Learning and Location

Joanne Sault

Otto Toivanen

And

Michael Waterson

No 693

WARWICK ECONOMIC RESEARCH PAPERS

DEPARTMENT OF ECONOMICS

THE UNIVERSITY OF WARWICK

LEARNING AND LOCATION

Joanne Sault, Otto Toivanen, and Michael Waterson*

Abstract

In this paper we study whether learning from rivals affects within-market location decisions between competing firms. We show it does, using detailed locational data from two leading hamburger chains in the UK. Using four different tests, we demonstrate that alternative explanations – pre-emption and product differentiation – have less bite than between firm learning.

---

* Sault and Waterson- Department of Economics, University of Warwick, Coventry CV4 7AL, UK; Toivanen- Helsinki School of Economics, PO Box 1210, 00101 Helsinki, Finland, and department of economics, University of California, Berkeley. Email correspondence should be addressed to michael.waterson@warwick.ac.uk. We are grateful for the very helpful comments received during presentations at various stages in the paper's construction, including seminars at Essex, LSE and Warwick, at the AEA annual meeting in Washington, 2003, and EARIE in Helsinki, 2003. In particular, we thank Michael Mazzeo, Peter Davis, Tobias Kretzmer, Paul Walsh, V Bhaskar, Ari Hyytinen, Michelle Goeree and Robert Porter for their helpful comments and suggestions. We are grateful to the ESRC for funding this research (award #R000238402). Toivanen gratefully acknowledges financial support by the Yrjö Jahnsson Foundation.

I INTRODUCTION

In this paper we study whether between firm learning leads to increased agglomeration of close rivals within given markets. While on the industry level, it has been documented that different forces may lead to agglomeration (e.g. Ellison and Glaeser, 1997, 1999), and there are good examples of retail industries where search costs provide a compelling reason for agglomeration (to give just a couple, in London, Tottenham Court Road is famous for electronics retailers, and Hatton Garden is famous for its jewelers), it is far less clear that this should happen in industries that are characterized by multiple outlets per firm, between firm competition, and (relative) unimportance of search costs.

Whilst economists have made good progress in understanding the dynamics of competition in various industries, retailing has been relatively neglected despite its tremendous importance to modern societies. Analogous to the old saw of the literature on technology diffusion which states that the benefits of a new technology are only realized through (widespread) adoption of the technology, (widespread) consumption possibilities are only created once retail firms establish themselves within the reach of potential customers. Similarly, one could argue that location decisions in retailing are one form of new product introductions, whose importance to welfare is undisputed, even if hard to quantify empirically (for significant attempts, see Trajtenberg, 1989, Petrin, 2002). For these reasons alone, an improved understanding of the forces determining where to locate retail outlets is important.

We study these questions using data on McDonald's (McD) and Burger King (BK) outlets in the UK in the mid-90s. Toivanen and Waterson (2003) show that between firm learning affects these firms' decisions on which markets to enter. Here we ask whether between firm learning affects location choices within a given market. The rationale for studying UK fast food burger chains is pragmatic: it can be argued that these two firms were the only two strategic competitors in the market in the early 90's; furthermore, they were opening outlets at a fast and increasing pace, creating variation over geographical markets necessary to our tests. In addition, reasonable geographical proxies for local markets are available, as are socio-economic variables characterizing these markets. Also, it is important to us that it can be argued that BK's expansion possibilities experienced a discontinuity in 1990, due to firm reorganization.

Our research strategy is as follows. We concentrate mostly on BK location decisions, for reasons that will become clear below. Using survey evidence, we first document that product differentiation between these firms is small even when not controlling for effects of distance. Nonetheless, we then study whether the location patterns we observe in the data are what one would expect to see if a) pre-emption, b) product differentiation, c) between firm learning is the driving force of BK location decisions. We perform three types of tests. First, we study markets where McD was established before BK. We test whether BK locates its first outlet closer to the first (second etc.) McD outlet than would be expected by pure chance. We show that BK locates its first outlet closer to the first McD outlet than would be expected, thereby ruling out the pre-emption story. Second, we look at markets where 1) BK opens an outlet (McD being the first) and 2) there is a total of three outlets by the end of our observation period. We document that the distance between the BK outlet and the first McD outlet is smaller than would be expected if only product differentiation was the determinant of location. Finally, we compare distances between the first McD outlet and the first BK outlet to those between the first McD outlet and other fast food chains such as Kentucky Fried Chicken, whose degree of product differentiation vis-à-vis McD is clearly larger than that of BK's. We document that BK does not locate significantly further away from McD than these other chains, thereby providing evidence against the product differentiation hypothesis.

