Snyder (1999) show that the effect of size on the buyer's bargaining position depends on the curvature of the supplier's gross surplus function. Increases in firm size—e.g. as a consequence of a merger—enhance (worsen) the buyer's bargaining position if the gross surplus function is concave (convex).

[3] Ellison and Snyder (2010), in a study of US wholesale prices in pharmaceutical markets, distinguish between different buyer types—health maintenance organisations and chain and independent drug stores—controlling for institutional differences in drug administration. Using cross-section data, as opposed to the transaction panel data that are used in this study, they cannot account for buyer heterogeneity within type.

(2007) in a study of the Italian grocery retail sector.[4] Their general merits are discussed by Boyer (1996) and Hyde and Perloff (1995). Competition authorities also stress the role and benefits of nonstructural analysis in competition practice and the importance of empirical investigations being robust to different models of conduct; see, e.g., Directorate General Competition DGComp (2010).

2.2 Price Discrimination

A large theoretical literature exists on pricing in intermediate goods industries, including Dobson and Waterson (1997), Chipty and Snyder (1999), Inderst and Wey (2003), and Smith and Thanassoulis (2008); many of these articles consider bargaining settings with prices that are specific to individual buyers. Katz (1987) and Inderst and Valletti (2009) study intermediate goods prices that discriminate by transaction volume. And Thisse and Vives (1988) and Stigler (1949) investigate price discrimination that arises from geographic aspects that are due to buyer and seller locations.

There is little empirical work on price discrimination in intermediate goods markets. While final goods prices at the retail level are public, intermediate goods prices are typically commercially sensitive and as such kept confidential between the transacting parties. The data that are used in this paper thus offer an opportunity to contribute to our understanding of intermediate goods pricing.

Absent transaction level data for business-to-business relationships, a small literature has turned to more indirect routes to shed light on the likely vertical model. Villas-Boas (2007) provides an approach that permits indirect identification—from conventional demand and cost estimates—of the strategic model that is appropriate for the interaction between buyers and sellers when transaction data are not observed. Her application also focuses on a narrowly defined market: for yogurt that is sold in large stores in a large US urban area. A study by Bonnet and Dubois (2010) of bottled water in France employs a similar technique.

2.3 Competition Analysis

The analysis of buyer power is often an integral part of antitrust inquiries. The UK Competition Commission (CC) Merger Guidelines (2003, revised 2010) consider buyer power in merger assessment: Do buyers, either because of their size or commercial significance to their suppliers, have the ability to prevent the exercise of market power by suppliers?[5] This ability, if present, is akin to Galbraith's (1952) notion of countervailing buyer power. The Competition Commission considers such countervailing power as one potential mitigating factor, next to others such as entry and switching costs, in the assessment of upstream mergers.

[4] See also Adelman (1959), Boulding and Staelin (1990), Brooks (1973), Buzzell et al. (1975), Lustgarten (1975), Clevenger and Campbell (1977), McGukin and Chen (1976),and McKie (1959) for early nonstructural works that provide evidence on countervailing power.

[5] The Competition and Markets Authority (CMA)—established as the successor of the first-stage authority, the Office of Fair Trading (OFT), and the second-stage authority, the Competition Commission (CC), in 2014—has adopted the merger guidance that was originally published by the OFT and the CC.

In the competition assessment in its market investigations, the CC investigates the "relative importance [to each other] of [each firm's] business with the other party".[6] The guidelines enumerate several factors that are viewed as potentially affecting the buyers' ability to constrain suppliers: the buyers' ability to find alternative suppliers; the ease with which buyers can switch suppliers; the extent to which buyers can credibly threaten to set up their own supply arrangements, e.g. by backward integration or by sponsoring entry; the extent to which buyers can impose costs on suppliers, e.g. by delaying or stopping purchases or by transferring risk.

Buyer power has featured as a concern in many competition investigations. For example, the UK Competition Commission prominently investigated buyer power in its grocery market inquiry [Competition Commission (2008, Appendix 5.3)], and the Directorate General Competition DGComp (1998) in the automobile sector.

Price discrimination is also a notable policy concern. In the US, the Robinson-Patman (1936) amendments to the Clayton Act (1914) aim at protecting small businesses from price discrimination. Thisse and Vives (1988) provide a survey of US and European competition cases in which geographic price discrimination was a line of inquiry.

3 Industry Background and Data

3.1 The UK Brick Industry

This study uses data from the UK brick industry. Bricks have a long history as building materials. In England, their popularity in construction dates back to the Tudor period and experienced a particular upsurge in the Victorian period. Bricks still dominate the building heritage and aesthetic taste in architecture in the UK today. In 2000 (2006), 61.2 (51.7)% of UK cladding was bricks.[7]

The UK brick sector was the focus of a 2007 merger inquiry by the Competition Commission (CC): the second-stage competition authority at the time. The following description of the UK brick industry draws on the CC Report: Competition Commission (2007).

There were four main brick manufacturers prior to the merger that triggered the inquiry. Each of these four manufacturers was involved in all stages of the brick manufacturing process. This process starts from extracting clay from the soil and processing it (shaping and moulding it), and eventually burning it in large kilns at temperatures in excess of 1000 °C.

As transportation costs (relative to sale value) are significant in this industry, most manufacturing plants are located close to clay deposits. The four

[6] Competition Commission Guidleines (2003) for market investigation references, paragraph 3.37. Additions in square brackets by the author.

[7] Competition Commission (2007, Appendix C, Table 1).

manufacturers in aggregate owned 54 plants, ranging from 7 to 23 plants per manufacturing firm.[8]

The manufacturing process yields two main brick products. Facing bricks are used as cladding material for building facades. They are made either as soft mud varieties, whereby molds are filled with clay in an automated process; or as extruded varieties, whereby clay is extruded through a nozzle and wire cut into brick size shapes. Some hand made soft mud varieties exist as well. Flettons are another variant of facing bricks with inferior technical properties and are usually used for repairs, maintenance and improvements.

The second product category—engineering bricks—is designed for high load bearing and low levels of water absorption: typically, for retaining walls or ground work. They are usually manufactured using the extruded technique.[9]

The CC inquiry notes that different brick product types entail different production costs, and these in turn contribute to different product level profit margins.[10]

Bricks are sold to two types of buyers. First, bricks can be sold directly to builders who buy for their own use. Second, bricks can be sold to builders' merchants, which act as retailers: They supply building products, materials, and equipment to end users: builders and retail customers.[11] While builders and merchants play different roles in the construction industry supply chain, they are treated alike by brick manufacturers whose sales operations are organized by location (region), rather than by buyer type.[12]

This organization of the industry rests on the economics of the industry: Due to the high weight-to-value nature of the product, transportation costs are significant, and geography plays an important role. And due to the brick manufacturing cost structure, with high fixed operating costs and declining marginal costs over the relevant output range (Bower 1964), manufacturers aim at continuous utilization of

[8] Competition Commission (2007, Figure 4) shows plant locations. Bricks have a high weight-to-value ratio, while the main fuel to operate kilns, natural gas, has a low weight-to-value ratio. So it is economical to transport the fuel to brick plants at the clay deposits, not to transport clay to delivery points of the natural gas pipeline network. Furthermore, the extracted clay needs to be pre-processed before it can be used to form and fire bricks. Pre-processing involves crushing, filtering, and drying. This requires a processing plant to be close to the clay deposit, even before the brick-forming and firing processes.

[9] The manufacturers in the data also produce a small number of concrete or cinder blocks whose characteristics—notably in terms of load-bearing capacity—are similar to engineering bricks. The CC in its investigation concluded that "the relevant product market affected by the merger [of two brick manufacturers in the sample] included all clay facing and engineering bricks. [...] the relevant product market does not include [...] (b) concrete bricks [i.e. blocks]." (CC Report, paragraph 6) Additions in square brackets are by the author. As concrete blocks do not belong to the same product market as facing and engineering bricks, they are not considered in this analysis.

[10] Competition Commission (2007, paragraphs 8 and 5.20).

[11] They can also be sold to factors, that also buy for resale and that are specialist distributors—acting on behalf of architects or builders—and distinct from merchants in that they do not have physical storage facilities. The accounting data do not distinguish factors from merchants, so the analysis treats them as merchants.

[12] This is confirmed by industry associations that represent brick manufacturers, builders, and merchants. One of the four manufacturers in the data, for example, in 2008 had five regional sales offices in England, one in Scotland, and one in Northern Ireland.

plants: as close to capacity as possible. They prefer large and predictable orders. Whether these originate from builders or merchants is thereby immaterial.

Transport may be arranged either by the manufacturer or the buyer.[13] Merchants primarily serve small builders and retail customers, so they typically hold smaller quantities in inventory than the requirements for a newly built structure. As a consequence, merchants' transport cost are relatively small compared to that of builders, while their storage costs are relatively small compared to those that are incurred by manufacturers and by some builders that store bricks on site to minimize disruptions in the construction process. Merchants have specialized vehicles to enable them to deliver bricks and other bulk products to their customers. They can also organise delivery directly to a customer site from the manufacturing plant of the required bricks.[14]

Three of the four manufacturers had published price lists, at least during part of the time that is studied in this paper. For many buyers, however, these price lists were mostly used as benchmarks for individual price negotiations with manufacturers, either for an ad hoc brick purchase or for non-binding framework agreements.[15] Buyers pay different prices, which depend on purchase volume, firm size, relationship with the manufacturer and whether they buy ad hoc or subject to a framework agreement.

