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Strategic Interaction Across Countries and Multinational Agglomeration: An Application to the Cement Industry

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Agglomeration in foreign direct investment (FDI) is typically attributed to location-specific characteristics such as natural resource advantages or production-related spillovers between multinational firms. The increasing collocation of the largest global firms in the cement industry since the 1980s is not easily attributed to either of these explanations. This paper draws on theories of multimarket contact to test whether strategic interaction across national markets has influenced the successive market entry decisions generating the observed agglomeration. We first establish that there is indeed nonrandom agglomeration of the six largest cement firms. We next show that preexisting cross-market interaction with current incumbents helps predict which firm will enter a given market and also the choice of market a given firm enters. The association does not appear to be caused by strategic convergence or mimicry of recent entry events and cannot be explained by production side effects, which depend only on local conditions. The findings are consistent with multimarket contact models where collocation allows firms to sustain higher prices in all markets. This latter inference is also supported by evidence of an association between global firm market share and local cement price. The paper suggests that pricing spillovers can serve as an alternative motivation for FDI agglomeration.

Key words: FDI; agglomeration; MNEs; multimarket contact
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1. Introduction

The phenomenon of agglomeration of industrial activity has been widely studied. A subset of this literature examines whether multinational enterprises (MNEs) tend to collocate in certain countries or spread out across locations. Recent contributions on this topic include Alcácer's 2006 study of location choices in the cellular handsets industry and Gimeno et al. (2005), who examine the international expansion of U.S. telecommunications firms. Agglomeration of industrial activity of any kind is typically attributed to effects that are specific to given locations, such as natural advantages arising from factor endowments or to production-side spillovers between agglomerated firms. These effects are described in Ellison and Glaeser (1997) and Head et al. (1995). Agglomeration of foreign direct investment (FDI) may also reflect strategic interaction of another kind between individual firms—pricing spillovers. The goal of this paper is to look for evidence that pricing spillovers caused by softened price competition among collocated firms can serve to motivate FDI agglomeration.

A separate literature illustrates how multimarket contact can reduce price competition.[1] Bernheim and Whinston (1990) and Spagnolo (1999) formalize the intuition that the threat of retaliation in all markets can sustain collusion in each market if firms have a large enough market share to jointly determine price in each market. These models have at least two different sets of implications. First, firms in a collusive equilibrium sustained by multimarket contact set higher prices than those in a competitive equilibrium and generate correspondingly higher profits. Second, the ability to sustain the collusive equilibrium is affected by the extent of current multimarket contact and determines the relative attractiveness of new market entries. Preexisting multimarket contact hence introduces cross-market dependencies into the decision about whether to enter new markets. The small

[1] Edwards (1955), as cited in Scherer (1980), provides perhaps the first description of this type of competitive interaction in the context of the potential competitive advantage of large conglomerates when present in many different product markets. Hymer (1976) foresaw a world in which MNEs capture value by changing the nature of competition in foreign markets.

number of cross-border competition and regulatory authorities perhaps makes international cooperation of this kind feasible.

There is some empirical evidence of price softening caused by multimarket contact, mostly within a single country. There is also empirical work on the impact of multimarket contact on entry and exit—either across products in the same geography or across segmented local markets in the same product. Theory predicts that firms may choose to enter markets to increase or decrease multimarket contact. Baum and Korn (1996, 1999), Haveman and Nonnemaker (2000), and Stephan et al. (2003) explain why there may be an inverted U-shaped relationship between the extent of multimarket contact and subsequent entry. Multimarket contact can generate more entry because of reduced uncertainty about competitors in new markets and/or the desire to strengthen mutual footholds. If, however, an entry move is perceived as an aggressive act, the fear that the entry will trigger retaliation in other markets can outweigh this positive association, and high levels of multimarket contact elsewhere then deter subsequent market entry.

We investigate the possibility that entry decisions and the resulting worldwide agglomeration of FDI in the global cement industry are associated with strategic firm interaction across international markets. There are two main reasons why this industry provides a good setting for this investigation. First, despite the fact that cement is considered a local industry, a surge of FDI since the second half of the 1980s has significantly increased the concentration of global capacity and production in the hands of a few MNEs. The existence of MNEs in this industry is somewhat of a puzzle in itself, as it meets none of the traditional necessary conditions for horizontal MNEs set out in Caves (1996), such as a high level of R&D or advertising intensity. Indeed, although MNEs may well embody relatively superior process or technology management, cement is viewed as a homogeneous product produced with a standard technology. Our focus here, however, is on the additional puzzle that entry decisions have led to the agglomeration of MNE activity. The industry technology provides little opportunity for knowledge or production-side spillovers across global firms, nor are there significant natural production advantages found only in a subset of national markets. We describe a mechanism through which MNE agglomeration is nonetheless the result of profit-maximizing entry choices in a world without information asymmetry.

The second reason for our choice of industry setting is that FDI has been overwhelmingly in the form of acquisition, with global firms acquiring existing cement assets worldwide rather than investing in greenfield sites. This fact means that entry by a foreign firm changes the structure of the local market only through changes in existing asset operations and owner behavior, rather than also leading to an increase in the number of local competitors.[2] As will be discussed in §4, this fact allows us to narrow in on particular predictions for prices post entry. Pricing spillovers may well motivate agglomeration in other industries but may be harder to identify because of the confounding effects of lower prices when entry increases the number of competitors.

The six largest cement MNEs in 2000 were Lafarge, Holcim, Cemex, Heidelberger, Italcementi, and Blue Circle Industries. Each still had clearly identifiable national origins and controlled leading shares of their respective home markets. However, each also operated production facilities in anywhere between a dozen and several dozen countries around the world. Throughout the paper, we refer to these firms collectively as the "Big 6." Although FDI by the two largest MNEs—Lafarge and Holcim—predated World War II, interregional FDI remained insignificant until the 1970s. It really took off, in terms of new countries entered by the major firms and their share of worldwide capacity, in the late 1980s. The Big 6 collectively entered new national markets 115 times between 1988 and 2000, but only 19 times between 1970 and 1988.[3, 4]

We adopt a three-stage empirical approach to explore the role played by cross-market strategic interaction in FDI activity. First, we devise a test to establish that foreign ownership of cement production is indeed agglomerated. To do this, we compare the actual concentration of ownership to a benchmark distribution of foreign ownership, where the benchmark represents randomly assigned Big 6 ownership within a geographical region. This test draws on the intuition developed in the "dartboard" analytical index of U.S. manufacturing concentration (Ellison and Glaeser 1997) but uses an empirical simulation method similar to the approach taken in Alcácer (2006). We find that ownership of cement assets by the Big 6 cement firms in 2000 is more agglomerated than one would expect at random in the majority of

[2] In some cases, such as the Philippines, international firms entered through acquisition and subsequently consolidated several small operations. Many models of local industry structure suggest that this consolidation activity would tend to further decrease local price competition. Greenfield entry is more likely to increase the degree of local market price competition.

[3] As a case in point, Cemex, which had become the third largest, and often most profitable, MNE by the early 2000s, did not make its first investments in production capacity outside its Mexican home base until 1992.

[4] An electronic companion to this paper provides more detail about the entry events and changes in Big 6 collocation over time and is available as part of the online version that can be found at http://mansci.journal.informs.org/.

world regions, given the number of cement plants and firms in each country. That is, historical entry decisions have led to FDI agglomeration.

In the second stage of the empirical work, we investigate whether successive entry decisions are influenced by cross-market strategic effects rather than by the local market effects typically discussed. In particular, we want to study whether multimarket contact elsewhere is related to entry choices. The predicted direction of the effect depends on the industry context (as in Baum and Korn 1996). We show that the average collocation worldwide of potential entrants with current incumbents is associated with the likelihood of market entry. There is a U-shaped relationship between a potential entrant's probability of entry and its preexisting collocation levels with incumbent firms. Separate tests suggest that, on the condition that a firm will make at least one entry move in a year, its choice of market is positively associated with its worldwide collocation with current incumbents. Firms' entry decisions reinforce existing collocation patterns and hence increase the extent of FDI agglomeration. There is no evidence of the inverse U-shaped relationship identified in other industry contexts.

We conduct some further tests to examine whether the positive association between collocation and subsequent entry choices is due to mimicry of entry strategy. We find some evidence that cross-firm similarity in entry moves cannot explain the established association between collocation and subsequent entry. To do this, we distinguish between the role played by collocation, resulting from all prior entry moves, and the role played by the subset of this data, which relates to recent entries. We then discuss how our results relate to existing theory on this topic. One way to reconcile our findings with previous empirical work is to note that entry through acquisition, as we see in this industry, is less likely to be interpreted by rival firms as an aggressive move that serves to trigger retaliation in other markets. This moderates the mechanism generating the downward slope of the relationship between multimarket contact and entry predicted at high levels of collocation in previous papers.