All these tests are performed under the implicit assumption that all locations within a market are equal. They all point to the direction that BK locates close to the first McD outlet. There is at least one obvious reason why the location of the first outlet might be better than that of subsequent outlets, providing a potential alternative explanation for the above results. It may well be that McD opens the first outlet in each market in the location with the highest within-market demand. To control for this, we resort to two approaches. First, we compare distances between outlets in two sets of markets: one in which each of the first three outlets is a McD, and another where there is one BK and two McD outlets. We show that the distance between the first McD outlet and the BK outlet is less than any of the other distances; this is evidence against the proposition that the first outlet's location is more profitable. Second, we run regressions explaining the distance between the first (and second) McD outlet and the first BK outlet by market level controls and the rank of the McD outlet in question, together with the time it has been in the market prior to 1990. The idea is that the rank of the outlet controls for location specific demand, and the time in the market is a measure of the strength of the signal[1] to BK. BK could, thanks to its reorganization, more effectively use this information after 1990 than prior to it. We find that, ceteris paribus, the longer the first McD outlet has been in the market, the closer BK locates to it. Taken together, these results suggest that even a firm like BK, which has great experience in opening outlets, resorts to between firm learning when deciding where to locate its outlets, and that this effect more than outweighs the effects that smaller distance would have on competition between firms.

The literature on entry and competition (in retail) has taken great strides recently, particularly with the papers of Mazzeo (2002), Seim (2002), Thomadsen (2002), and Davis (2002). All of these build on the seminal work of Bresnahan and Reiss (1989, 1990, 1991) and Berry (1991). Mazzeo studies product differentiation decisions in the hotel industry. In her paper, Seim examines location decisions, but explicitly concentrates on the effects of competition. Thomadsen takes location as given, and studies pricing decisions, using (US) data on McD and BK. Davis, using an extensive data set on movie theaters, studies competitive effects between firms, and the effect distance has on these.

[1] More accurately, it is a measure of how many draws from the sampling distribution of profitability BK has been able to obtain.

This paper is organized as follows. In the following section, we briefly and informally discuss the different relevant theories affecting location decisions of firms. In the third section, we describe the industry and the data. Section four contains our tests, and Section five concludes.

II THEORY

1. Pre-emption

The well-established theoretical pre-emption literature (Prescott and Visscher, 1977; Schmalensee, 1978; Eaton and Lipsey, 1979) states that a firm may have the foresight to crowd the product space in order to prevent rivals from entering, so as to increase its profits. If this was truly successful, we would see a preponderance of markets with several McDs and no BKs at all, and possibly some with several BKs and no McDs. There are examples of such markets, but far more common is the case where several McDs are present before a BK arrives. Plausibly, action by the incumbent has significantly delayed opening by the other player. This suggests a variant of the hypothesis, namely that the leaders' outlets, or at least a subset of them, are on average closer to each other than to the follower outlet. The explanation for this would be that the leader has crowded out the best locations in the town by placing so many outlets in it/them that it becomes unprofitable for the follower to enter those locations. If there are systematic profitability differences between the outlets (e.g., the first one in each market being located where the within market demand is highest), successful pre-emption should make it less likely that the rival opens close to more profitable outlets.