The brick industry shares certain similarities with ready-mixed concrete, another prominent construction material the economics of which have been studied for the US market (Hortaçsu and Syverson 2007; Miller and Osborne 2014; Syverson 2007, 2008). For both, bricks and ready-mixed concrete, transport costs are significant, and hence demand and competition are local, with causation running from local demand to local competition, not the reverse.

But there are also important differences. Ready-mixed concrete is highly perishable, requiring bespoke delivery vehicles and even more stringently timed delivery than in the case of bricks. And in the US, 80% of concrete producers own a single plant, whereas UK brick manufacturers are multi-plant firms. This implies that ready-mixed concrete buyers and producers have fewer potential bilateral contacts than UK brick buyers and manufacturers. The scope for such bilateral contact provides UK brick buyers with more outside options in their negotiations with brick manufacturers, compared to US ready-mixed concrete buyers vis-à-vis producers.

3.2 Data

The raw data for this study comprise more than 2 million accounting records from the four manufacturers' databases over the period 2001–2006. Apart from a fringe

[13] Competition Commission (2007, paragraph 4.54).

[14] I have access only to manufacturer data, not merchant data. Not all manufacturer data provide consistent information on haulage. Therefore, the data do not permit a comprehensive investigation of haulage in the UK brick industry.

[15] Framework agreements set out annual matrices of ex-works and/or delivered prices vis-à-vis brick specifications and target volumes. These are not formal contracts, but are merely indicative commercial conditions subject to which transactions can, but need not, be called off.

of small manufacturers and some (relatively expensive) imports, these data records cover almost the entire UK brick supply over that period.

In many cases the volumes of orders in the accounting records relate to pallet (ca. 500 bricks) or truck (12,000–13,000 bricks) size orders. They often involve the same brick product, originating from the same plant and delivered to a unique buyer location, in a given (fiscal) year. A UK fiscal year runs from 1 April to 31 March. The accounting data, covering six calendar years, therefore cover seven fiscal years, 2000/2001—2006/2007. It is therefore likely that accounting records that share brick product, manufacturing plant, buyer location, and fiscal year are call-offs from the same transaction or "contract". For the purpose of this analysis, the accounting records are therefore aggregated according to a definition of transaction, or contract, that is determined by brick product, manufacturing plant, buyer location and fiscal year. According to this contract definition, there are 608,197 contracts.

Tables 1, 2 and 3 provide summary statistics for the contract data. Table 1 summarises contracts by buyer type, distinguishing (132) builders and (1161) merchants. It provides an overview of the size distribution of brick buyers, by buyer type. The first row of the respective panel of the table relates to the distribution of market shares in terms of contracts, conditional on buyer type. For example, among builders, the median market share is 0.12%, and the largest builder has a market share of 15.58%. The second row provides statistics of the distribution of market shares by expenditure, the third by contract volume, and the fourth by delivery sites. The tenth row provides statistics of the distribution of firm size in terms of average number of bricks bought per year.

The last column shows that builders account for just over 21 (23)% of all brick sales in terms of value expenditure (volume), while merchants account for the large remainder of 78 (76)%. The penultimate column also shows that volumes and values of sales to builders are more concentrated, in terms of Herfindahl-Hirschman indices (HHIs), than those to merchants. While for both buyer types most contracts account for a small proportion of all contracts by number, volume, and value, there are a few contracts that account for more than 10%.

Builders purchase fewer brick products for a given location—in their case, a building or development site—than do merchants for whom delivery locations correspond to retail outlets. This is consistent with merchants' position as intermediaries in the construction supply chain.

Finally, while builder and merchants have operations that are roughly equal in terms of their geographic spread—measured in terms of the maximal east–west and north–south distances between their respective delivery locations—the spread of the volume of merchants' business, defined as annual brick volume (in 1000 bricks) divided by the product of east–west and north–south spread (in km^2), is a multiple of that of builders. The median (maximum) value for merchants is 1.6 (46.77) bricks per km^2, while it is only 0.6 (15.65) bricks per km^2 for builders.

These buyer-type statistics suggest that buyers are heterogeneous, both across and within type.

Table 1 Summary statistics: buyer types

	608,197 contracts[a]								
	Mean	SD	Min.	Lower quartile	Median	Upper quartile	Max.	HHI[b]	Of all buyers[g]
Builders (132)									
% of contracts[b]	0.76	2.14	8.36e−5	0.05	0.12	0.41	15.58	0.068	9.21
% of expenditure[b]	0.80	2.54	2.68e−5	0.02	0.05	0.19	18.21	0.092	21.32
% of volume[b]	0.76	2.62	2.0e−5	0.02	0.05	0.18	19.54	0.097	23.28
% of delivery sites[b,c]	0.76	2.08	1.0e−4	0.05	0.10	0.37	13.68	0.064	13.82
# products delivered to location	23.96	33.89	2	6	12	26	191		
Local footprint (1000 bricks)[d]	321.92	517.07	0.01	22.00	127.30	401.10	753.30		
East–west spread (km)	326.56	138.81	0	253.67	382.74	409.92	528.67		
North–south spread (km)	481.29	242.77	0	292.60	612.36	643.87	913.29		
Bricks (1000) per km^2 [e]	0.340	1.93	2.0e−6	0.0001	0.0006	0.0061	15.65		
Bricks (million p.a.)	2.46	8.50	7.40.e−3	6.81e−2	0.165	0.581	63.39		
# merchants near small builder sites[f]	4.8	0.15	3	3	4	5	5		
Merchants (1161)									
% of contracts[b]	0.09	0.55	2.12e−5	0.01	0.02	0.03	12.95	0.036	90.79
% of expenditure[b]	0.09	0.54	1.28e−6	0.01	0.01	0.02	10.53	0.035	78.68
% of volume[b]	0.09	0.53	7.11e−7	0.06	0.10	0.18	9.64	0.033	76.72
% of delivery sites[b,c]	0.08	0.43	2.12e−6	0.01	0.02	0.03	0.022	0.036	86.18
# products delivered to location	173.78	352.78	1	15	66	175	3249		
Local footprint (1000 bricks)[d]	141.24	767.52	0.002	6.99	20.68	75.53	1070.50		
East–west spread (km)	286.41	181.09	0	102.72	335.63	471.57	513.93		
North–south spread (km)	441.62	322.06	0	101.30	462.03	801.36	1101.61		
Bricks (1000) per km^2[e]	0.134	1.61	2.0e−6	0.0004	0.0016	0.0070	46.77		
Bricks (million p.a.)	0.921	5.63	7.60e−3	6.82e−2	0.107	0.197	103.07		

Table 1 continued

	608,197 contracts[a]								
	Mean	SD	Min.	Lower quartile	Median	Upper quartile	Max.	HHI[b]	Of all buyers[g]
# merchants near small merchant sites[f]	4.9	0.23	0	4	4	5	5		

[a] A contract is defined as product (description) delivered over a specific link: a manufacturing plant to a buyer location, in a given fiscal year

[b] Shares and HHIs (Herfindahl-Hirschman Indexes) are calculated conditional on buyer type; e.g., the builder with the maximum market share, in terms of contracts, accounts for 15.58% of all builders' contracts

[c] A buyer site is a unique, buyer-specific delivery location. For some buyers, their type is not recorded

[d] Average annual brick volume of any brick product (in 1000 bricks) to a given buyer site

[e] This is calculated at the buyer level as the average annual brick volume divided by the product of east–west and north–south spread (1000 bricks per km^2)

[f] Number of five largest merchants within 50 km of delivery site; small firms defined as handling less than 3.4 million bricks p.a.

[g] Of all buyers; e.g. builders account for 9.21% of all contracts in the data

Table 2 Summary statistics: contract characteristics

Contract volumes	608,197 contracts[a]						
	Mean	SD	Min.	Lower quartile	Median	Upper quartile	Max.
(1,000 bricks)							
All	17.79	37.96	0.02	1.81	7.50	18.30	3111.5
Builders	47.86	67.11	0.02	6.0	20.0	64.0	1178.3
Merchants	15.85	34.43	0.06	1.62	7.20	17.03	3111.5

Brick characteristics	All		Builders[b]		Merchants[b]	
	Mean	SD	Mean	SD	Mean	SD
Use category (%)						
Facing	86.48	30.66	89.50	34.48	86.21	34.48
Engineering	2.96	16.95	2.19	14.62	2.82	16.56
% other[c]	10.56	30.74				
Manufacturing category (of facing bricks, %)						
Extruded	56.13	49.62	64.89	47.73	54.33	49.82
Soft mud	24.07	42.75	21.33	40.96	25.02	43.32
Flettons	16.55	37.16	10.59	30.76	17.47	37.97
Handmade	2.08	14.15	1.25	11.13	2.19	14.63
Other[d]	1.17	10.79				

[a] A contract is defined as product (description) delivered over a specific link: a manufacturing plant to a buyer location, in a given fiscal year

[b] Percentage of builders' (merchants') contracts for facing bricks; analogous for other use and manufacturing categories

[c] Category not recorded. According to the CC report, these include "specials": facing bricks that differ in size and shape from industry standards

[d] These may be blocks, tiles, etc

Table 2 describes contracts in terms of various characteristics. The table summarizes contract volumes and brick use and manufacturing categories which are dictated by construction and planning regime requirements. Contract characteristics that are likely the outcome of bilateral contracting between manufacturer and buyer are summarized in Table 3.