Our hypothesis is that firms in the cement industry enter new markets to increase multimarket contact to raise prices and/or to soften price competition in their existing markets. This mechanism has direct implications for cement prices and firm profitability, as well as indirect implications for successive entry choices.

The third stage of our empirical investigation turns to evidence on prices and performance. The analysis in this section is somewhat limited because price information is hard to come by and the predictions are not always straightforward. For example, multimarket contact may lead to higher prices or enable firms to maintain current high prices. Nonetheless, we present two sets of evidence in this section. First, we look at a country cross section of data from analyst reports and show that the share of local cement production capacity operated by Big 6 firms is positively associated with local cement prices. Moreover, the interaction of worldwide collocation of incumbents and their joint market share is positively associated with higher prices in each market. We note that neither of these variables is associated with lower costs. Second, we look at time series data from six countries that had either a very high cement price in 2000 or at least three new Big 6 entries between 1988 and 2000. Because entry often occurs in times of local recession, we might expect the cement price to rise post entry in the absence of any strategic behavior by the new entrants. For this reason, we examine the cement price relative to the price of other building materials. There is a tendency for the relative price of cement to increase in the wake of Big 6 entry and expansion.

The paper contains three distinct empirical sections, and we present the hypotheses, data, estimation approach, and results of each section in turn. Section 6 of the paper contains a discussion of the implications of the analysis taken as a whole and then concludes.

2. Measuring Multinational Firm Agglomeration

Before we investigate the various reasons for dependencies in MNE location choice, we examine different measures of the extent of agglomeration in the context of the global cement industry. First, we construct a pairwise measure of firm collocation across markets. It resembles the measures developed by Alcácer (2006) in his study of cellular handsets, and we will use it as a key independent variable in much of our upcoming analysis.

Firm-Pair–Level Collocation. For each pair of firms (i, j) drawn from the set of Big 6 global cement firms, the collocation measure for firm i with firm j is the number of markets in which both firms are present divided by the total number of markets in which firm j is present. It measures the extent to which firm i is present in firm j's markets. The extent of collocation of firm j with firm i has the same numerator and is divided by the number of markets in which firm i is present. That is, we measure pairwise collocation as follows:

$$C_{i,j,t} = \frac{\sum_x (1 * x_{i,j,t})}{\sum_y (1 * y_{j,t})}, \qquad C_{j,i,t} = \frac{\sum_x (1 * x_{i,j,t})}{\sum_y (1 * y_{i,t})}, \quad (1)$$

where $x_{i,j,t}$ is an indicator equal to 1 if both firms i and j are present in market x in year t and 0 otherwise

and $y_{i,t}$ is an indicator equal to 1 if firm i is present in market y in year t.[5]

These cross-sectional measures do not tell us whether the surge in FDI in the industry since 1985 has led to more or less foreign ownership agglomeration. Although there are more positive pairwise observations, the index decreases for some firm pairs over time.[6] Furthermore, a certain amount of increase in pairwise firm collocation is to be expected in the context of industry multinationalization because of the fixed number of national markets. This means that collocation measures for any one year could well reflect random agglomeration across countries. Before we look at whether existing agglomeration may have arisen because of strategic motives, we need to establish that firms are indeed agglomerated to a greater extent than what could have been expected if entry moves were random.

A similar question is tackled by Ellison and Glaeser in their 1997 paper about industrial activity agglomeration across U.S. states. They construct an industry-level index based on the sum across states of the squared differences between the share of an industry's employment in a given state and that state's share of total employment. We want to know if Big 6 ownership of cement plants, rather than industry employment or the location of cement production, is more agglomerated than could be expected at random. There is no straightforward analytical equivalent to Ellison and Glaeser's adjustment that can be applied to our context. Instead, as in Alcácer (2006), we use their "dartboard" intuition to develop an alternative approach. Alcácer (2006) tests whether the observed market location choices of firm subsidiaries of different types are agglomerated. He compares the observed location choices to a simulated distribution of agglomeration where location choice is based solely on market-level characteristics. Rather than focus the choice of market by each firm, we take the number of plants and firms in each market as given and examine whether Big 6 ownership is agglomerated. The key contribution of our approach here is that holding the overall distribution of cement plants fixed in the simulated distribution of random Big 6 ownership allows us to control for market-level characteristics that determine the overall number of cement plants in a country.[7]

Agglomeration of Big 6 Ownership. We construct an empirical distribution of the extent of Big 6 ownership agglomeration we expect to see if ownership were randomly allocated across plants within a geographic area, holding fixed the total number of plants in each country. We then compare the observed level of agglomeration to the distribution under this null. Scott (1982) gives a similar intuition in a study of U.S. manufacturers operating in different product markets. If the observed level is sufficiently different from the mean level estimated under the null of no nonrandom agglomeration, we infer that Big 6 ownership of cement plants is agglomerated in that geography. We use data from the industry trade association Cembureau to construct a list of cement firms and plants for each country worldwide.[8] The data are from 2002, as this year provided the most comprehensive data set closest in time to the other data sets used in the paper. Using firm name, we match Big 6 subsidiaries to their relevant parent. This gives us the total number of cement plants and firms per country and the total number of these plants and firms that are controlled by one of the Big 6 firms. More detail about the estimation process is given in the e-companion.

Results. Table 1 presents the results of the analysis at the plant and the firm level. The plant-level results indicate significant nonrandom agglomeration in all of the nine regions except Australasia. In other words, in all regions except Australasia, the observed extent of Big 6 agglomeration is more than two standard deviations greater than the mean level of agglomeration under the null hypothesis. Because some firms consist of several plants, the mean level of agglomeration under the null that all agglomeration is random is higher in the firm-level analysis. Nonetheless, the firm-level results also indicate nonrandom agglomeration of Big 6 firms within Africa, North and South America, Asia, and Western and Eastern Europe. This tells us that Big 6 firms have tended to enter the same countries within these regions rather than spreading out across different countries.

We have established that there is nonrandom agglomeration of ownership, but as in Ellison and Glaeser's equivalent measure, we cannot use this type of test to find out why firms have chosen to locate together. In their paper, Ellison and Glaeser (1997) note they can't tell natural advantages and spillovers apart. Cross-market concerns and pricing spillovers

[5] Figure 2 in the e-companion reports these indexes for each possible pairing of the Big 6 cement firms in different years.

[6] For example, three firms—Lafarge, Cemex, and Heidelberger—go from operating in a subset of Holcim's markets to also operating in markets where Holcim is not present; hence the collocation observations with Holcim as firm i decrease for these three firms.

[7] This method does not control for market-level factors that appeal particularly to multinational firms that may make all Big 6 firms more likely to enter the same market regardless of any strategic interaction. Separating these two determinants of observed agglomeration is the challenge addressed in §3.

[8] China was excluded from this analysis, as were the former Soviet states, Botswana, Mauritania, Swaziland, Palestine, and Kosovo because of limited data availability.

Table 1 Results of the Agglomeration Analysis

Region	No. of countries	No. of plants	No. of Big 6 plants	Observed agglomeration	Mean agglomeration under null	Lower bound	Upper bound	Nonrandom agglomeration?
			Plant-level analysis—2002, All plants					
Africa	38	145	58	0.048	0.010	0.004	0.016	Yes
America, Central	14	64	42	0.027	0.006	−0.001	0.013	Yes
America, North	2	143	83	0.007	0.001	−0.002	0.004	Yes
America, South	13	145	26	0.162	0.023	−0.005	0.051	Yes
Asia	23	384	62	0.174	0.012	0.000	0.023	Yes
Europe, Eastern	15	79	35	0.060	0.014	0.001	0.027	Yes
Europe, Western	20	362	187	0.021	0.002	0.000	0.004	Yes
Middle East	13	97	3	0.671	0.264	−0.004	0.532	Yes
Australasia	5	20	4	0.130	0.092	−0.060	0.244	No
Region	No. of countries	No. of firms	No. of Big 6 firms	Observed agglomeration	Mean agglomeration under null	Lower bound	Upper bound	Nonrandom agglomeration?
			Firm-level analysis—2002, All firms					
Africa	38	100	43	0.029	0.013	0.005	0.020	Yes
America, Central	14	29	16	0.026	0.026	0.005	0.046	No
America, North	2	59	18	0.112	0.010	−0.017	0.037	Yes
America, South	13	97	17	0.154	0.039	−0.013	0.092	Yes
Asia	23	240	46	0.139	0.016	0.002	0.029	Yes
Europe, Eastern	15	60	26	0.076	0.019	0.002	0.036	Yes
Europe, Western	20	166	54	0.026	0.011	−0.002	0.024	Yes
Middle East	13	76	2	0.633	0.400	−0.004	0.805	No
Australasia	5	12	3	0.167	0.166	−0.059	0.390	No

Sources. Cembureau's *World Cement Directory* (1996, 2002).
Notes. Under the null hypothesis of random agglomeration, the share of Big 6 owned plants/firms in each country should equal the share of the regions plants/firms in each country, accounting for the discreteness of plants/firms. This test simulates random agglomeration under this null hypothesis and constructs an empirical distribution of expected agglomeration. It then compares the observed level of agglomeration of Big 6 ownership to this simulated null distribution. If the observed level of Big 6 ownership agglomeration exceeds 95% of the observations generated under the null distribution, we reject the hypothesis that ownership agglomeration is random.

are not applicable to their context of cross-industry variation. We aim to evaluate whether some of the nonrandom agglomeration we observe in the cement industry is in fact due to cross-market effects.