2. Product differentiation

Irmen and Thisse (1998) show in a tightly parameterized model of multi-dimensional product differentiation that rivals want to locate their products (=outlets in our case) as close to each other in all but one dimension of product quality. In this, the most important dimension, they maximize differences. Assume for a moment (we provide evidence below) that location or distance is the most important source of product differentiation between the two firms in our sample, and consider a market with two McDs and one BK outlet. We would then expect that BK would locate its outlet further away from a given McD outlet than McD locates its second outlet. The reason for this is that BK wants to avoid head-to-head competition, whereas McD can internalize the demand effects that two adjacent outlets have on each other.[2]

As an extension of this hypothesis, if another chain produces a significantly different product from McD (say, a pizza range), the Irmen-Thisse model predicts a close physical location is likely, assuming the first McD location was well chosen. It is also more likely that a pizza restaurant locates near McD than BK locating close to McD.

3. Learning

The story about learning we have in mind builds on two different literatures. On the one hand, the economics learning literature (see e.g. Caplin and Leahy, 1998) shows that firms may want to locate close to each other because later arrivals learn from the early arrivals about the profitability of the location. On the other hand, the management literature suggests that

[2] Here we note that there is an important difference between the UK and the US. In the US (see e.g. Thomadsen, 2002) managers/franchisees of individual outlets have considerable pricing freedom, this is far less true in the UK.

firms learn ‘vicariously’ from each other. As Baum et al. (2000, p. 774) put it, “organizations learn vicariously, imitating or avoiding specific actions or practices... For expanding chains, location choices of large chains may be a particularly important source of information to reduce uncertainty about locations that can support growth...”.

In Section IV.3 we demonstrate how a standard decision theoretic framework suggests that if (Bayesian) learning is taking place, the longer the first McD has been in existence, the more likely it is that BK chooses a site close to that McD outlet.

III DATA

1. The Industry

Our data come from the UK fast food industry. As detailed in Toivanen and Waterson (2003), for the early 1990’s at least, this industry is very straightforward. One can argue that there are only two players large enough to be considered strategic: McD and BK. The third largest firm, Wimpy, was excluded from the counter service market both by contract (a contract between Wimpy and BK precluded Wimpy from opening over the counter outlets before June 1993), and it seems, by choice (by end of 1994, all 240 Wimpy outlets were table seated, by mid-1996 it had grown only to 272 outlets, and in 2001 still had less than 300 outlets; its marketing budget is an order of magnitude smaller than the other two). Table 1 outlines the development of these two firms and the industry. What is important to us is that since its entry into the UK in 1974, McD has grown steadily and consistently by opening new outlets of its own. BK as it now exists, in contrast, is the outcome of a complicated story where two relatively small competitors (BK and Wimpy) are first merged and then partly separated. The outcome was that by 1990 BK emerged with a clearly larger number of outlets, and larger resources for expansion than Wimpy.

TABLE 1 HERE

It is important, in the British context, to have in mind a picture of the "typical" location of a fast food outlet within the district at the time of our study. This is not in a mall (i.e. a confined and defined space), nor in a drive-through edge-of-town location. Rather, it is on a high street, within a traditional shopping area that lacks tightly defined boundaries[3]

Another characteristic of difference between outlets in the UK and those, for example, in the US (see Thomadsen, 2002) is that price competition between outlets within a chain is extremely muted. It is common for both BK and McD national television advertising campaigns to feature price information on particular fast food items (albeit always with the necessary legal caveat "at participating restaurants")[4]. Furthermore, encroachment is not a contentious issue in the UK. McD's contracts typically offer the

[3] Specifically, the modal McDonalds outlet in the data set we use is of this type. For example, all but seven of the 57 first outlet McDonalds are in a high street location, several of them actually on a street with this name!

[4] At time of writing, the McDonalds UK website lists prices for a range of menu items including a "Happy meal", a cheeseburger, etc. Burger King's UK website also features a range of prices including the price for its signature product, the Whopper. By coincidence, the Happy Meal and the Whopper are identically priced.

franchisee a site the company has developed, and are explicit in excluding legal claims from franchisees regarding subsequent openings.[5]

We match the company outlet data[6] with Local Authority District (LAD) data. LADs are administrative and planning districts, largely centered on a particular town, that reasonably well proxy for markets. Socio-economic data is available at LAD level on an annual basis[7]. Table 2 shows that they vary a good deal across a number of dimensions such as population, leading to very different degrees of penetration by our burger chains.