Table 3 Summary statistics: contracting outcomes

	608,197 contracts[a]						
	Mean	SD	Min.	Lower quartile	Median	Upper quartile	Max.
All (608,197 contracts)							
Ex-works price (£per 1000 bricks)	563.53	6458.42	10.20	181.63	221.35	275.14	5137.38
Distance to chosen plant (km)	118.44	86.93	0.06	51.58	102.71	167.99	987.70
Closest chosen (%)	9.73	29.64					
Invade[g] (km)	82.85	81.96	0	14.72	64.01	126.85	611.12
# established manufacturers (50 km)	1.52	1.25	0	1	1	2	4
# established manufacturers (100 km)	2.35	1.28	0	1	2	4	4
# plants (100 km), any manufacturer	11.68	6.58	0	6	12	16	25
Builders (56,018 contracts)							
Ex-works price (£per 1000 bricks)	693.82	6691.68	12.50	161.00	185.04	227.99	5137.38
Distance to chosen plant (km)	117.20	80.31	0.13	54.60	102.36	167.10	601.31
Closest chosen (%)	8.89	28.45					
Invade[b] (km)	83.07	78.04	0	19.42	65.81	127.84	583.58
# established manufacturers (50 km)	1.46	1.21	0	1	1	2	4
# established manufacturers (100 km)	2.20	1.27	0	1	2	3	4
# plants (100 km), any manufacturer	11.55	6.58	0	6	12	16	25
Merchants (552,214 contracts)							
Ex-works price (£per 1000 bricks)	544.21	6723.04	10.20	186.10	224.86	277.35	5034.56
Distance to chosen plant (km)	119.08	86.85	0.06	52.15	103.36	169.26	987.70
Closest chosen (%)	9.82	29.75					
Invade[b] (km)	82.82	82.03	0	14.93	64.70	128.01	611.12
# established manufacturers (50 km)	1.67	1.28	0	1	1	3	4
# established manufacturers (100 km)	2.62	1.21	0	2	3	4	4
# plants (100 km), any manufacturer	11.69	6.50	0	7	12	16	25

[a] A contract is defined as product (description) delivered over a specific link: a manufacturing plant to a buyer location, in a given fiscal year

[b] "invade"—sales overlap, km distance between chosen manufacturing plant and rival manufacturer plant that is closest to the buyer's site (zero if chosen plant is the closest)

Contract volumes, in terms of 1000 bricks, are right-skewed. The median contract volume is 7500 bricks, which roughly corresponds to the brick requirement for a "dwelling", or detached house.[16] The mean contract volume is 17,790 bricks, reflecting some contracts of very large volumes, up to more than 3 million bricks, which corresponds to brick requirements of very large developments, such as London's iconic St. Pancras station.[17]

Small—and indeed, very small—orders are driven by repair, maintenance and improvement (RMI) work. This includes renovation and conservation work and building extensions. It requires colour-matched bricks, often for very small surface areas, e.g. to rebuild chimneys and walls around flues.[18] This type of construction work dominates the UK construction output, unlike in the US. Over the observation horizon, according to the Office of National Statistics (ONS), the annual volume of new housing was on the order of £6 billion, while the annual volume of repair, maintenance and improvement was more than twice as large, on the order of £13 billion. The dominance of the RMI over the newly built sector is due to rigid nature conservation and architectural heritage protection regulations in the UK.

The RMI market is primarily, but not exclusively, served by builders' merchants.[19] Merchants tend to buy bricks in bulk and divide these bulk orders into smaller loads in their yards for sales to smaller buyers or buyers of mixed loads. Compared to the hundreds of different brick varieties that are offered by manufacturers, merchants tend to have only a relatively small range of popular brick products in their yards, to minimize storage costs. Therefore, builders that require specific bricks for RMI work in order to match colour, texture, and shape of surrounding bricks source these directly from manufacturers.

The vast majority of contracts—more than 86%—involve facing brick products. Of these, the majority—56.13%—are of the extruded variety, followed by soft mud and fletton bricks.

Table 3 characterises brick contracts in terms of outcomes that may result from negotiations between manufacturer and buyer. Prices are ex-works: free-on-board, net of any transport costs or other costs or discounts, expressed in GBP (£) for 1000 bricks. Given a brick requirement of 60 bricks for 1m^2, these are prices for approximately 16.7m^2 of wall surface. This seems a sensible reference size increment, or measure of marginal price, for a study of prices that investigates possible nonlinearities due to volume or location. Documentation by the UK's brick industry representation (the Brick Development Association) also uses prices for 1000 bricks as reference.

[16] According to the UK National Association of Estate Agents, the average detached house in 2006 required 5400 bricks. The CC report, paragraph 4.30, states 7000–10,000 bricks per dwelling.

[17] The restoration and modernisation of the station about a decade ago required 60 million bricks; http://www.bifm.org.uk/bifm/filegrab/StPancrasFactSheet.pdf?type=documents&ref=2965.

[18] Flues are outlets of waste gases, from boilers, heating, and ventilation systems.

[19] Competition Commission (2007, paragraph 4.45).

Table 4 Price variation: "Weston Red Multi Stock" brick

	Quartiles of price for 1000 bricks, in £						
	Overall	Volume quartiles[a] (1000 bricks)				# Est.d manufacturers (in 100 km)	
		Q1	Q2	Q3	Q4	1	4
Lower quartile	178.6	214.7	179.4	169.1	173.0	179.7	172.7
Median	200.5	241.3	203.7	190.5	187.0	215.9	190.5
Upper quartile	232.9	258.4	232.2	212.8	203.8	247.0	214.8

There were 2398 contracts for this brick. Prices are ex-works: free-on-board, net of any transport or other costs

[a]Volume quartile, 1000 bricks, Q1: ≤ 3.5; Q2: 3.5–14.0: Q3: 14.0–46.5; Q4: ≥ 46.5

Prices for 1000 bricks have a median of £221.35, but can range up to more than £5000, for bespoke hand-made bricks.[20] The mean price of £563.53 for 1000 bricks is below the price one would have to pay for 1000 bricks at a DIY shop, where bricks are sold on average at £0.71 per brick.

There are several contracts in the data that involve very low prices, as low as on the order of £10 for 1000 bricks. These are likely to involve stock clearances or sales of "rejects" which are substantially cheaper due to possible imperfections in their colour, texture and shape or their physical characteristics. Nonetheless, such bricks are sometimes deemed able to provide a good all-round performance in a build, especially for some types of RMI work.

Table 4 shows that, for a given, relatively popular facing brick product, the price for 1000 bricks varies both, within and across contract volume quartiles. The first column of the table provides quartiles of the unconditional price distribution for this product. The following four columns condition on quartiles of the associated contract volumes. For example, the median price for contract volumes in the lowest quartile (Q1, up to 3500 bricks), £241.30, is higher than the median price for contract volumes in the highest quartile (Q4, above 46,500 bricks), £187.00.

In the brick industry, variation within volume quartile cannot be explained with conventional rationales for price dispersion such search costs because brick products are well known, with some standardised and other well documented characteristics. The price variation within and across volume quartiles that are exhibited in Table 4 therefore is likely a reflection of bilateral bargaining.

Only about 10% of brick contracts are sourced from the closest manufacturing plant. Bricks travel on average just over 100 km, but can travel as much as 987 km.[21] Distances of several hundred kilometers are not uncommon for specific brick requirements: The bricks for London's St. Pancras station were manufactured in

[20] Prices of more than £4.50 per hand-made brick are not uncommon, according to manufacturers' online product price lists.

[21] This appears to be the case of a brick delivery in Cornwall that originated at a plant in the Newcastle area.

Nottingham (ca. 200 km from London), and for the London School of Economics' student centre in Liverpool (ca. 350 km).[22]

About 90% of brick contracts are sourced from plants other than the closest to the buyer location. In the parlance of Stigler's (1949) analysis of freight absorption, in such cases of "overlapping sales" the chosen manufacturer "invades" the geographic turf of the competitor whose plant is the closest to the buyer's location. The median "invasion" distance, or "sales overlap", is 64 km.

In light of the fact that substantial brick quantities are transported over significant distances and of the apparent sales overlaps, the CC concluded that the geographic market for bricks is national.[23] To account for geographic differences in buyer demand that are derived from the demand for newly built housing and RMI, the analysis in this paper distinguishes urban from rural delivery sites, based on ONS urban boundaries.[24]

Buyers do not necessarily source their brick purchases from any one of the four manufacturers. Instead, they may have preferences for certain manufacturers. An *established manufacturer* that supplies bricks to a buyer is defined as a manufacturer that the buyer transacted with over the period 2001–2006. The number and identity of established manufacturers is a buyer's commercial decision. These buyer level decisions on the number of suppliers result in the average number of established manufacturers with a plant within 50 km (100 km) of a contract's delivery site (buyer location) being 1.52 (2.35).