3. Entry Location Choice

To establish whether new entry choices are related to existing cross-market interaction, we need to distinguish between the traditional reasons for agglomeration examined in Head et al. (1995) and Alcácer (2006) and the cross-market effects that are the focus of this study.

3.1. Specification 1

We first test whether the extent of collocation with incumbent firms in other markets helps identify who the next entrant to a given market will be, on the condition that at least one Big 6 firm enters the market in a given year. Starting with all the firms already present in a market, which is soon to be entered by a new Big 6 firm, we find the extent of average collocation across all other markets with the current incumbent firms for each of the potential new entrants. We ask whether there is an association between the likelihood that a firm is the next entrant and the extent to which the firm interacts with incumbent firms elsewhere. If entry were driven only by market conditions in the country in question, or by spillovers specific to that market, there would be no reason to expect the likelihood of entry to be associated with the extent of cross-market interactions elsewhere.

Like Head et al. (1995), we use a conditional logit model for this specification, but unlike in their approach, we control for market-level factors since at least one new firm enters that market in a given year. The within-market factors are implicitly assumed to affect the attractiveness of market entry to all potential entrants equally. In this specification, each potential entrant either enters the market in year t or does not, generating a binary dependent variable equal to 1 if firm entry occurs. Data on all new Big 6 firm entries from January 1988 to February 2000 indicate 115 new entries and 102 different country-year groups with entry events (because, on occasion, more than one Big 6 firm enters the same market in the same year). For each country-year group there are a number of different potential

entrants. All together, we have 549 observations, 164 of which are associated with an entry into a market with incumbent Big 6 firms. Each of the Big 6 firms makes between 6 and 31 entries over the time period. By 2000, 91 countries featured at least one of the Big 6 firms.[9]

We construct the average collocation index in year t for each potential Big 6 entrant, j, with each of the other i Big 6 firms that are already present in market m in that year. This variable, and its square, are the key independent variables in this section.[10] The averaged index is the mean, across all markets other than m, of the share of firm j's current markets in which each firm i is already present:

$$Coloc_{j,m,t} = \frac{\sum_i C_{i,j,t} * I_{i,m,t}}{\sum_i I_{i,m,t}}, \quad (2)$$

where i indexes the five Big 6 firms other than firm j and $I_{i,m,t}$ is an indicator variable equal to 1 if firm i is present in market m in year t. $C_{i,j,t}$ is defined in Equation (1) and measures worldwide collocation between firms i and j. For all pioneer entries, this variable is missing because the absence of incumbents means there is no firm i against which to measure each firm j's worldwide collocation. Unlike factors relating only to market m, this collocation measure varies across potential entrants because they differ in the extent to which each shares existing markets with the set of incumbent firms. The mean collocation level of potential entrants with the incumbents is 0.22, and the standard deviation is 0.16.

Let $\mathbf{y}_{m,t}$ be a series of 1s and 0s representing whether or not we observe entry of each firm j into market m at time t, respectively. We want to find the probability that we see the observed series, given the total number of entries into that market in that year (the sum of vector entries related to that market-year group). So for each market-year group, we estimate $\Pr(\mathbf{y}_{m,t} \mid \sum \mathbf{y}_{m,t}) = F(\boldsymbol{\delta}_{j,i,-m,t}, \boldsymbol{\gamma}_{m,j})$, where $\boldsymbol{\delta}$ is the vector of collocation measures for each potential entrant with the firms already present in market m. $\boldsymbol{\gamma}$ is a vector of control variables that attempt to control for fact that certain firms may be more likely to enter particular countries, because of gravity model type concerns—distance and language. These controls vary across potential entrants; for example, Cemex originates in Mexico so may be more likely than other firms to enter Spanish-speaking countries. Also included in $\boldsymbol{\gamma}$ are firm fixed effects to control for the possibility that some firms are always relatively more likely to make an entry in a given year.[11] Table 2, Panel A, presents summary statistics about the data set used in the analysis.[12]

3.2. Specification 2

We next estimate an alternative specification that is similar to the approach taken in Head et al. (1995). We assume that a given firm makes at least one entry in a given year and ask whether the choice of market(s) entered is associated with the entering firm's worldwide collocation with the current incumbents. Because the choice set for each firm is now all countries in which it is not already present, there are many more observations per entry event. In this specification, $\mathbf{y}_{j,t}$ is a series of 1s and 0s representing, respectively, whether or not we observe entry of firm j into each possible market m at time t. Summary statistics for the dependent and independent variables in this alternative specification are given in Table 2, Panel B. The key independent variable, collocation, is defined for market m in Equation (2), where j identifies the entering firm. This variable is found for each potential entry location, m. Collocation varies across countries for the same entrant because there is variation in the identity of current incumbents. We estimate $\Pr(\mathbf{y}_{j,t} \mid \sum \mathbf{y}_{j,t}) = F(\boldsymbol{\delta}_{j,i,t}, \boldsymbol{\gamma}_{j,m})$, where $\boldsymbol{\delta}$ is the vector of preexisting collocation measures for firm j with the i firms present in each market m in year t. $\boldsymbol{\gamma}$ is a vector of control variables.

It is likely that country-level natural endowments and spillovers across MNEs within the market are correlated with both the likelihood of entry and collocation. Country fixed effects would control for invariant market factors such as natural endowments, but the large number of countries prevents their inclusion. We present a model that includes region dummies and some country-level characteristics that are expected to be correlated with the level of market appeal for any one entering firm: distance from firm headquarters, a shared language dummy variable, total cement usage, and cement usage

[9] It is not the case that firms are simply "running out" of new markets to enter, leading to an inevitable association between entry and collocation. There are many countries where none of the firms were present and many where only one or two of the firms were present in 2000.

[10] $Coloc_{j,m,t}$ is the key independent variable employed in both the first and second conditional logit specifications. For the first specification, the data are grouped by country and year and the coefficients are identified using variation within group across potential entrants, j. In the second specification, the data are grouped by firm and year, and identification comes from variation across the countries, m, potentially entered by a given firm j in year t.

[11] In this analysis, we condition out whether the market being entered is the home market of a Big 6 firm or whether it has long been a stronghold of any of the incumbent firms. These variables are constant across all potential new entrants.

[12] Of the 41 new entries into markets where incumbent firms are already present, 2 are made by BCI, 7 by Cemex, 7 by Heidelberger, 7 by Holcim, 8 by Italcementi, and 10 by Lafarge. (These data are omitted from Table 2.)