TABLE 2 HERE

2. Outlet locations

As we are interested in within market location, we calculated the distances between outlets in our chosen markets. Using the facility on http://www.streetmap.co.uk/ for converting postcodes to Ordnance Survey grid co-ordinates, each was mapped to a co-ordinate[8] and the Euclidean distance between outlets calculated. We chose markets fulfilling the following three criteria into our sample:

a. Both key players (McD and BK) are in the market at the end of our period (end 1995).

[5] The source of these last observations is inspection of the set of agreements registered with the Office of Fair Trading under the provisions of the Restrictive Trades Practices Act 1976 and subsequent legislation. Files numbered 6193, 6194, 15127 and 15678 contain examples.

[6] All McD data was received from the company itself. For BK, we received the addresses of all their outlets as of end of 1995, and for a proportion, the opening dates. For the rest, we collected the opening dates from a variety of sources. For details, see Toivanen and Waterson (2003) data appendix.

[7] These data largely come from Regional Trends or its sources; see again the Data Appendix to Toivanen and Waterson (2003).

[8] Each UK postcode covers no more than 15 addresses, roughly a block or less. Coordinates thus generated are accurate to within 100 metres.

b. We can date order which player was first into the market, and determine the ordering of outlets up to the point at which the other player entered.

c. There are at least three outlets associated with these players in total.

From the set of 57 markets fitting these criteria, we stopped recording outlet details regarding location (i.e. their postcode) once the second player had entered for the first time. Our set of districts is divided into two subsets. In the first, consisting of the first 34 observations listed in Table 3, there are three or more outlets (up to 6), of which only the most recent is the outlet of a different firm than all previous entries. In the second set, the final 23 observations, there are three outlets, with the chronological order of outlet openings by firms A and B being A, B, A, or A, B, B.[9] We use different sub-samples of these data. Some key distance and firm statistics are shown in Table 3. By comparison with Table 2, we note that on average, the included districts are around 1/3 the area of the average district. Large, typically rural, LADs mostly have few or no fast food outlets.

TABLE 3 HERE

It is noteworthy that there is a very significant difference in Table 3 between the median distance between same-firm outlets and different-firm outlets.

3. Consumer behavior

If customers largely patronized the outlets of different firms, close spatial location of McD and BK outlets would not be problematic from the viewpoint

[9] In four cases, we are unsure of characterization since the second and third outlets open in quick succession, but this does not affect the hypotheses tested.

of avoiding head to head competition. In fact, most people who buy burgers visit both brands of outlet. A report by a market research company, Mintel (1998) details information that allows us to calculate lower bounds for the overlap between McD and BK by reporting what percentage of their sample i) has visited any hamburger restaurant in the last three months, ii) McD, iii) BK. By assuming that all those that visited a hamburger restaurant but did *not* visit McD did visit BK, we can calculate that over all customer groups, at minimum 73% of those consumers in the Mintel sample that visited a BK outlet also visited a McD outlet. For different age groups, the figure varies between 87% for 20-24 year olds and zero for those over 65. Calculating the same statistic for Kentucky Fried Chicken (KFC) and BK, and setting a lower bound of zero for the measure, we find that 0.6% of BK customers also patronized a KFC during the three month period. This information not only confirms the probably common prior that McD and BK are closer in product space than BK and KFC, but also that McD and BK are close in product space. Recall that the Mintel figures do not condition on distance, and therefore these lower bounds already include the differentiating effect of distance. The amount of product differentiation due to product quality is therefore even less than these figures suggest.