Consequently, on average, in any bilateral negotiation, the buyer can claim at least one established manufacturer as an outside option within 100 km. Table 4 shows that quartiles of the distribution of prices for 1000 bricks of a popular facing brick decline when buyers can claim more outside options. The final two columns of the table condition on the number of established manufacturers within 100 km. The median price of contracts for delivery locations in which there is a monopolist established manufacturer, £215.90, is higher than that for delivery in locations with four established manufacturers in direct competition, £190.50. This is consistent with prices on average reflecting some degree of competition between manufacturers when they bargain with buyers.

In terms of overall brick manufacturing capacity, there are 54 plants in the data.[25] On average, there are 11.68 plants of any of the four manufacturers within 100 km of a buyer location.

[22] http://www.bbc.co.uk/news/magazine-33095262.

[23] Competition Commission (2007, paragraph 5.44).

[24] https://www.gov.uk/government/collections/rural-urban-classification.

[25] Competition Commission (2007, Figure 4) shows the locations of manufacturing plants.

4 Empirical Strategy

4.1 Modelling Approach

As described in the preceding section, buyers of bricks differ along various dimensions, in terms of their type, business model, and role in the construction supply chain, and in terms of the size and spread of their business activities. Builders are end-users of bricks, while merchants are intermediaries whose business model hinges on offering prices that some builders—notably smaller ones—could not achieve when dealing directly with manufacturers. Conversely, small builders in the data that do deal directly with manufacturers would therefore be expected to be especially savvy buyers vis-à-vis manufacturers.

In light of such buyer heterogeneity, the empirical strategy in this paper pursues a non-structural industrial organisation modelling approach that relates contract prices to brick characteristics (as the main non-common cost drivers), distance, contract volume (to capture possible scale economies in production), and local buyer-level characteristics (to capture third-degree price discrimination and countervailing power). This approach is robust enough to accommodate the heterogeneity of buyers and the ensuing different conceivable models of buyer-seller relationships.

By contrast, structural approaches, such as Beckert et al. (2016) for example, focus on a specific subset of buyers—namely the twenty largest builders—for whom a specific structural bargaining model of their relationship with manufacturers can plausibly be postulated. Beckert et al. (2016) trade off structural refinement against the richness of data that is being explored.[26]

In this paper, I adopt an approach that I call a "reduced form" approach. It is strictly not an econometric reduced form since I allow for endogeneity in the determining variables, but it is not a fully structural theoretical model because it is not derived from an explicit optimising model of firm behavior. The advantage of this sort of semi-structural "reduced form" is that it is likely to be more robust to failures of the assumptions of theoretical models, and it allows me to use much richer data of heterogeneous firms where the assumptions of the theoretical model in Beckert et al. (2016) may not hold.

4.2 Econometric Modelling Assumptions

The analysis is based on the following assumptions.

It is assumed that—conditional on included regressors and buyer fixed effects—contracts are independent. Any correlation between contracts is controlled for by the buyer fixed effects. The data do not contain any information that would allow a linking of contracts (e.g., framework agreements, which arguably are not binding anyway) or bundling of products, so any other assumption would be speculative at

[26] Boyer (1996) and Hyde and Perloff (1995) discuss the merits of reduced form versus structural analysis of market power more generally.

best.[27] Independence of contracts is also supported by manufacturers' significant excess capacity over the period of analysis[28] and because brick contract volumes are small relative to the respective total plant capacity.

In line with the perspective that has been taken in the literature on ready-mixed concrete (Hortaçsu and Syverson 2007; Syverson 2007, 2008), local demand for bricks is assumed to be exogenous. This is also supported by the fact that the value of bricks accounts for 1–1.5% of the cost of housing in 2006.[29] The CC report also states that demand for bricks is likely to be price-inelastic and that the choice of brick is determined by aesthetic appearance and planning requirements.[30]

Contracts are observed between the buyer and the manufacturer from which the buyer selects to purchase the required bricks. The selection mechanism can be thought of as follows. For a given brick requirement, buyer i and each seller j generate a joint surplus, δ_{ij}, and they bargain over its split. This surplus is larger when the distance d_{ij} between the manufacturer and the buyer's location (delivery site) is shorter. For example,

$$\delta_{ij} = \alpha_{ij} - \tau d_{ij},$$

where α_{ij} capture buyer-manufacturer specific gross surplus, τ is a positive parameter and $-\tau d_{ij}$ capture transport cost; so δ_{ij} is the joint surplus, net of transport cost. The buyer selects the manufacturer with whom maximal surplus is generated, out of the buyer's set of established manufacturers, $\mathcal{S}_i$:

$$j(i) = \arg\max_{j \in \mathcal{S}_i} \{\delta_{ij}\}.$$

The resulting contract price $p_{ij(i)}$ equals marginal costs plus a mark-up $m_{ij(i)}$ that reflects the split of the bargained-over surplus between buyer and seller. This mark-up thus is a direct reflection of the buyer-level mechanism of seller selection. The mark-up is a function of the buyer's relative bargaining weight and the difference between the surplus $\delta_{ij(i)}$ and the surplus that the buyer would obtain from his outside option: the second-best alternative, $\delta_{i,r(i)}$ where $r(i) = \arg\max_{k \in \mathcal{S}_i \setminus \{j(i)\}} \{\delta_{ik}\}$. Structural bargaining models—as in Beckert et al. (2016), for example—induce this structure.

With regard to the mark-up, consider first the buyer's bargaining weight. It is assumed not to depend on the identity of the seller (manufacturer) and to arise from the demand that the buyer brings to the local market. This is referred to as the size of the buyer's *local footprint*. It is the business that the manufacturer can gain locally from the buyer. It is measured as the number of bricks of any manufacturing and use

[27] See Competition Commission (2007, Appendix C, paragraph 23) for the non-binding nature of framework agreements.

[28] See Competition Commission (2007, paragraph 5).

[29] According to CEBR (2016), in 2006 the cost of housing per brick was £64.59 in London and £52.37 in Cambridge, for example. This compares to an average price of a facing bricks of £0.75 in the contract data.

[30] See Competition Commission (2007, paragraph 4.32 and Appendix C, paragraphs 15 and 18).

category that is delivered to the delivery site that is associated with the respective buyer-seller contract over the entire observation horizon: over all seven fiscal years.

Second, consider the contribution to the mark-up that arises from the difference in surplus between the chosen and outside options. The buyer's outside options arise from the manufacturers that the buyer has transactional relationships with and that have plants around the delivery site. The manufacturer's outside option is to keep bricks in storage. Through the buyer's outside options, this contribution to the mark-up depends on the buyer's set of established manufacturers, $\mathcal{S}_i$. The more choice options $s_i = \#\mathcal{S}_i$ that the buyer has, the larger is the buyer's outside option, and the lower is the mark-up.

The model also implies that it is the difference in distances between the chosen manufacturer $d_{ij(i)}$ and the runner-up, $d_{i,r(i)}$—or "sales overlap" in the terminology of Stigler (1949)—on which the selection term depends. If the latter is smaller than the former, then in the Stiglerian sense the chosen manufacturer $j(i)$ "invades" $r(i)$'s geographic market, by $invade_{ij(i)} = d_{ij(i)} - d_{ir(i)}$ km; there is no "invasion" if the chosen manufacturer is closest to the buyer. The larger is this "invasion", the lower is the mark-up. This is consistent with the economics of freight absorption.

It is worth noticing that the invasion distance, or "sales overlap", through the dependence on the unobserved runner-up $r(i)$ is also a function of $\mathcal{S}_i$. As the runner-up is not observed in the data, for the calculation of the invasion distance it is assumed that, among the manufacturers with which the buyer has established relationships, the runner-up is the chosen manufacturer's competitor that is closest to the buyer's delivery location.

The set of buyer i's established manufacturers, $\mathcal{S}_i$, itself is a strategic choice outcome for buyer i. Therefore, the number of buyer i's established manufacturers, s_i, and the local invasion distance that is implied by it are potentially endogenous regressors.

The composition of the buyer's local demand in terms of brick product varieties needed and supplied—referred to as the profile of the buyer's local footprint—matters to the buyer because each order involves fixed costs, due to order processing and delivery. It therefore is a driver of the number of manufacturers with which a buyer has established transactional relationships and, as a consequence, of the chosen manufacturer's invasion distance into competitors' geographic markets.

Manufacturers produce all brick varieties within their product range at all times, given the large number and heterogeneity of their buyers and their buyers' demand. So product variety is a strategic choice of the manufacturer that is made before individual buyer demand is realised. Hence, the profile of the buyer's local footprint is irrelevant to the manufacturer, which cares only about the size of the buyer's local footprint, because it is more economical for the manufacturer to produce a large quantity, in line with the cost structure of brick manufacturing (Bower 1964). Therefore, the profile of the buyer's local footprint does not feature in the pricing model. The number of product *varieties supplied* to a buyer thus serves as an instrument for the potentially endogenous regressors: the number of local established manufacturers and the implied invasion distance.