Table 2 Summary Statistics for §§3, 4, and 5

Variable	No. of observations	Mean	Standard deviation	Minimum	Maximum	Pairwise correlations 1	2	3	4	5	6	7	8
Panel A: Variables used in the conditional logit analysis in §3, main specification													
1 Entry (0 or 1 if firm enters)	548	0.210	0.408	0	1	1.00							
2 Average collocation with current incumbents	164	0.221	0.165	0	0.75	0.14	1.00						
3 Average collocation above 30% dummy	164	0.232	0.423	0	1	0.08	0.84	1.00					
4 Average collocation above 60% dummy	164	0.043	0.203	0	1	0.23	0.61	0.38	1.00				
5 Average collocation above 50th percentile	164	0.500	0.502	0	1	0.04	0.71	0.55	0.21	1.00			
6 Average collocation above 90th percentile	164	0.110	0.314	0	1	0.16	0.78	0.64	0.60	0.35	1.00		
7 Shared language dummy	548	0.190	0.392	0	1	0.05	−0.20	−0.10	−0.10	−0.26	−0.06	1.00	
8 Distance to home country (miles)	452	6,216	3,879	195	17,377	−0.14	−0.22	−0.22	−0.14	−0.10	−0.28	−0.13	1.00

Variable	No. of observations	Mean	Standard deviation	Minimum	Maximum	Pairwise correlations 1	2	3	4	5	6	7	8	9	10
Panel B: Variables used in the conditional logit analysis in §3, additional specification															
1 Entry (0 or 1 if firm enters)	15,824	0.007	0.085	0	1	1.00									
2 Average collocation with current incumbents	4,633	0.395	0.210	0	1	0.03	1.00								
3 Average collocation above 30% dummy	4,633	0.623	0.485	0	1	0.03	0.80	1.00							
4 Average collocation above 60% dummy	4,633	0.623	0.485	0	1	0.03	0.80	1.00	1.00						
5 Average collocation above 50th percentile	4,633	0.501	0.500	0	1	0.02	0.84	0.78	0.78	1.00					
6 Average collocation above 90th percentile	4,633	0.092	0.288	0	1	0.01	0.56	0.25	0.25	0.32	1.00				
7 Shared language dummy	12,567	0.168	0.374	0	1	0.02	0.15	0.10	0.10	0.10	0.03	1.00			
8 Distance to home country (miles)	12,437	6,843.277	4,043.378	195.245	19,007.46	−0.04	0.11	0.10	0.10	0.12	0.09	−0.20	1.00		
9 Total cement usage in country, million tons	13,445	9,652.371	43,712.840	10	502,581	0.01	−0.08	−0.08	−0.08	−0.10	−0.04	−0.07	0.06	1.00	
10 Cement usage per person, tons	13,445	345.665	426.195	2	2,490	−0.01	−0.10	−0.09	−0.09	−0.07	−0.02	−0.11	−0.01	0.07	1.00

Subset of observations used in §4 for analysis of entry strategy mimickry	No. of observations	Mean	Standard deviation	Minimum	Maximum	Pairwise correlations 1	2	3	4	5
Panel C: Variables used in the conditional logit analysis in §4										
1 Similarity of entry moves with most recent incumbent	127	0.212	0.358	0	1	1.00				
2 Average collocation with current incumbents	88	0.240	0.169	0	0.75	−0.05	1.00			
3 Collocation including zeros for pioneer moves	168	0.126	0.171	0	0.75	−0.07	1.00	1.00		
4 Shared language dummy	168	0.179	0.384	0	1	−0.05	−0.14	−0.21	1.00	
5 Distance to home country (miles)	148	5,483	4,220	195	15,761	0.06	−0.18	−0.02	−0.09	1.00

per capita.[13] The effect of within-country spillovers among MNEs on the production side is expected to be correlated with the number of current incumbent MNEs. Hence, we also include this variable.

[13] The data for the last two variables are from Cembureau's *World Statistical Review* (2000) and are for 1997.

3.3. Results of the Two Conditional Logit Specifications

Table 3 shows the results of specification 1. Column 1 shows that a Big 6 nonincumbent firm is significantly more likely to be the next entering firm when it is more collocated elsewhere with the incumbent Big 6 firms. The extent of cross-market collocation

Table 2 (Continued)

Variable	No. of observations	Mean	Standard deviation	Minimum	Maximum	Pairwise correlations 1	2	3	4	5	6	7	8	9
Panel D: Cross-sectional price and cost analysis in §5[a]														
1 Price per ton ($)	25	59.52	15.35	38.00	96.00	1.00								
2 Cost per ton ($)	25	36.96	7.69	23.00	51.00	0.66	1.00							
3 EBITDA ($), (= Price − Cost)	25	22.56	11.81	10.00	60.00	0.87	0.20	1.00						
4 Market share of Big 6 firms	25	0.48	0.32	0.00	1.00	0.49	0.20	0.51	1.00					
5 Market share of 6 largest firms (local and Big 6)	25	0.82	0.20	0.38	1.00	0.29	−0.02	0.39	0.30	1.00				
6 Average collocation of current Big 6 incumbents	25	0.23	0.18	0.00	0.47	0.38	0.23	0.34	0.60	0.13	1.00			
7 Big 6 capacity share ∗ Average worldwide collocation	25	0.14	0.13	0.00	0.38	0.61	0.34	0.57	0.85	0.27	0.85	1.00		
8 Gross domestic product (GDP)	25	950	1,842	65	8,790	0.17	0.50	−0.11	−0.08	−0.32	0.03	−0.04	1.00	
9 GDP per capita	25	10.98	10.18	0.43	32.49	0.33	0.74	−0.06	0.06	0.01	0.05	0.08	0.73	1.00
10 Share of cement sold in bags	23	0.52	0.51	0.00	1.00	−0.24	−0.59	0.07	−0.02	−0.19	0.10	0.03	−0.44	−0.83
11 Share of manufacturing employment in construction	24	7.30	1.97	3.88	11.80	0.15	0.29	0.01	−0.45	0.04	−0.23	−0.27	0.11	0.32
12 Construction GDP as a proportion of manufacturing GDP	25	29.81	12.55	9.57	64.59	0.09	0.04	0.08	−0.07	−0.02	−0.42	−0.31	0.01	0.11

Sources. ING Barings (2000), Cemex, Cembureau for excess demand, demand and demand growth data, CIA's *World Factbook* (2004) for distance and language data, and Euromonitor's *Global Market Information Database* (2000).

[a]There are 22 countries for which the data set is complete: Argentina, Brazil, Canada, Egypt, France, Germany, Greece, Indonesia, Italy, Japan, Malaysia, Mexico, the Philippines, Poland, Portugal, South Korea, Spain, Thailand, Turkey, United Kingdom, United States, and Venezuela.

with incumbent firms is significant at a greater than 1% level in a one-tailed *t*-test. The second column in the table includes the square of the collocation measure as an independent variable. The coefficient on the squared term is positive and significant, suggesting that collocation matters more as a predictor of the likelihood of entry as its level increases. Columns 3 and 4 show the results when firm-market controls are included. The positive coefficient on the collocation variable remains significant, but when the square of this measure is included, the coefficients for collocation are no longer significant. Distance tends to have significantly negative effects on the likelihood of entry and a shared language is associated with an increased likelihood, as predicted by prior gravity-based work.

The next four columns of Panel A of Table 3 introduce firm fixed effects. Columns 5 and 7 show a weak negative relationship between collocation and the likelihood of firm entry, whereas columns 6 and 8 reveal the presence of a U-shaped relationship. The likelihood that a potential entrant actually enters is highest for firms with low and high levels of preexisting collocation with incumbent firms. There are instances of firm entry at collocation levels on both sides of the inflection point implied by these coefficients.

The results of specification 2 are given in Table 4. Column 1 shows that collocation with incumbent firms is positively correlated with market entry, controlling for several market level controls and region fixed effects intended to capture natural endowments. Column 2 provides no evidence of an inverted U-shaped relationship in this industry. Column 3 presents evidence that the total number of incumbents is also positively correlated with the likelihood of market entry, perhaps because of positive production-side spillovers between MNEs. In column 4, however, we see that collocation continues to be positively associated with market choice when the total number of market incumbents is included.

Our results so far suggest that preexisting collocation across markets—that is, cross-market effects—play a significant role in determining entry choices. Specifically, the association between worldwide collocation and subsequent market entry suggests that firms enter markets in a manner that serves to increase the extent of collocation when preexisting worldwide collocation is either low or high. In addition, when firms enter markets in which incumbents are present, firms are more likely to enter markets where they interact with the incumbent firms in other world markets. We find no evidence of the inverted U-shaped relationship between multimarket contact and entry, discussed in Baum and Korn (1996, 1999). In the following section we discuss our results and try to reconcile them with the previous findings about multimarket contact and entry. We also conduct further tests to address alternative explanations of the relationship between collocation and subsequent entry.