IV TESTS

1. Pre-emption

Our first test is designed to discriminate between the pre-emption explanation on the one hand, and product differentiation or learning on the other hand. For this purpose, we use the first subset, of 34 districts. We test whether the distance between the outlet of the following firm and any of the leader's outlets is greater or less than the distance between any of the leaders' outlets. The Null is that there is no difference on average (i.e. that physical location does not matter). Hence, under the Null, if the entry pattern is A, A, B, the probability of the distance between B and one of the A's being less than the distance between the two A's is 2/3. Similarly, if the pattern is A, A, A, A, A, B, then the equivalent probability is only 1/3 (5 ways out of 15). Our test uses a series of simulations to take into account that the probability under the Null varies across observations.[10] The alternative hypothesis of pre-emption predicts that the follower outlet is further away from leader outlets than the leader outlets are from each other, on average.[11]

For each observation in the sample, a simulation round involved a random draw of a zero-one variable, where the indicator function takes the value

1 iff mindist (A, B) < mindist (A, A'), for all A, A'

for a market with n "A" outlets and one "B" outlet and the probability of this happening comes from the above calculations based on actual market structures. We then weight these draws by the relative frequency of the different market structures that we observe, and calculate the distribution of the sum of "1" answers we have generated, which is a sufficient statistic for the test. The 99th percentile of that generated distribution, 28, is compared

---

[10] We are very grateful to Michael Pitt for his work on the details of this approach including providing the coding which enabled this test. We took a total of 40,000 simulations.

[11] West (1981) has performed an alternative test of pre-emption, using data on supermarket locations in greater Vancouver. His approach, using market boundaries, is less appropriate in the context of a market where many consumers may choose not to purchase from any outlet.

to what we observe in the data. This figure, 29, easily allows us to reject the Null at better than 1% level. This is strong evidence against the pre-emption story.

2. Product differentiation

Unlike learning, product differentiation affects the distances between any pair of outlets. We therefore proceed under the implicit assumption that all locations are identical, and look at markets with two outlets of one firm, and one of the other. In this second subset of Table 3, with the form A_1, B_1, A_2, or A_1, B_1, B_2, (or in four cases, a tie between A_1, B_1, B_2 and A_1, A_2, B_1) we test whether the distance between the first outlet of the follower (B_1) and the initial leader outlet (A_1) is less than the distance between the other pairs, follower and third outlet and initial outlet and third outlet. Under the Null, where fascia is irrelevant, the probability of this is 1/3. Assuming nationally set prices (see footnote 3 above), if product differentiation is of some importance, we expect a greater distance between the two outlets of the same firm than between either of the other pairs, as two outlets of the same firm produce identical products, whereas there is some – even if only a limited amount of – product differentiation in the quality dimension between the two rivals. Under the learning alternative we expect the least distance between the outlets B_1 and A_1. [12]

Twenty of the second set of 23 districts, listed in Table 4, across which this test can be performed, satisfy the alternative hypothesis that is consistent

[12] Joseph (2003) shows in a model of product differentiation (but without learning) where there is simultaneous location of two McD outlets, followed by BK choosing a location, that one possible equilibrium is for BK to locate very near one of the McDs. But this involves clearly different timing from that in our experiments.

with learning. With a t-value of -7.64, this allows us to reject the Null in favor of the one-sided (learning) alternative at better than 1% level. We can alternatively test the difference between mean distances across the three pairs. As seen in Table 4, there are large numerical differences between these mean values. Again, the alternative consistent with learning is accepted over the Null and the product differentiation alternative, with the t-value related to the lesser difference being -3.57 and the difference between the other two mean distances being insignificant.

TABLE 4 HERE

Our second test of product differentiation involves looking at the distances between McD and BK, McD and KFC, and BK and KFC, and similarly between the hamburger firms and Pizza Hut. The common prior would probably be that the two hamburger firms are closer together in product space than either is to KFC or Pizza Hut. If this is so, then we would expect that KFC and Pizza Hut locate closer to the hamburger firms than these to each other. Here we do not have data on opening date, simply data on presence as of 1994. These come from the source *Retail Directory of the UK*. This provides a street-by-street listing of retail outlets in most major UK town centres, from which we extracted information on the additional chains of interest. Therefore, in this final sample, we restrict outlets under consideration to those that appear in the town centre.[13] In order to make the

[13] The town centre is a sub-element of a local authority district. Where there is more than one McDonalds or Burger King, we took the min of the distances.

tests meaningful, we restrict our sample to those town centres where three or four of the players appear.