The brick manufacturing capacity which is local to the buyer's delivery location is another exogenous driver of the number of established manufacturers local to the buyer. The more plants that are nearby to the buyer's delivery locations, the greater is the likelihood that some are owned by suppliers with which the buyer has established transactional relationships. Since plant locations are determined by clay deposits, local brick manufacturing capacity (which is measured by the number of plants of any manufacturer within 100 km of the delivery location) is exogenous.

Annual buyer size (in million bricks) spread over the area of the buyer's activity—which is approximated as the product of maximum easting and northing distances between a buyer's delivery locations—was considered as an additional instrument. It captures the buyer's overall business spread, beyond the local footprint. It is an exogenous buyer characteristic, but does not vary across contracts as it is not a local measure. It does not belong in the pricing model because only the size of the local footprint matters. This instrument turned out to be weak in first-stage regressions.

The ensemble of instruments, however, passed the Sargan–Hansen *J*-test in all models.

4.3 Model Specification

The baseline model for the logarithm of the price for 1000 bricks, $p_{ikj(i)}$—which is specified in the contract between buyer i and i's chosen manufacturer $j(i)$ for a given brick product to be delivered to site k—is specified as

$$p_{ikj(i)} = \mu_i + \gamma_{j(i)} + \alpha_d invade_{ikj(i)} + \alpha_v q_{ik} + \alpha_f f_{ik} + \alpha_s s_{ik} + \alpha_u u_k + c'_{ik}\theta + \epsilon_{ikj(i)}, \; j(i) \in \mathcal{S}_i,$$

where μ_i is a buyer fixed effect; $\gamma_{j(i)}$ is a chosen supplier dummy; $invade_{ikj(i)}$ is the invasion distance (which is defined in the preceding subsection); q_{ik} is the logarithm of the exogenous brick volume requirement of buyer i at location k; f_{ik} is buyer i's local footprint, defined as buyer i's aggregate brick volume requirements at location k over the observation horizon;[31] s_{ik} is the number of i's established manufacturers in the area around location k; u_k is an indicator that takes the value one if site k is classified as "urban" by the ONS and controls for local derived demand for construction materials[32]; c_{ik} is a vector of cost controls for the brick product that i buys for location k, which includes dummy variables for cost-relevant product attributes, such as use and manufacturing categories, as in Table 2; $\epsilon_{ikj(i)}$ is an i.i.d. error term; and the αs and θ are estimable parameters.

Given the available data, this model can account for cost only through log volume q_{ik} and cost relevant product attributes c_{ik}.

[31] The specification of the pricing equation that is linear in the levels of this variable produced a better fit than a specification that is linear in the log of this variable. There are no a priori theoretic reasons for either specification. This is an empirical matter. The semi-log specification in this application means that the elasticity of price with respect to the buyer's local commercial significance is not constant, but varies with the level of that variable.

[32] An urban versus rural split is motivated by construction restrictions that are due to rigid nature conservation regulations in the UK.

Table 5 Estimation results

	Log price of 1000 bricks			
	FE(1)	IV(1)	FE(2)	IV(2)
Manufacturer 2	0.172***	0.153***	0.172***	0.181***
	(0.004)	(0.022)	(0.004)	(0.017)
Manufacturer 3	− 0.236***	− 0.298***	− 0.236***	− 0.298***
	(0.003)	(0.018)	(0.003)	(0.013)
Manufacturer 4	− 0.070***	− 0.319***	− 0.070***	− 0.262***
	(0.003)	(0.026)	(0.003)	(0.016)
Nonlinear pricing				
Invade[a] (100 km)	0.010***	− 3.334***	0.010***	− 2.549***
	(0.001)	(0.280)	(0.001)	(0.160)
Log volume[b] (1000 bricks)	− 0.247***	− 0.332***	− 0.247***	− 0.310***
	(0.001)	(0.007)	(0.001)	(0.004)
Bargaining				
Local footprint[c] (1m bricks)	− 4.295***	− 13.607***	− 4.295***	− 8.428***
	(0.213)	(1.389)	(0.213)	(0.893)
# est.d manufacturers[d] (50 km)	− 0.002*	− 0.926***		
	(7.2e−04)	(0.077)		
# est.d manufacturers[d] (100 km)			0.001	− 0.706***
			(0.001)	(0.043)
Cost relevant characteristics				
FY 2001[e]	0.065***	0.106***	0.065***	0.100***
	(0.003)	(0.018)	(0.003)	(0.013)
FY 2002	0.129***	0.272***	0.129***	0.240***
	(0.003)	(0.021)	(0.003)	(0.014)
FY 2003	0.220***	0.405***	0.220***	0.358***
	(0.003)	(0.023)	(0.003)	(0.015)
FY 2004	0.244***	0.419***	0.244***	0.374***
	(0.003)	(0.023)	(0.003)	(0.015)
FY 2005	0.285***	0.479***	0.285***	0.436***
	(0.003)	(0.024)	(0.003)	(0.016)
FY 2006	0.347***	0.539***	0.347***	0.500***
	(0.003)	(0.024)	(0.003)	(0.016)
Urban	0.006***	0.782***	0.005***	0.198***
	(0.002)	(0.065)	(0.002)	(0.014)
Facing	− 0.132***	− 0.310***	− 0.132***	− 0.284***
	(0.002)	(0.020)	(0.002)	(0.014)
Engineering	− 0.141***	0.135***	− 0.141***	0.073***
	(0.004)	(0.034)	(0.005)	(0.023)
Extruded	− 0.660***	− 0.383***	− 0.660***	− 0.445***
	(0.006)	(0.043)	(0.006)	(0.030)

Table 5 continued

	Log price of 1000 bricks			
	FE(1)	IV(1)	FE(2)	IV(2)
Soft mud	– 0.451***	– 0.222***	– 0.451***	– 0.225***
	(0.006)	(0.041)	(0.006)	(0.030)
Fletton	– 0.358***	– 0.069*	– 0.358***	– 0.038
	(0.007)	(0.045)	(0.007)	(0.035)
Cons	6.500***	10.129***	6.500***	10.135***
	(0.008)	(0.305)	(0.008)	(0.227)
	Competition effect[f]			
	– 0.002*	– 0.604***	4.8e−4	– 0.506***
	(0.001)	(0.030)	(0.001)	(0.021)
N	608,197	608,197	608,197	608,197
R^2	0.5360	–	0.5362	–

Standard errors are in parentheses. *,** and *** indicate statistical significance at the 10, 5, and 1 % level, respectively. All regressions include buyer fixed effects. Instruments for "invade" and "established manufacturers": the number of varieties supplied to, and the number of plants of any manufacturer that is within 100 km of, the buyer's site

[a] "invade": sales overlap, km distance between the chosen manufacturing plant and the rival manufacturer plant that is closest to the buyer's site (zero if chosen plant is the closest)

[b] Log volume is the logarithm of volume (in units 1000 bricks), as in Table 2

[c] "local footprint": the average annual brick volume of any brick product that is delivered to the buyer's site, in millions of bricks

[d] "established manufacturers": manufacturers with which the buyer transacted during fiscal years 2001–2007 with plants in 50 (100) km

[e] Fiscal year, commencing on 1 April 2001; analogously for subsequent fiscal years

[f] Calculated as $\exp(\hat{\alpha}_s) - 1$, where α is the coefficient on # established manufacturers

In this specification, the number of buyer *i*'s established manufacturers that are local to the delivery site *k*, s_{ik}, and the resulting local invasion distance, $invade_{ikj(i)}$, are endogenous. Instruments for these endogenous regressors are the number of product varieties that are supplied to buyer *i* at site *k* and the number of plants of any manufacturer within 100 km of site *k*.

As was detailed in the preceding subsection, the mark-up of price over cost in this model captures the split of any surplus that buyer *i* and selected manufacturer *j*(*i*) generate through the contract for location *k*. The portion of this surplus that accrues to the buyer is accounted for in the model through two effects. First, the buyer's local commercial significance, f_{ik}, captures the countervailing power effect. And second, the buyer's local choice options s_{ik}, and the implied extent to which the chosen manufacturer invades a competitor's turf, $invade_{ikj(i)}$, capture the effect of competition.