Table 3 Results of the Conditional Logit Analysis Testing Whether the Identity of the Next Entrant to a Given Market Is Associated with Worldwide Collocation with Market Incumbents

	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)
Average collocation across markets	3.74 [1.40]***	−5.11 [3.95]	3.34 [1.67]**	−3.26 [4.24]	−5.62 [2.92]*	−20.89 [7.03]***	−5.75 [3.27]*	−17.79 [7.13]**
Average collocation squared		13.28 [5.87]**		9.90 [6.06]		25.58 [10.03]**		20.00 [9.75]**
Shared language			1.04 [0.49]**	0.82 [0.50]			2.00 [0.90]**	1.74 [0.93]*
Distance between market and home base			−0.00016 [0.00]*	−0.00018 [0.00]*			−0.00011 [0.00]	−0.00013 [0.00]
Cemex fixed effect					1.59 [0.84]*	2.12 [0.91]**	2.14 [1.02]**	2.59 [1.08]**
Heidelberger fixed effect					2.42 [0.96]**	3.22 [1.09]***	3.91 [1.40]***	4.40 [1.49]***
Holcim fixed effect					5.96 [1.74]***	4.59 [1.93]**	6.58 [2.04]***	5.56 [2.17]**
Italcementi fixed effect					1.72 [0.86]**	1.70 [0.91]*	2.95 [1.28]**	2.90 [1.34]**
Lafarge fixed effect					3.60 [1.05]***	4.50 [1.24]***	4.65 [1.45]***	5.27 [1.57]***
Number of observations	163	163	148	148	163	163	148	148
Log likelihood	−50.430	−47.540	−41.930	−40.529	−42.012	−38.221	−32.801	−30.583
LR chi squared	7.99 (1df)	13.77 (2df)	15.33 (3df)	18.13 (4df)	24.82 (6df)	32.40 (7df)	33.59 (8df)	38.02 (9df)
Prob > chi squared	0.005	0.001	0.002	0.001	0.000	0.000	0.000	0.000
Pseudo *R* squared	0.073	0.127	0.155	0.183	0.228	0.298	0.339	0.383

Sources. ING Barings (2000), Cemex, Cembureau for excess demand, demand and demand growth data, CIA's *World Factbook* (2004) for distance and language data, and Euromonitor's *Global Market Information Database* (2000).

Notes. One observation is dropped because of no variation within groups, that is there is only one possible entrant to a given market (Cemex entering the United States in 1988 when all other Big 6 firms are already present). Distance and language data are available for 148 of the 163 observations.

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

4. Discussion of the Cross-Market Effects, and Further Tests

Discussion. Bernheim and Whinston (1990) provide an analytical model that allows them to isolate the conditions under which multimarket contact can facilitate collusion between firms across markets. In a model with two firms and two countries, the research shows that when markets differ in size, when there are scale economies, or when firms have differing costs (for example, each has a cost advantage in its home market), collusive prices can be maintained in each market. Spagnolo (1999) shows that risk aversion generates the same result even when firms and markets are symmetric.[14]

[14] The Big 6 cement firms are likely to have at least one of these characteristics. These theory models can be extended to N-firm settings by noting that in the collusive outcome, the monopoly price is obtained and is not a function of N. Each individual firm can consider the actions of the other $(N-1)$ firms as a group when deciding whether to set prices below the monopoly price in any one market. Bernheim and Whinston note in their conclusion that precise empirical tests of the effects of multimarket contact are difficult because the theoretical predictions vary critically with industry conditions such as firm costs and features of the market.

Later studies discuss the relationships among multimarket contact, competition levels, and market entry. Baum and Korn (1996, 1999) clearly set out the intuition behind the different mechanisms affecting this relationship. Stephan et al. (2003) summarize the paradox at the heart of this debate. For multimarket contact to arise and act as a deterrent to competitive behavior, firms must enter each other's markets, "which is just the kind of action that the deterrent is supposed to limit" (p. 403). Haveman and Nonnemaker (2000) motivate their observed inverted U-shaped relationship between level of multimarket contact among firm and entry as the result of a trade-off between these competing influences.

Our results are consistent with a framework in which the benefit from increasing multimarket contact is highest when preexisting contact is low or high. We suggest this may be due to the nature of the industry context. Firms with low preexisting collocation could well be entering to create mutual interdependence with competitor firms, and firms with high preexisting collocation could be entering to strengthen their relative position in a context of established mutual interdependence. All else being equal, incumbent firms may prefer to coexist in each market with

Table 4 Results of the Conditional Logit Analysis Testing Whether Market Choice Is Associated with Increased Collocation with Incumbent Firms, for a Given Entering Firm in a Given Year

	Pr(Market *m* is entered)	Pr(Market *m* is entered)	Pr(Market *m* is entered)	Pr(Market *m* is entered)	Pr(Market *m* is entered)
Average collocation across markets	2.17	8.61		2.68	7.27
	[1.04]**	[4.38]**		[1.18]**	[4.45]
Average collocation squared		−7.35			−5.22
		[4.77]			[4.82]
Total number of incumbents in market			0.39	0.47	0.41
			[0.12]**	[0.20]**	[0.21]*
Shared language	0.94	0.90	0.61	1.07	1.02
Shared language	[0.40]**	[0.40]**	[0.31]**	[0.41]**	[0.41]
Distance between market and home base	−0.0001	−0.0001	−0.0001	−0.0001	−0.0001
	[0.0001]	[0.0001]	[0.00]*	[0.00]	[0.00]
Total cement usage in country, million tons	0.00	0.00	0.00	0.00	0.000
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Cement usage per person, tons	0.00	0.00	0.00	0.00	0.00
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Region fixed effects	Yes	Yes	Yes	Yes	Yes
Log likelihood	202.87	201.55	447.47	200.37	199.74
Number of observations	3,370	3,370	10,992	3,370	3,370
LR chi squared	62.88 (5df)	65.51 (6df)	92.35 (5df)	67.88 (6df)	69.14 (7df)
Prob > chi squared	0	0	0	0	0
Pseudo *R* squared	0.134	0.140	0.094	0.145	0.148

Sources. ING Barings (2000), Cemex, Cembureau for excess demand, demand and demand growth data, CIA's *World Factbook* (2004) for distance and language data, and Euromonitor's *Global Market Information Database* (2000).
Notes. There are a large number of observations in column 5 because all countries that contain zero incumbents are included in this specification. By definition, the collocation variable is missing for these observations.
*Significant at the 10% level; **significant at the 5% level.

firms with which they compete in many markets if the alternative situation is to compete with a local firm. Models of multimarket contact show how it is easier to maintain collusive pricing with a firm it also interacts with elsewhere. In the cement industry, entering a market through acquisition of existing assets is not necessarily an aggressive move. Unlike other industries, such as the California airline industry studies by Baum and Korn (1996, 1999), entry involves the acquisition of local firms and is therefore less likely to trigger multimarket retaliation in prices. Our results suggest that Big 6 cement firms' entry decisions increase their mutual interdependence and their own ability to retaliate against other firms, without the concern that their entry will be interpreted as a competitive threat.

Nonetheless, to show that pricing spillovers among the Big 6 have prompted the observed agglomeration, we need to show more than just that cross-market effects are associated with increased likelihood of a given firm's entry. We want to know whether these cross-market effects are "strategic" in the sense that they affect profits in each market. To do this, it is important to address the possibility that there may be variables other than market level effects discussed in §3 that are correlated with both collocation elsewhere and likelihood of entry. In particular, firms could be mimicking each other's entry strategies or footprint, generating a relationship between collocation and entry, because firms mimicking each other in the past will naturally end up collocated and, if they continue to mimic each other, they are more likely to enter new markets in quick succession. This would mean that firm *j* is also likely to be the next entrant to a market where firm *i* recently entered and is now an incumbent. An alternative possibility is that firms independently arrive at the same internationalization strategy, leading to a similar sequence of entry moves. Lieberman and Asaba (2006) and others describe why firms may imitate each other's strategies explicitly. Knickerbocker's much studied 1973 hypothesis illustrates how, in a loose-knit international oligopoly, when one MNE enters a market other MNEs will follow it in lest they find themselves at a disadvantage in subsequent interactions.

Further Tests. To partially address the possibility that one of these effects is driving the results in §3, we ask whether the identity of the subsequent entrant to a given market can be predicted by the similarity of each potential entrant's recent entry strategy in other markets with firms that have recently entered that market. The common feature in models of mimetic behavior is that the degree of recent entry strategy similarity of all potential entrants with the previous

market entrant will predict who the next entrant will be. We use our data on the timing of entry moves to test whether this holds. The collocation variable constructed in §3 is based on the stock of all prior entry events of all current incumbents and potential entrants, whereas the key independent variable in this section is the similarity in recent entry events between each potential entrant and the most recent prior entrant incumbent firm. If recent entry strategy is associated with subsequent entry, then the observed agglomeration could be the result of strategic imitation or of some other omitted variable.

For this test, we reduce the data set analyzed to include only country-level observations where two or more firms enter the country for the first time over a certain three-year period; further, we focus on all but the first entry event.[15] This gives us a total of 38 events and 127 observations, because we have an observation for each potential subsequent entrant. We know the identity of the previous entrant and the fact that (at least) one more Big 6 firm will enter the country in the same year or during the following two years. Possible predictors of the identity of the next Big 6 entrant are then examined.