As Table 5 shows, this distance data is noisy. A series of comparisons are available. In the upper panel, these are performed using absolute distances within matched sub-samples. In the lower panel, we bring distance to a common base, so we analyze relative distances within maximally sized sub-samples. In some ways, the median provides the best method of comparison in this table, since outliers where the nearest outlets are some kilometers apart affect all the means. Looking first at the three-way comparison between McD, BK and Pizza Hut, we might expect under product differentiation that the MB distance would be greater than the other two. However, it is not. By contrast, the three-way comparison involving KFC does provide some support for the product differentiation hypothesis. Yet, turning to the comparisons involving Wimpy, no support is offered, since the MB distance is smallest.

Now turning to the lower panel, the values listed are taken as a proportion of the “diameter” of the LAD, assuming it approximates a circle. Thus for example, the median distance between McD and Wimpy outlets across 20 cases is less than 2% of the diameter of those respective districts. The main feature coming out of this comparison is that the median proportions are *all* small, save that between successive McD outlets, which is significantly larger.

TABLE 5 HERE

3. Learning

All the above tests produced evidence that BK locates closer to the first McD outlet than we would expect if pre-emption behavior, product differentiation or pure chance explained the location patterns. Our suggestion is that this pattern is due to learning. Alternatively, however, it could be that the first McD outlet is located in a particularly profitable location, and BK therefore places its (first) outlet close to the first McD. For this to be true, one has to provide an explanation as to why the location of the first McD would consistently be better than that of subsequent McD outlets. One possibility is the following: assume that demand for fast food (hamburgers) in the UK ever since the mid-70s, has increased at a constant rate both between and within markets. Assume also that within market differences in demand are known. Assume further that even a firm like McD faces constraints as to how many outlets per period it can open, or alternatively, that the costs of opening an outlet in a given period are convex in the number of outlets opened in that period. What would be an optimal entry strategy in such circumstances?

According to this story, McD could already in 1974 when it entered the UK rank all the possible outlet locations in terms of profitability. It would however not be optimal to enter all locations right away, as this would increase costs of entry compared to the alternative of opening in some locations in the following year(s). It would be optimal to open in the best locations first. If this is the strategy McD has followed, then the first location in each market is the most profitable location in that market. Our above reported findings would then simply provide evidence that BK, too, is able to rank locations within (and between markets), and therefore locates close to the first McD outlet. No inter-firm learning takes place. We test this story against learning in two ways.

Our first test of learning involves a subset of the data used above. In the product differentiation test, we looked at markets with three outlets. It turns out that 16 of them have the entry time ordering mbm. By chance, there are also 16 cases in our data that start mmm. This suggests a comparison between the sets of distances in each case. In other words, the mmm cases might serve as a useful point of reference from which to analyse the mbm ones. Especially, it allows us for the first time to tackle the issue of location heterogeneity. If it is true that the first McD is located in the most profitable location within a market, then we would expect the second McD also to be located 'close' to the first one (close meaning closer than the third is to the first). Table 6 sets out the relevant means and standard deviations for these two samples. As is fairly evident from the raw means, there is no significant difference between any of the mean distances between outlets in the mmm cases, providing evidence against the first outlet's location being better than the others. However, there is a significant difference between the m_1b and the other two distances in the mbm cases, with a t-value of over 4. This provides evidence for learning against product differentiation. It is also interesting that the m_2b distance is not significantly different from the m_1m_2 distance.

TABLE 6 HERE

The theoretical justification for our second test of learning comes from standard Bayesian decision theory. It can be shown that, conditional on the draws being positive (higher than the prior) on average, the posterior of an experiment with a larger number of draws is larger (on average) than that of an experiment with a smaller number of draws.[14] Further, this difference is growing in the difference in the number of draws. In our data, the inability of BK to exploit information prior to 1990 gave it a chance to sample from different distributions, i.e., to observe the profitability of first McD outlets in different markets. The number of draws available to BK varied over the markets depending on when McD had opened the first outlet, giving us observable variation in this metric. Also, the fact that BK tends to locate close to the first McD is evidence for the draws (signals of profitability of the location of the first McD outlet) being on average higher than the prior.