Table 6 Estimation results: large versus small buyers

	Log price of 1000 bricks					
	Large buyers		Small buyers			
	IV(1)	IV(2)	IV(3)	IV(4)	IV(5)	IV(6)
Manufacturer 2	0.161***	0.195***	0.189***	0.213***	0.189***	0.212***
	(0.022)	(0.017)	(0.025)	(0.028)	(0.025)	(0.029)
Manufacturer 3	− 0.208***	− 0.219***	− 0.352***	− 0.389***	− 0.353***	− 0.390***
	(0.017)	(0.013)	(0.018)	(0.021)	(0.018)	(0.021)
Manufacturer 4	− 0.257***	− 0.217***	− 0.238***	− 0.250***	− 0.238***	− 0.250***
	(0.025)	(0.017)	(0.016)	(0.019)	(0.016)	(0.019)
Nonlinear pricing						
Invade[a] (100 km)	− 2.532***	− 2.084***	− 2.007***	− 2.316***	− 2.013***	− 2.318***
	(0.231)	(0.150)	(0.145)	(0.186)	(0.146)	(0.187)
Log volume[b] (1000 bricks)	− 0.315***	− 0.301***	− 0.295***	− 0.300***	− 0.296***	− 0.300***
	(0.007)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Bargaining						
Local footprint[c] (1m bricks)	− 22.659***	− 12.100***	− 0.478	− 0.628	− 0.471	− 0.001
	(1.953)	(1.055)	(1.189)	(1.207)	(1.223)	(0.001)
# est.d manuf.s[d] (50 km)	− 0.698***		− 0.669***		− 0.663***	
	(0.062)		(0.049)		(0.048)	
# est.d manuf.s[d] (100 km)		− 0.553***		− 0.988***		− 0.980***
		(0.039)		(0.080)		(0.080)
# merchants[e] (50 km)					− 0.668***	− 0.606***
					(0.132)	(0.145)
Cost rel. characteristics						
FY 2001[f]	0.110***	0.104***	0.077***	0.087***	0.077***	0.087***
	(0.020)	(0.015)	(0.015)	(0.016)	(0.015)	(0.016)
FY 2002	0.275***	0.245***	0.181***	0.206***	0.180***	0.205***
	(0.023)	(0.017)	(0.015)	(0.017)	(0.015)	(0.017)
FY 2003	0.401***	0.357***	0.295***	0.323***	0.295***	0.323***
	(9.025)	(0.018)	(0.016)	(0.018)	(0.016)	(0.018)
FY 2004	0.390***	0.349***	0.333***	0.365***	0.333***	0.365***
	(0.024)	(0.017)	(0.016)	(0.019)	(0.016)	(0.019)
FY 2005	0.440***	0.406***	0.399***	0.433***	0.399***	0.433***
	(0.024)	(0.018)	(0.017)	(0.020)	(0.017)	(0.020)
FY 2006	0.474***	0.454***	0.485***	0.517***	0.485***	0.517***
	(0.023)	(0.017)	(0.018)	(0.021)	(0.018)	(0.021)
Urban	0.697***	0.202***	0.290***	0.071***	0.290***	0.073***
	(0.062)	(0.015)	(0.024)	(0.014)	(0.024)	(0.014)
Facing	− 0.179***	− 0.186***	− 0.354***	− 0.385***	− 0.354***	− 0.385***
	(0.015)	(0.012)	(0.018)	(0.022)	(0.018)	(0.022)
Engineering	0.336***	0.282***	− 0.185***	− 0.200***	− 0.184***	− 0.200***
	(0.053)	(0.038)	(0.019)	(0.022)	(0.019)	(0.022)

Table 6 continued

	Log price of 1000 bricks					
	Large buyers		Small buyers			
	IV(1)	IV(2)	IV(3)	IV(4)	IV(5)	IV(6)
Extruded	– 0.568***	– 0.590***	– 0.367***	– 0.345***	– 0.367***	– 0.345***
	(0.045)	(0.035)	(0.032)	(0.036)	(0.032)	(0.036)
Soft mud	– 0.314***	– 0.281***	– 0.272***	– 0.254***	– 0.271***	– 0.254***
	(0.047)	(0.038)	(0.030)	(0.034)	(0.030)	(0.034)
Fletton	– 0.410***	– 0.287***	0.186***	0.242***	0.187***	0.243***
	(0.043)	(0.036)	(0.044)	(0.052)	(0.044)	(0.052)
Cons	9.599***	9.897***	8.638***	9.922***	8.828***	10.085***
	(0.274)	(0.235)	(0.162)	(0.282)	(0.179)	(0.297)
	Competition effect[g]					
	– 0.502***	– 0.425***	– 0.488***	– 0.628***	– 0.485***	– 0.625***
	(0.031)	(0.022)	(0.025)	(0.030)	(0.025)	(0.030)
N	302,529	302,529	305,629	305,628	305,628	305,628

Standard errors are in parentheses. *,** and *** indicate statistical significance at the 10, 5, and 1 % level, respectively. All regressions include buyer fixed effects. Instruments for "invade" and "established manufacturers": number of varieties that are supplied to, and number of plants of any manufacturer that is within 100 km of, the buyer's site

Split at volume 3.4 million bricks p.a.; this ensures roughly an even split between the two groups in terms of number of contracts

[a] "invade": sales overlap, km distance between the chosen manufacturing plant and the rival manufacturer plant that is closest to the buyer's site (zero if chosen plant is the closest)

[b] Log volume is the logarithm of volume (in units 1000 bricks), as in Table 2

[c] "local footprint": the average annual brick volume of any brick product that is delivered to the buyer's site, in millions of bricks

[d] "established manufacturers": manufacturers with which the buyer transacted during fiscal years 2001–2007 with plants in 50 (100) km

[e] "merchants": the number of five largest merchants, by number of bricks sold per year; within 50 km of the buyer's site

[f] Fiscal year, commencing on 1 April 2001; analogous for subsequent fiscal years

[g] Calculated as $\exp(\hat{\alpha}_s) - 1$, where α is the coefficient on the # of established manufacturers

5 Results

Tables 5 and 6 present the main estimation results. For the IV regressions, Table 7 provides the relevant coefficient estimates of the first-stage regressions.

When we compare the fixed effects (FE) and instrumental variables (IV) estimation results—Table 5, FE(1), FE(2), IV(1) and IV(2), respectively—the estimates of the effect of invasion distance (*invade*, or sales overlap) and of the number of established manufacturers (# *est.d manufacturers*) are biased downward in absolute value absent instrumentation. Indeed, the bias in the estimate of the coefficient on *invade* even reverses the sign of the coefficient estimate.

Table 7 First-stage regression results

Tables	Regression	Instrumented regressor	Instruments		R^2
			# varieties supplied[a]	# plants of any manufacturer in 100 km	
5	IV(1)	Invade	0.001***	− 0.026***	0.04
			(1.5e−5)	(2.2e−4)	
		# est.d manufacturers (50 km)	− 4.1e−04***	0.097***	0.22
			(1.6e−05)	(2.3e−04)	
	IV(2)	Invade	3.0e−4***	− 0.026***	0.04
			(1.5e−5)	(2.2e−4)	
		# est.d manufacturers (100 km)	− 2.0e−04	0.098	0.52
			(8.4e−06)	(1.2e−04)	
6	IV(1)	Invade	4.0e−4***	− .028***	0.04
			(2.0e−5)	(0.001)	
		# est.d manufacturers (50 km)	− 5.7e−4***	0.104***	0.33
			(2.6e−5)	(3.2e−4)	
	IV(2)	Invade	4.0e−4***	− 0.028***	0.04
			(2.0e−5)	(2.5e−4)	
		# est.d manufacturers (100 km)	− 4.0e−4***	0.109***	0.57
			(1.4e−5)	(1.8e−4)	
	IV(3)	Invade	2.9e−4***	− 0.021***	0.04
			(2.5e−5)	(0.001)	
		# est.d manufacturers (50 km)	− 2.9e−4***	0.063***	0.20
			(1.6e−5)	(0.001)	
	IV(4)	Invade	2.9e−4***	− 0.021***	0.04
			(2.5e−5)	(4.9e−4)	
		# est.d manufacturers (100 km)	− 1.1e−4***	0.049***	0.28
			(7.6e−6)	(1.5e−4)	
	IV(5)	Invade	2.9e−4***	− 0.019***	0.03
			(2.5e−5)	(0.001)	
		# est.d manufacturers (50 km)	− 2.9e−4***	0.063***	0.17
			(1.6e−5)	(0.001)	
	IV(6)	Invade	2.9e−4***	− 0.020***	0.04
			(2.5e−5)	(4.9e−4)	
		# est.d manufacturers (100 km)	− 1.1e−4***	0.049***	0.28
			(7.6e−6)	(1.032)	

Standard errors are in parentheses. *,** and *** indicate statistical significance at the 10, 5, and 1 % level, respectively. Instruments for "invade" and "established manufacturers"

[a]Number of varieties that are supplied to, and number of plants of any manufacturer that are within 100 km of, the buyer's location. Definitions: "established manufacturers": the manufacturers with which the buyer transacted during fiscal years 2001–2007 with plants in 50 (100) km; "invade": km distance between the chosen manufacturing plant and the rival manufacturer plant that is closest to the buyer's site. An additional instrument, annual buyer size (in million bricks) spread over area of activity, in terms of product of maximum easting and northing distances between buyer sites, turned out to be weak in first-stage regressions, but the ensemble of instruments passed the Sargan–Hansen *J*-test in all models

These biases would be expected if loyal buyers receive lower prices and remain with fewer established manufacturers, inducing a positive correlation between the number of established manufacturers and errors in the pricing equation. Because such buyers stick to fewer manufacturers, they are less likely to invade competitors' turf, so invasion distances for them tend to be shorter, which again induce a positive correlation between price errors and invasion distances.