The key independent variable in this analysis is the pairwise degree of previous market entry similarity for each potential entrant (firm j) and the previous entrant (firm i). This is calculated for each year by counting the number of times both firms in a pair have both entered the same new market over the three years preceding the year of this particular entry event, year t. This number is then divided by the total number of market entries that firm j has made in the same time period. The measure of similarity is thus how often, when it makes a new entry, firm j enters a market that firm i has just entered or is also entering. That is, we measure the pairwise similarity of recent market entries between potential entrant j and previous entrant i as follows:

$$S_{i,j,t} = \frac{\sum_x (1 * x_{i,j,t})}{\sum_y (1 * y_{i,t})}, \tag{3}$$

where $x_{i,j,t}$ is an indicator equal to 1 if both firms i and j have entered market x within the last three years up to and including year t and 0 otherwise; $y_{i,t}$ is an indicator equal to 1 if firm i entered market y in the last three years. Both the denominator and numerator are summed over all markets, excluding the market which is the subject of this entry event. For each observation, we calculate this measure for the previous entrant and all potential entrants j at time t. For the 127 observations, the mean level of $S_{i,j,t}$ is 0.212 and the standard deviation is 0.358. There are values equal to both 1 and 0, corresponding respectively to observations where firms i and j have only entered markets together over the last three years and to observations where firm j has entered none of the same markets as firm i over the last three years. These data are summarized in Table 2, Panel C. The pairwise correlation between $S_{i,j,t}$ and $Coloc_{i,j,t}$ in this smaller subset of observations is -0.0467, suggesting that the measure of recent entry similarity uses only a subset of the information embodied in the collocation measure based on the stock of all past entries.

Results. The results of this second set of tests, for whether cross-firm similarities in recent entry strategy are leading to the agglomeration of Big 6 ownership observed in §2, are reported in Table 5. The first column shows that recent entry similarity with incumbent firms is not significantly associated with an increased likelihood of market entry. It remains insignificant when gravity-type controls are included in column 2, and when firm fixed effects are included with and without the gravity-type controls in columns 3 and 4. Columns 5 and 6 include collocation and then collocation and its square. In this subset of entry events, collocation remains positive and significant, and the U-shape is observed once more, although neither coefficient is significant. Finally, columns 7 and 8 include both similarity and collocation measures as dependent variables. Although the similarity of recent entry moves remains insignificant, the estimated coefficient for collocation remains positive and significant. The U-shaped relationship for collocation does not survive the inclusion of the similarity of recent entry events, but this could be because of data limitations that also prevent us from including firm fixed effects together with recent entry similarity, collocation, and collocation squared.

Although it is still feasible that mimicry of existing footprint may play some role in the observed association of collocation and entry, the similarity of recent entries does not help predict the next entrant's identity. This finding casts doubt on the possibility that the cross-market dependencies identified in §3 are a byproduct of deliberate or coincidental similarity in internationalization strategy.

[15] The choice of a three-year time period reflects a trade-off. Too narrow a window limits the size of the data set and makes it more difficult to infer significance from the similarity measure. Too large a time window, on the other hand, leads to potential collinearity between the collocation and similarity variables in cases with only one incumbent firm. We chose three years in the light of industry conditions. Under the assumption that firm j is mimicking firm i's entry moves, three years is arguably the longest time it would take firm j to make an acquisition (given that there are assets for sale, which must be the case because there is at least one new subsequent entry in the next three years) once the announcement of firm i's acquisition is made. The results, however, are robust to using longer or shorter time periods as the definition for entry occurring within a two- or a four-year period.

Table 5 Results of the Conditional Logit Analysis Testing Whether a Particular Firm Is More Likely to Be the Next Entrant to a Market If It Tends to Enter Similar Markets as the Most Recent Previous Entrant

	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)	Pr(Firm *j* is next entrant)
Similarity of past entries	0.27	0.64	0.45	0.49			3.33	3.30
	[0.59]	[0.66]	[0.72]	[0.77]			[2.14]	[2.13]
Shared language		0.62		1.15	1.09	3.84	3.98	4.01
		[0.57]		[0.84]	[0.80]	[1.78]**	[2.29]*	[2.29]*
Distance between market and home base		−0.0001		0.0016	−0.0001	0.0000	−0.0003	−0.0003
		[0.00]		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Average collocation across markets					5.67	−13.27	10.81	12.52
					[2.41]**	[11.54]	[4.77]**	[13.52]
Average collocation squared						21.25		−2.17
						[23.26]		[15.86]
Cemex fixed effect			−1.31	−14.41		2.02		
			[0.82]	[11.60]		[3.19]		
Heidelberger fixed effect			−0.41	1.11		6.26		
			[0.73]	[1.23]		[2.80]**		
Holcim fixed effect			0.66	1.66		5.87		
			[0.74]	[1.19]		[5.19]		
Italcementi fixed effect			−1.61	0.19		3.18		
			[0.80]**	[1.55]		[2.08]		
Lafarge fixed effect			0.43	1.14		3.49		
			[0.70]	[0.92]		[2.50]		
Number of observations	119	111	119	111	70	70	46	46
Log likelihood	−42.782	−38.636	−34.631	−31.294	−19.592	−11.797	−9.694	−9.685
LR chi squared	0.20 (1df)	3.20 (3df)	16.50 (6df)	17.89 (8df)	9.05 (3df)	24.65 (9df)	12.84 (4df)	12.86 (5df)
Prob > chi squared	0.655	0.361	0.011	0.022	0.029	0.003	0.0121	0.0248
Pseudo *R* squared	0.002	0.040	0.192	0.222	0.188	0.511	0.3984	0.3989

Sources. Cemex, Cembureau.

Notes. Conditional logit regressions estimated by maximum likelihood. Standard errors given in parentheses. Columns 3 and 4 contain fewer events because distance and language data are missing. Columns 5 and 6 are estimated using the set of observations for which collocation is nonmissing.

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

5. Multinational Presence and Average Prices and Profitability

The results so far suggest there is a firm-level interaction across markets so that firms enter new markets to increase multimarket contact and facilitate less-intensive price competition. To strengthen this inference, we now turn to look directly at the performance implications of collocation for the Big 6 firms. In single country studies, multimarket contact has been shown to generate uncompetitive pricing.[16] Our hypothesis that worldwide collocation allows firms to sustain higher prices across markets requires that multinational presence be associated with higher prices and profitability in local markets. It has no implications for a relationship between multinational presence and costs. In contrast, most variants of the idea that collocation is the result of strategy convergence or imitation do not imply higher prices. For example, Knickerbocker-style behavior to reduce risk should presumably depress average prices and (risk-unadjusted) profitability in local markets for at least some time after bunched entry. Most of the traditional explanations of local agglomeration have implications for lower costs, rather than higher prices. Hence, investigating the relationship between multinational presence and prices or profitability complements our earlier analysis.

5.1. Cross-Sectional Analysis of Prices, Costs, and Big 6 Presence

We begin by looking at the correlation between cement prices and costs and the presence of Big 6 MNEs using data from an analyst report issued by ING Barings on average long-run ex plant prices and operating costs per ton of output in 25 of the largest national markets. These data were combined with

[16] Evans and Kessides (1994) find that price competition is softened by multimarket contact in the U.S. airline industry, and Gimeno and Woo (1996) find that multimarket contact reduces the intensity of rivalry across U.S. airline markets. Parker and Roller (1997) make a similar inference in the U.S. cellular telephone industry, and Jans and Rosenbaum (1997) find that the markup over marginal cost in the regional U.S. cement markets is associated with the extent of firm multimarket contact. Fernandez and Marin (1998) study the issue in the context of the Spanish hotel industry. The paper by Jayachandran et al. (1999) contains a table that summarizes these results.