Our hypothesis is thus an implication of Bayesian decision making: the larger the number of draws (the longer the first McD has been in existence prior to 1990), ceteris paribus, the higher the mean posterior, and therefore, the more likely it is that BK locates close to the first McD outlet.

Our second set of tests exploits an implication of the above story of how the profitability of the locations of first McD outlets varies over markets, providing us with a way of controlling for differences in the profitability of the first McD outlets. If McD behaves as outlined above, then the ranking of McD outlets is an (exact, but ordinal) measure of the relative profitability of McD outlets. Further, if BK has used time prior to 1990 to observe the profitability of different (first in the market) McD outlets, the time a McD outlet has

[14] This assumes the same prior mean and precision for both or all locations, and same mean and precision for the draws. See e.g. deGroot (1970, p. 167). Another implication of the model is that the precision grows in the number of draws, strengthening our argument further.

existed prior to 1990 is a measure of the number of draws BK has been able to sample for a given McD outlet. We therefore take all markets where McD has at least two outlets by the time of BK entry, and estimate the following regression:

(1) $$dist_{m1,b,i} = X_i'a + b_1 time_{m1,i} + b_2 rank_{m1,i} + e_i \, .$$

In (1), the dependent variable is the distance (in meters) between the first McD outlet and the BK outlet in market i, X is a vector of market characteristics that controls for observed differences between markets, time is the time prior to 1990 that the first McD outlet has been in existence in market i, and rank is a measure of the rank of the first McD outlet in market i.[15] If our story is correct, time should be significantly negative in (1), controlling for rank.

TABLE 7 HERE

We have performed a large number of estimations of (1) using different distance, time and rank variables. We compile the evidence on the relationship between these variables into Table 7, but suppress the results on the control vector.[16] It is clear from the reported results that despite the small sample size, we find a consistent, most of the time statistically significant, negative relationship between the distance at which BK locates its first outlet from the first McD outlet and the time that the first McD outlet has been in

[15] Although these measures are naturally highly correlated, the correlation is not perfect due to the large number of outlets opened each year by McD in the 1980s.

[16] These are available upon request from the authors.

the market prior to 1990.[17] The rank of the first outlet almost never obtains a significant coefficient, supporting the earlier finding with the 16+16 matched markets above. These results give further evidence in support of the learning story.

V CONCLUSION

Although the evidence provided in this paper is of only two firms in one national market, the flavor is clear: BK consistently locates closer to the first McD outlet than we would expect if pre-emption, product differentiation, or pure chance (such as local planning) were driving the location decisions. We also find that the distance between the first McD outlet and the BK outlet is negatively affected by the time the first McD outlet has been in the market, conditional on the rank of the McD outlet. All this suggests that in making its location decisions, BK learns from (the first) McD, and that this effect overwhelms other effects on location.

The implication from an industrial organization point of view is that notwithstanding the importance of (strategic) competition in oligopolistic markets, inter-firm (knowledge) spillovers may be of overriding importance even for firms that have invested a great deal into solving the problems relating to optimal product positioning in the markets they serve. We know they are important in R&D intensive industries, but to find they are important in fast food retailing is rather more novel.

[17] When using the natural logarithm of the distance between the first McD and BK as the dependent variable (columns (7) and (8)), results were not robust to the choice of the rank variable. When using the actual rank, the signal coefficients were insignificant.

The implication from a public policy point of view is a negative one. The UK is subject to significant planning laws constraining the opening of certain types of retail outlet. In the case of fast food, an existing site must by "A3" classified in order to be suitable. In the case of a new site, in order to get a designation, the retail chain will need to assure the local planning authority, acting for residents, that a significant nuisance such as smell or traffic congestion will not ensue. It has been argued in other retail contexts, in particular supermarkets (Competition Commission, 2000) that planning law constrains the growth of competition, so enhancing the existing market power of incumbents (see also McKinsey, 1988). However in the present context, we found no evidence for the pre-emption view. Thus there is no evidence, in the context of small fast food outlets, that the growth of competition is being constrained.