Table 7 shows first-stage regression results for the effect of the instruments on the endogenous regressors.[33] Table 7 shows that buyers that require more product varieties tend to have fewer local established manufacturers. The likely reason is that there are economies of scale in procurement and delivery. Also, such buyers may need to go further to obtain the specific varieties that they want, because not all varieties are produced at every plant, which increases delivery distances and thereby invasion distances or sales overlap.

At the same time, the penultimate column of Table 7 shows that the larger is the local brick manufacturing capacity, in terms of the number of plants of any supplier within 100 km of the buyer, the larger is the number of local established manufacturers, as it is more likely that any of the local plants is owned by an established manufacturer. Since plants are collocated more densely when the number of local plants is larger, the invasion distance tends to be shorter.

If we return to the main IV results in Table 5, these results show a statistically and economically significant "invasion" (or sales overlap) effect on price, in the Stiglerian sense. The farther that the chosen manufacturer invades the geographic market of the competitor closest to the buyer, or the larger the sales overlap, the more that the chosen manufacturer absorbs the costs of distance: the cost of transport. This is akin to the freight absorption effect that is discussed by Stigler (1949).

The IV results also show a statistically and economically significant competition effect in terms of the effect of the number of established manufacturers on the price the buyer pays. The number of local outside options equals the number of established manufacturers in a given area, minus one. The more local outside options that the buyer has, the lower are the contract prices. If we compare IV(1) and IV(2) in Table 5, as one would expect this effect is stronger for established suppliers within 50 km, as compared to within 100 km.

The IV results in Table 6 distinguish large and small buyers. Buyers are split at a business size cut-off of 3.4 million bricks per year. This results in roughly 50% of contracts that originate from both groups. In the group of small buyers, there are 102 builders and 1137 merchants. The results show that the effect of established manufacturers on price is more pronounced for small buyers because small builders, and possibly small merchants, can credibly claim more outside options: They can also buy from large merchants, which large buyers cannot.[34] Conversely, this result shows that large buyers, when bargaining, may be hindered by their size, as the

[33] To economise on space, the first-stage coefficient estimates of the remaining coefficients are omitted, but are available on request.

[34] For both builders and merchants, F-tests failed to reject the hypothesis that interactions with a dummy variable for "small" are jointly zero at the 5% level. The result is stronger for merchants due to the larger sample size: 1161 merchants account for 90.8 % of contracts in the data.

threat of moving their custom elsewhere is less credible for them than for small buyers because competing local established manufacturers may not have sufficient capacity.[35] Incidentally, this result lends support to the view that a buyer's business volume is exogenous.[36]

This result that small buyers that buy directly from manufacturers achieve bigger discounts when they can claim more potential suppliers does not mean that they receive lower prices overall. Small buyers buy smaller volumes on average, hence they benefit less from nonlinear volume effects than do large buyers.[37] The median price for 1000 bricks that is paid by small buyers is £224.56, while it is only £218.02 for large buyers.

This result may also be due to a possible selection effect with respect to the small buyers in the contract data: Small buyers in the purchase-from-manufacturers data are likely to be savvy buyers that may well bargain with manufacturers because they have particular bargaining skills; less savvy small buyers don't bargain with manufacturers; instead, they buy from merchants at posted retail prices, and hence they are not in the purchase-from-manufacturers data.

To check whether this outside option effect in the case of small buyers is robust to all conceivable supply options that small buyers have, the specifications IV(5) and IV(6) in Table 6 also control for the number of the five largest national merchants within 50 km of the buyer location. The results show that this regressor is orthogonal to all of the regressors in specifications IV(3) and IV(4): the coefficient estimates remain virtually unchanged; the pronounced effect of established manufacturers remains; and the nearby presence of large merchants entails further downward pressure on the prices that small buyers pay.[38]

Since the data do not contain transactions between brick buyers and merchants, the data do not permit the estimation of a selection and incidental truncation model for small buyers in general: a model for small buyers' choice of supplier type

[35] Large buyers cannot pretend to be small by spreading the required volume across several manufacturers, however. Bricks are differentiated products, notably with regard to their aesthetic appearance. This is a consequence of the particular clay that is used. This means, in particular, that products by different manufacturers do not look the same. Therefore, for a given project, only bricks from a single manufacturer can be used, and order division is not an option.

[36] Builders have little, if any, incentive to merge. Delivery by the manufacturer is to a location—a construction site—and the number of bricks that are required at that location is determined by the nature of the building. With bricks being a small part of the overall construction cost, one would not redesign to change the number of bricks required. A merged firm or cooperative would have to arrange transport from the location to which the manufacturer delivers to any other location. To the extent that there is a cost advantage in this, merchants do it already.

[37] The econometric evidence on nonlinear volume effects is presented below.

[38] Since the network of large merchant store locations (large merchants have several hundred stores in the UK) is much denser than the network of manufacturing plants (54), virtually all transactions in the data bypass a large merchant—in the sense that the distance between delivery site and the chosen manufacturing plant exceeds the distance to the closest store of one of the five largest merchants. 99.8% (99.7%) of small builder (merchant) contracts (with manufacturers) bypass the closest of the five largest merchants. And 95.2% (95.1%) of small builders (merchants) have contracts only with manufacturers that bypass these merchants. The median bypass distance is 106 km (93.6 km) for builders (merchants). This suggests that the small buyers in the data reveal themselves as being selective with whom they deal. They could have bought from at least one of the five large merchants, but chose to bypass that merchant and to buy from a manufacturer instead.

Table 8 Robustness check: results using trimmed sample

	Log price of 1000 bricks				
	A: Pooled sample		B: Buyer size[a]		
			Large	Small	
	IV(1)	IV(2)	IV(2)	IV(4)	IV(6)
Nonlinear pricing					
Invade (100 km)	– 2.706***	– 2.059***	– 1.664***	– 1.883***	– 1.885***
	(0.226)	(0.128)	(0.121)	(0.152)	(0.153)
Log volume (1k bricks)	– 0.282***	– 0.263***	– 0.255***	– 0.256***	– 0.256***
	(0.006)	(0.003)	(0.004)	(0.004)	(0.004)
Bargaining					
Local footprint (1m bricks)	– 10.464***	– 6.189***	– 9.366***	2.904e−4	2.733e−4
	(1.113)	(0.729)	(0.846)	(0.001)	(0.001)
# est.d manufacturers (50 km)	– 0.755***				
	(0.062)				
# est.d manufacturers (100 km)		– 0.574***	– 0.443***	– 0.839***	– 0.833***
		(0.035)	(0.030)	(0.067)	(0.066)
# merchants <50km of builder					– 0.478***
					(0.120)
	Competition effect[b]				
	– 0.530***	– 0.436***	– 0.358***	– 0.568***	– 0.565***
	(0.029)	(0.020)	(0.020)	(0.029)	(0.029)
N	595,108	596,108	297,418	298,690	298,690

Standard errors are in parentheses. *,** and *** indicate statistical significance at the 10, 5, and 1 % level, respectively

The trimmed sample removes contracts with prices in the top and bottom percentile of the log price distribution. Standard errors in parenthesis

[a]Split at a volume of 3.4 million bricks p.a.; this ensures roughly an even split between the two groups in terms of number of contracts

[b]Calculated as $\exp(\hat{\alpha}_s) - 1$, where α is the coefficient on the # of established manufacturers. All regressions include buyer fixed effects. Instrumentation and definitions as in Tables 5 and 6

(manufacturer versus merchants) and for the price that results from the transaction with the chosen supplier. The result about small buyers therefore is to be interpreted as a result for those small buyers that chose to buy from manufacturers, rather than from merchants: Small buyers in the data that buy directly from manufacturers benefit more from having more outside options, because they can move their commerce more credibly to other manufacturers or to large merchants. This is not a result with respect to small buyers in general, only with respect to those small buyers that select to transact with manufacturers.

The estimated coefficient on the number of large merchants within 50 km needs to be interpreted with caution: Areas with a significant presence of merchant outlets reflect high demand that is derived from final consumer demand for construction materials more broadly.[39] This demand can be expected to put upward pressure on prices, ceteris paribus. Indeed, when included in the price regressions for large buyers, the effect of the number of large merchants within 50 km is positive and significant.[40] Moreover, in these regressions this additional regressor is orthogonal to all other regressors: To the extent that it captures the derived demand for construction materials in general, this demand is exogenous to brick prices. These findings suggest that the estimated downward effect on prices of the presence of nearby large merchants in the regressions for small buyers is an upper bound: The net effect is even stronger.

The effect of the number of established manufacturers on price by itself is a competition effect. And it is economically important. The bottom panels of Tables 5 and 6 show that this competition effect induces discounts of between 42 and 63%.[41] The magnitude of estimated discounts is consistent with the overcapacity of the UK brick industry over the observation period. According to the CC report, all brick manufacturers had significant excess capacity and higher-than-normal levels of inventories/stocks over the observation period.[42] So the manufacturers had an incentive to regularly liquidate their stocks. And such “cut-throat [price] competition” has long been recognised as endemic to the brick industry (Bower 1964).

The number of established manufacturers also constitutes a substantively important channel through which competition effects can materialize because the number of established manufacturers is an important strategic choice variable that is under the buyer’s control and substantiates threats on the part of buyers to switch their business.