Table 6 Regression of Big 6 Market Share on EBITDA, Price and Cost Per Ton

	Dependent variable			Dependent variable			Dependent variable		
Independent variable	EBITDA per ton	Price per ton	Cost per ton	EBITDA per ton	Price per ton	Cost per ton	EBITDA per ton	Price per ton	Cost per ton
Big 6 share of market capacity	31.07 [10.82]**	38.01 [14.27]**	6.95 [5.50]	−6.20 [15.40]	−11.79 [20.37]	−5.59 [9.15]			
Average worldwide collocation of incumbent Big 6 firms				−39.11 [25.55]	−48.51 [33.78]	−9.40 [15.18]			
Big 6 capacity share ∗ Average worldwide collocation				139.56 [52.65]**	184.83 [69.63]**	45.27 [31.28]			
Share of market capacity controlled by 6 largest firms Top6 (local or global).							29.32 [15.96]*	28.21 [21.05]	−1.11 [7.47]
Excess capacity (capacity/production)[a]	−26.42 [20.43]	−31.54 [26.94]	−5.12 [10.39]	−27.66 [17.50]	−34.53 [23.14]	−6.86 [10.39]	−9.55 [19.33]	−11.79 [25.50]	−2.24 [9.05]
Share bagged (=1 if >50% of cement sold in bags)	4.75 [11.94]	8.04 [15.75]	3.29 [6.07]	1.63 [10.48]	3.63 [13.86]	2.00 [6.22]	9.38 [13.41]	13.62 [17.70]	4.24 [6.28]
GDP	0.00 [0.00]	0.00 [0.00]	0.00 [0.00]	0.00 [0.00]	0.00 [0.00]	0.00 [0.00]	0.00 [0.00]	0.00 [0.00]	0.00 [0.00]
GDP per capita	−0.37 [0.67]	0.38 [0.88]	0.75 [0.34]**	−0.72 [0.60]	−0.12 [0.79]	0.60 [0.36]	0.07 [0.73]	0.97 [0.96]	−0.90 [0.34]**
Constant	42.89 [22.76]*	72.98 [30.02]**	30.09 [11.57]**	56.90 [20.79]**	93.24 [27.49]**	36.35 [12.35]**	5.46 [27.26]	34.61 [35.97]	29.16 [12.77]**
Adjusted R squared	0.1576	0.1472	0.5024	0.3820	0.3707	0.5017	−0.0394	−0.0535	0.4794
Number of observations	22	22	22	22	22	22	22	22	22

Sources. ING Barings (2000), Cemex, Cembureau for excess demand, demand and demand growth data, CIA's *World Factbook* (2004) for distance and language data, and Euromonitor's *Global Market Information Database* (2000).

[a]Excess capacity measure of market demand instrumented using share of employment manufacturing in construction, and construction GDP as a proportion of manufacturing GDP.

*Significant at the 10% level; **significant at the 5% level.

data on the share of total capacity controlled by Big 6 firms in each country, as summarized in Ghemawat and Matthews (2000). Data from Cembureau's *World Statistical Review* (2002) about country-level demand conditions were once again used as control variables. Because we are interested in the relationship between supply conditions and price, we instrument for the effect of demand (production relative to total capacity) by using measures of construction activity in each country from Euromonitor's *Global Market Information Database*. This is a suitable instrument because cement is a small fraction of total construction cost. We also control for the share of cement sold in bags in smaller volumes because this is expected to impact price through average cost per ton. Although this is a limited data set, the 25 countries in the analysis account for more than 50% of each of the Big 6 multinationals' total capacity footprint in the year 2000 and for more than two-thirds of capacity for each firm except Holcim. Table 2, Panel D shows that there is significant variation in per ton price and cost across countries.

Table 6 presents the results of instrumental variable regressions of the independent variables related to Big 6 share on per ton price, cost, and a measure of per ton margin—which ING Barings terms earnings before interest, taxes, depreciation, and amortization (EBITDA), and is found by subtracting cost from price. The regressions reported in the first three columns of the table indicate that the share of total capacity in a country accounted for by the Big 6 multinationals had a significant positive effect on average price per ton. The results suggest that an increase of one standard deviation (31.5 percentage points) in the share capacity controlled by Big 6 firms was associated with an $11.80 increase in price per ton. Interestingly, the cost equation estimated in Table 6 indicates a positive but statistically insignificant effect of the share of capacity controlled by the Big 6 on average operating costs per ton, after the inclusion of controls. This does not square with the suggestion that high margins for collocated Big 6 firms are driven by greater efficiency and lower unit costs.

To tie this analysis more closely to the idea that it is worldwide collocation between firms that is leading to higher prices in markets, rather than just the ability of Big 6 firms to coordinate in a given market unrelated to their interaction elsewhere, we now introduce measures of collocation as independent variables. For each market, for the Big 6 firms present, we find the

pairwise level of their collocation across all world markets, then take the mean level across all present pairs. This gives a country level measure of the degree of worldwide interaction that the present firms have at the time. We interact this variable with the market share of the Big 6 firms. Columns 4–6 show that this interaction term is positive and significantly associated with EBITDA per ton, and that this association comes about through higher prices rather than lower costs. That is, markets where the incumbent Big 6 firms are highly collocated globally are particularly likely to have higher cement prices.

As a robustness check, we also test whether greater market concentration in each market might be expected to lead to higher prices regardless of whether the firms with large market shares are local or multinational. We replace the independent variable measuring the Big 6 multinationals' share of capacity with a measure of the capacity share of the 6 largest firms in each country, whether local or multinational, using Cembureau data. The final three columns of Table 6 indicate that this variable does not display a significant relationship with average price or average cost.

5.2. Longitudinal Analysis of Relative Cement Price

The analysis reported so far in this section is consistent with the evidence in the previous sections in support of the idea of agglomeration in pursuit of higher prices.[17] There is, however, (at least) one additional objection to address. The Big 6 firms in general may simply have bought into existing local oligopolies that, in the long run, would have prices just as high had they been controlled by local interests. This claim is partially undermined by the results of the conditional logit analyses because it is not clear why worldwide collocation would be associated with the likelihood of further entry. Nonetheless, we look for further evidence to try to rebut this point.

Given the impossibility of observing what would have happened if MNEs didn't dominate the markets that they do, we look at the evolution of marketwide prices during windows associated with significant entry or expansion by MNEs. We have focused on six countries: Spain, Mexico, Venezuela, Colombia, the Philippines, and Canada.[18] Data collected by central banks and national statistics agencies for the purpose of constructing price indices for cement and building materials in general were used to construct marketwide pricing indices.[19] We compare the cement price index with the building materials price index. In several cases, the Big 6 firms choose to enter the market in the midst of a local economic recession at low asset prices, especially in foreign currency terms. The price of cement may well rise postrecession, irrespective of ownership changes. For this reason, the relative change in cement price provides more precise evidence of the effects of Big 6 ownership on cement price over time. The data that we were able to obtain are summarized in Table 7. We consider the six countries one by one because they provide somewhat different perspectives on the hypothesized performance effects of multimarket contact.

Spain. The Spanish price for cement relative to building materials did not, according to Table 7, change much between 1992, when Cemex entered the market, and 2002. Note, however, that according to Cemex, the major motive for its first big cross-border acquisition was the strategic move of countering Holcim, which had entered Mexico by acquisition in 1989 and had started to expand aggressively in the early 1990s. Cemex apparently had little appetite for a price war in Mexico to check Holcim—and Lafarge, which had also entered—because it stood more to lose in absolute terms because of its larger market share. Moreover, Holcim and Lafarge were much larger, very diversified geographically, and much better funded. Both had significant capacity in Spain, which also appeared to be an attractive target to Cemex because of several similarities to Mexico—a shared language, colonial links, and relative maritime proximity (Cemex began by exporting to Spain before making its acquisitions)—as well as market-specific attributes such as a high demand growth rate compared with other developed countries. But the more important point for our purposes is that in entering Spain, Cemex's management focused on multimarket price-raising (or price-preserving) benefits in Mexico

[17] Limitations of this cross-sectional analysis include that the Barings report contains little information about the quality of their data, as well as the limited number of data sources. Annual reports corroborate some of the findings. For example, high prices and per ton margins in Mexico and Venezuela in the Barings data are mirrored in Cemex's annual report of around the same time which reveals highest EBITDA margins in these countries, along with Colombia.

[18] We narrowed our data search to countries that had experienced at least three new Big 6 entries between 1988 and 2000; Canada, Spain, the Philippines, Turkey, and Egypt. To these countries, we added the two countries with the highest cement price in the ING Barings data—Mexico and Venezuela—and Colombia, which we knew, as mentioned above, generated high margins for at least one of the Big 6 firms. We were unable to find price series data for cement and building materials for Egypt and Turkey, which had four and three new entries between 1988 and 2000 respectively. However, the concentration data tell us that despite these entry moves, the Big 6 firms had small market shares (30% and 35%) in these countries versus 97% in the Philippines.

[19] We are grateful to Alberto Salvo for suggesting this type of price data source, as used in Salvo (2007).