Countervailing power operates through benefits that arise from the size of the buyer’s local business that sellers can capture. The results show an effect of the buyer’s local footprint, which is measured in terms of the aggregate brick volume across all contracts that the buyer brings to the delivery location associated with a given contract. The larger is the local footprint of the buyer, in terms of purchase volume, the lower are the contract prices. This effect demonstrates the—at least partial—neutralization of the manufacturer’s power upstream through the buyer’s power downstream, in the parlance of Galbraith’s notion of countervailing power. To the extent that local demand is exogenous, this is outside of the buyer’s control.

If we compare the results for large and small buyers in Table 6, these results show that only overall large buyers, with consequently a larger local footprint, enjoy this countervailing power effect. Unlike the competition effect, the local footprint effect—while attributable to the buyer’s business size characteristics—is not under the buyer’s strategic control, at least not in the short term. It is really a reflection of the buyer’s local commercial significance. Hence, the competition effect is enjoyed

[39] Merchants carry a wide variety of construction materials other than bricks, including timber, plumbing, electric equipment, paints, etc.

[40] See Table 9 in the Appendix, which replicates specifications IV(1) and IV(2) in Table 6, with the number of large merchants within 50 km of the buyer site included.

[41] As the estimated model is log-linear, these estimates are calculated as $\exp(\hat{\alpha}) - 1$.

[42] Competition Commission (2007, paragraphs 5 and 9, and paragraphs 4.33–4.37).

by, and under the strategic control of, both large and small buyers, while the effect that is due to local commercial significance is enjoyed only by large buyers.

All IV results also demonstrate nonlinear volume effects. The identified volume discounts are the same for all buyers, irrespective of their size. Thus, this is exogenous to the buyer.

Volume discounts can result for a number of reasons. They might be reflective of scale economies in brick manufacturing. This is consistent with how brick manufacturers characterise brick production cost, as cited in Competition Commission (2007).[43] Volume discounts may also reflect per-transaction economies, which are due to transport and logistics, loading, contract administration and billing. And, with bargained prices, volume discounts might represent the hope that if the manufacturer can obtain multiple large and predictable contracts with the same buyer, then a larger and more predictable order flow per unit of time will materialize and yield economies of scale. Absent cost information and given the heterogeneity of buyers in this industry, with large buyers known to manufacturers and small buyers unlikely to be known, interpreting nonlinear volume effects as second-degree price discrimination is not warranted.

The data that are used in this study do not contain any further information about production cost.[44] The main cost drivers for bricks are labour cost and energy, which are common across bricks that are produced at a given plant. To control for product-level cost differences, the model specifications include product characteristics. With regard to brick use category, the effects of facing bricks and engineering bricks are relative to the non-standard "specials": The latter are bespoke and therefore more expensive. With regard to brick manufacturing category, the effects of extruded, soft mud and fletton varieties are relative to more expensive "hand-made" facing bricks.

To check the robustness of the results, the IV specifications are re-estimated on a trimmed sample that excludes the top and bottom percentile of the price distribution. Table 8 shows estimation results from the trimmed sample for the effects of nonlinear pricing and bargaining. The results are qualitatively and quantitatively similar to those of the entire sample.

6 Conclusions

This paper uses business-to-business transaction panel data of the UK bricks industry to study the effect of countervailing power and geographic price discrimination on ex-works brick prices.

The main findings are: (a) nonlinear volume and freight absorption effects; (b) a countervailing power effect that is due to a buyer's local business size or commercial significance: buyers with larger local presence enjoy higher bargaining weights and get lower ex-works prices, unlike smaller buyers; (c) a local

[43] e.g. Paragraphs 4.61–4.64.

[44] Separate data contain some coarse information on cost at the manufacturing plant level, but even this information does not appear to be consistent across all pants. Therefore, it is not utilised in this study.

competition effect: having more established manufacturers that are local to the delivery site as outside options when bargaining reduces the prices that buyers pay; and (d) a capacity constraint effect: Small buyers that buy directly from manufacturers benefit more from outside options because, unlike large buyers, with regard to their outside options they are not constrained by the capacity of potential suppliers.

The relative magnitude of the identified effects is substantively important. The local competition effect dominates the countervailing power effect: The former is enjoyed by large and small buyers, while the latter benefits only large buyers. This is important for competition assessment because the former, at least to some extent, is under the buyer's control, while the latter is not, at least not in the short run.

Given the scarcity of reduced-form empirical work in business-to-business bargaining, the approach that is presented in this paper has the potential to contribute to empirical competition analysis and practice as it relates to markets that involve business-to-business relationships. The primary challenge will be to adapt the empirical approach to the respective industry details.

For example, while brick transaction quantities in the construction industry may plausibly be regarded as exogenous demand that is dictated by building designs, transaction quantities in grocery wholesaling between supermarkets and their suppliers are more likely to be endogenous, as part of negotiations between grocers and their suppliers at the national level. Similarly, the importance of transport costs and the related degree of variation in competition across geographical markets is a salient feature of many bulk industries, but less so for service industries.[45]

While reference to industry specific detail enhances the substantive robustness of this study, it may at the same time erect some barriers to immediate generalizations to other industries. Empirical work in industrial organization requires a firm grounding in institutional detail, and it is hoped that this study can guide such work in the area of business-to-business bargaining and price discrimination, which will extend beyond the present application.

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[45] Examples of other inquiries into bulk industries where buyer power was considered are Office Of Fair Trading OFT (2011a, b); Competition Commission (2012a, b). An example of a business-to-business relationship that involves bilateral bargaining for services is statutory company audits. The OFT refers to countervailing power of some auditees in its referral document to the CC; see OFT (2011c, paragraph 5.25).

Appendix: Supplementary Results

See Table 9.

Table 9 Estimation results: large buyers

Log price of 1000 bricks		
	Large buyers	
	IV(1)	IV(2)
Manufacturer 2	0.159***	0.193***
	(0.022)	(0.017)
Manufacturer 3	− 0.209***	− 0.220***
	(0.017)	(0.013)
Manufacturer 4	− 0.257***	− 0.217***
	(0.025)	(0.017)
Nonlinear pricing		
Invade[a] (100 km)	− 2.527***	− 2.077***
	(0.230)	(0.149)
Log volume[b] (1000 bricks)	− 0.315***	− 0.301***
	(0.007)	(0.005)
Bargaining		
Local footprint[c] (1m bricks)	− 22.669***	− 12.848***
	(1.951)	(1.051)
# est.d manuf.s[d] (50 km)	− 0.701***	
	(0.063)	
# est.d manuf.s[d] (100 km)		− 0.556***
		(0.039)
# merchants[e] (50 km)	1.096 ***	0.977***
	(0.134)	(0.099)
Cost rel. characteristics		
FY 2001[f]	0.109***	0.103***
	(0.020)	(0.015)
FY 2002	0.273***	0.243***
	(0.023)	(0.017)
FY 2003	0.399***	0.355***
	(9.025)	(0.018)
FY 2004	0.388***	0.347***
	(0.023)	(0.017)
FY 2005	0.438***	0.404***
	(0.024)	(0.018)
FY 2006	0.472***	0.453***
	(0.023)	(0.017)
Urban	0.697***	0.200***
	(0.062)	(0.015)

Table 9 continued

Log price of 1000 bricks		
	Large buyers	
	IV(1)	IV(2)
Facing	-0.181^{***}	-0.187^{***}
	(0.016)	(0.012)
Engineering	0.334^{***}	0.279^{***}
	(0.053)	(0.038)
Extruded	-0.567^{***}	-0.590^{***}
	(0.045)	(0.035)
Soft mud	-0.315^{***}	-0.282^{***}
	(0.047)	(0.038)
Fletton	-0.411^{***}	-0.287^{***}
	(0.043)	(0.036)
Cons	9.061^{***}	9.418^{***}
	(0.229)	(0.204)
	Competition Effect[g]	
	-0.504^{***}	-0.426^{***}
	(0.030)	(0.021)
N	302,529	302,529

Standard errors are in parentheses. *,** and *** indicate statistical significance at the 10, 5, and 1 % level, respectively. All regressions include buyer fixed effects. Instruments for "invade" and "established manufacturers": the number of varieties that are supplied to, and number of plants of any manufacturer that are within 100 km of, the buyer's site

Split at volume 3.4 million bricks p.a.; this ensure roughly even split between the two groups in terms of number of contracts

[a] "invade": sales overlap, km distance between the chosen manufacturing plant and the rival manufacturer plant that is closest to the buyer's site (zero if chosen plant is the closest)

[b] Log volume is the logarithm of volume (in units 1000 bricks), as in Table 2

[c] "local footprint": the average annual brick volume of any brick product that is delivered to the buyer's site, in millions of bricks

[d] "established manufacturers": manufacturers with which the buyer transacted during fiscal years 2001–2007 with plants in 50 (100) km

[e] "merchants": the number of five largest merchants, by number of bricks sold per year; within 50 km of the buyer's site

[f] Fiscal year, commencing on 1 April 2001; analogous for subsequent fiscal years

[g] Calculated as $\exp(\hat{\alpha}_s) - 1$, where α is the coefficient on the # of established manufacturers

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