Table 7 Cement Price and Building Materials Price Indexes

	Spain		Mexico		Venezuela		Colombia		The Philippines		Canada	
Year	Cement	Building materials	Cement	Building materials	Cement	Building materials	Cement	Building materials	Cement	Building materials	Cement	Building materials
1990	1.00	1.00	**1.00**	**1.00**	1.00	1.00			1.00	1.00	**1.00**	**1.00**
1991	0.98	1.00	**1.15**	**1.16**	1.41	1.24			1.10	1.05	**1.03**	**0.96**
1992	**0.92**	**1.01**	**1.32**	**1.30**	1.97	1.55			1.02	1.07	**1.02**	**0.96**
1993	**0.98**	**1.03**	**1.46**	**1.37**	2.77	2.12	1.00	1.00	1.02	1.13	**1.03**	**0.97**
1994	**1.02**	**1.06**	**1.57**	**1.43**	**4.85**	**3.73**	1.18	1.22	1.03	1.16	**1.08**	**0.99**
1995	**1.05**	**1.11**	**2.56**	**2.13**	**6.72**	**5.45**	1.35	1.44	1.18	1.21	**1.11**	**1.02**
1996	**1.06**	**1.12**	**3.63**	**2.64**	**14.58**	**12.24**	**1.80**	**1.70**	1.22	1.24	**1.14**	**1.04**
1997	**1.05**	**1.14**	**3.97**	**3.15**	**21.54**	**16.47**	**2.14**	**2.00**	**1.11**	**1.27**	**1.17**	**1.06**
1998	**1.08**	**1.16**	**4.94**	**3.74**	**24.96**	**19.84**	**2.66**	**2.34**	**1.01**	**1.30**	**1.22**	**1.08**
1999	**1.10**	**1.19**	**5.39**	**4.31**	**28.52**	**22.69**			**1.06**	**1.33**	**1.26**	**1.10**
2000	**1.08**	**1.21**	**5.93**	**4.61**					**1.20**	**1.37**	**1.29**	**1.16**
2001	**1.13**	**1.24**	**6.10**	**4.71**					**1.29**	**1.40**	**1.29**	**1.20**
2002	**1.17**	**1.26**	**6.17**	**4.84**					**1.19**	**1.45**		
2003			**6.51**	**5.19**					**1.27**	**1.57**		

Sources. Statistics Canada; Banco de Mexico; INE; Banco Central Venezuela; DANE; National Statistics Office, Republic of the Philippines; IMF statistics yearbook; BLS.
Note. Years when the Big 6 firms were present and controlled a large market share are shown in bold type.

of a sort that would not show up in tests of changes in prices in the market entered.[20]

Mexico. Cemex's home market saw foreign entry and expansion by Holcim and Lafarge, starting with Holcim's acquisition of Apasco in 1989, as the country opened up to foreign investment. By 2000, these three firms controlled 85% of the Mexican market. The data in Table 7 suggest some real increases in Mexican cement prices in the wake of multinational entry and expansion. Although these may partly reflect the removal of price controls at the start of the 1990s, there was a steady price increase through the first half of the 1990s; Mexican cement prices have since stabilized at a high level. Annual reports reveal the very high profitability of Cemex's and Holcim's Mexican operations.

Venezuela. Cemex entered the Venezuelan market through acquisition in 1994. Over the next two years Holcim and Lafarge significantly expanded their existing toeholds, yielding an oligopoly in which these three firms, led by Cemex, held close to 100% of local capacity. The data in Table 7 suggest that although cement prices rose faster than building material prices in Venezuela over the 1990s, the relative increase immediately predated this period of multinational entry/expansion. However, it is also worth noting that this period was one of unusually high inflation in Venezuela: The cement price index increased at an average annual rate of 67%, so that its level in 1997 was nearly eight times as high as in 1993. A deeper examination of the Venezuelan cement industry over this period by Dumez and Jeunemaitre (2000) provides more support for multinationalization raising prices. In their account, based on microdata on Venezuelan prices, a general economic slump at the beginning of the 1990s prompted a price war between the three dominant domestic producers, leading to large losses. However, after acquisitions by these three firms, Venezuelan cement prices rose significantly over the next few years while the general slump continued.

Colombia. Colombian cement prices were until recently also considered among the highest in the world, although, unlike Mexico and Venezuela, the country was not included in the Barings sample discussed earlier in the section. The Colombian time series in Table 7 is particularly short but does suggest an increase in the relative price of cement starting around the time of Cemex's entry in 1996.[21]

The Philippines. The Asian crisis of the late 1990s made cement assets in the Philippines particularly good value for Big 6 firms. The industry suffered from the fall in demand from residential and general construction activity. At the same time, the country was flooded by low-priced cement imports from Japan, Taiwan, and Indonesia. Locally owned firms sought government assistance and considered filing dumping charges against importing firms. Between them, Holcim, Cemex, Lafarge, and BCI invested

[20] For further analysis of Cemex's internationalization strategy and its impact on that firm's economics, see chap. 3 of Ghemawat (2007).

[21] Colombia's cement industry is actually more concentrated than multinationalized: slightly more than one-half of local capacity is accounted for by Argos, a syndicate of quasi-independent local firms that can coordinate on price, followed by Cemex and then Holcim, with the combined share of these three companies approximating 90%.

$1.7 billion in 16 local companies over the two-year period from 1997 to 1999. Holcim had had a presence in the Philippines since 1974 but in 1997 was joined through acquisition by Cemex and in 1998 by Heidelberger, BCI, and Lafarge. By the end of 1998, 97% of cement capacity was controlled by these five firms, all of which undertook substantial consolidation. Table 7 shows that although relative cement prices fell between 1996 and 1998, the price increase in percentage terms was faster than for other building materials between 1998 and 2001. In 1999, the cement price rose by 5% and the price of other building materials rose by 2%. In 2000, these numbers were 13% for cement versus 3%, and in 2001 the figures were 8% for cement versus 2% for other building materials.

Canada. By 2000, more than 95% of Canada's production capacity was controlled by one of the Big 6 firms. Lafarge and Holcim had a presence there prior to the time period of interest. Italcementi, Heidelberger, and BCI took control of assets there in 1992, 1993, and 1997, respectively. In each year, from 1992 to 1998, cement prices rose by a greater percentage than construction materials prices.

Overall, the evidence in this section suggests a positive association between multinational presence and prices that seemed to reflect more than just MNEs purchasing into existing oligopolies. Together with the analyses in previous sections, it uncovers patterns that are hard to explain except in terms of the pursuit of positive multimarket pricing spillovers.

6. Conclusions

These findings suggest that strategic interaction worldwide among the Big 6 global firms plays a role in explaining successive market entry decisions in the cement industry. Specifically, firms with a low or high degree of market overlap elsewhere tend to enter markets to increase collocation. There is also a positive association between market choice and preexisting multimarket contact with incumbent firms. Over time, market entry has led to significant nonrandom agglomeration of FDI in the industry. Cross-sectional analysis of a subset of markets reveals that markets where FDI is concentrated tend to have higher cement prices, but not lower production costs. Longitudinal analysis provides some evidence that foreign entry is associated with an increase in price level.

Theoretical models of multimarket contact allowing firms to sustain higher prices across all markets generate predictions that are consistent with these findings. We argue that entering new markets to increase the degree of multimarket contact is attractive to global firms in the cement industry because it reinforces the channels that lead to higher prices. Hence, MNE agglomeration is a natural result of a set of profit-maximizing strategies. It is reasonable to assume that in this industry, entry itself will not trigger multimarket retaliation in prices because entry tends to involve acquisition of local firms. Under the assumptions of multimarket contact models, incumbent global firms prefer to meet other global firms rather than local firms in as many markets as possible.

Empirically, we make several advances. First, we establish that ownership is agglomerated using an empirical method adapted from the analytical index given in Ellison and Glaeser (1997). As in Alcácer (2006), we compare observed agglomeration to a simulated distribution of random agglomeration, but we control for market-level effects by holding the number of plants/firms in each market fixed and simulating random ownership distributions. Second, we show that cross-market effects matter in entry decisions. In our first specification, we use a conditional logit framework that incorporates potential entrants' worldwide collocation with Big 6 incumbents as the key independent variable. This specification allows us to control for the fact that some markets attract multinational entry because of natural endowments or within-country spillovers. Our second specification shows that firms entering markets where other Big 6 firms are present are more likely to choose a market where their preexisting contact with those incumbent firms is high. We also provide limited evidence that entry moves are not simply mimetic by adapting the conditional logit framework to control for similarity in recent entry moves between the most recently arrived incumbent firm and all potential new entrants.

The results have implications for competition policy. Although domestic firms in this industry have been known to collude, if MNEs are more able to raise prices when competing with each other, it prompts the policy concern that at least in some cases multinationalization may lower welfare by reducing allocative efficiency. In the case of cement, buyers in at least a few relatively poor countries dominated by multinationals may have ended up paying more than twice the marginal cost of a product often described as "essential."

In sum, the cement industry appears to present a puzzle, because firm- and market-level characteristics cannot explain the observed level of FDI agglomeration worldwide. We find that cross-market interactions affect entry decisions in a way that increases agglomeration. Price levels postentry provide corroborating evidence that firms are able to maintain higher prices when they meet the same firms in many other markets. The cement industry is an appropriate context in which to test for FDI-enhanced market power. It is very feasible that the mechanisms set out here play a role in other industry settings.

7. Electronic Companion

An electronic companion to this paper is available as part of the online version that can be found at http://mansci.journal.informs.org/.

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