Table 1:
Key dates in the UK history of burger retailing

Date	Event
1960s	Wimpy brand established as offshoot of J Lyons
1970s	Wimpy established limited counter service concept
1974	McDonalds opens first store
1977	Wimpy chain bought by United Biscuits
1983	McDonalds exceeds 100 outlets
1986	McDonalds exceeds 200 outlets
	McDonalds starts to franchise outlets
1988/89	Burger King brand (at this time small) bought by Grand Met
1989	Grand Met buys Wimpy from United Biscuits
1990	Burger King has 60 outlets
	Grand Mets burger operations separated into table and counter service
	Counter Service operations mostly re-badged as Burger King
	Wimpy International (with 220 table-service outlets) formed by management buy-out from Grand Met
	Grand Met insists on 3 year agreement preventing Wimpy opening counter service or drive in outlets
1993	June: Grand Met/ Wimpy agreement expires
	McDonalds has around 500 outlets
1994	Wimpy has 240 outlets, all eat-in
end 1995	Burger King has approx. 300 outlets McDonalds has over 600 outlets
May 1996	Wimpy has 272 outlets
	McDonalds and Burger King each opening around 70 restaurants per year
2001	Wimpy still has less than 300 outlets, McDonalds over 1000 outlets.

Table 2
Descriptive statistics of local authority districts

Variable	Mean	Standard Deviation	Minimum	Maximum
Area (thousand square km)	0.493	0.717	0.015	6.497
Population (thousands)	124.0	94.956	11	1017
Youth (%)	14.0	1.127	7.0	17.0
Pensioners (%)	19.0	3.452	12.0	35.0
Council Tax (£)	419.761	163.724	0	963
Wage (£000)	13.985	1.801	1.085	17.208
Unemployment (%)	6.0	2.386	1.0	26.0

Table 3
Sample characteristics

District ref #	Market area sq. km.	Entry order	1st/2nd same chain dist. metres	First mb pair dist. metres
4	204	mmb	2445	2690
26	112	mmb	475	87
50	367	mmmb	8934	971
53	410	mmb	11165	11177
59	78	mmmmmb	2571	122
89	637	mmb	14358	20889
94	75	mmmb	1544	125
100	333	mmb	1917	147
117	43	mmb	1252	1114
180	315	mmb	3597	11536
181	32	mmb	1609	5468
231	80	bbm	422	185
275	290	mmb	3617	180
283	93	mmb	1325	612
291	97	mmmb	5471	680
292	98	mmmmb	3877	3877
296	69	mmb	1453	45
309	160	mmb	5790	5886
314	199	mmmb	9541	260
315	137	mmb	2300	2307
316	35	mmmb	1876	299
323	142	mmb	2655	4893
331	153	mmmmmb	21717	21716
333	159	mmmb	3477	3548
370	246	mmb	5304	160
422	235	mmb	3293	3374
437	81	mmmb	3852	6468
438	48	mmmb	4614	5419
444	110	mmmmb	6326	4482
448	38	mmmb	3603	3317
451	38	mmmb	3021	302
453	56	mmmb	656	420
455	29	mmmmb	2931	3187
456	43	mmb	294	473

Table 3 continued
Sample characteristics

District ref #	Market area sq. km.	Entry order	1st / 2nd same chain dist. metres	First mb pair dist. metres
12	197	mbm	2556	152
46	29	mbb	218	141
55	333	mbm	1592	436
65	130	mbm	1108	1975
96	41	bmb	780	410
107	39	mbm	1776	148
111	39	mbm	1506	178
116	477	mbm	1388	311
128	309	mbm	4778	113
148	42	mmb/mbm	331	63
166	212	mbm	3662	440
168	98	bmm	8593	242
178	309	mbm	9236	253
219	375	mbm	2014	112
248	41	mmb/mbm	3422	1086
297	448	mbm	1689	138
306	99	mmb/mbm	5009	241
310	97	mbb	1021	790
365	120	mbm	3161	275
385	184	mbb	640	324
410	285	bmb	2748	1772
419	307	bmm	3092	3232
435	87	mmb/mbm	381	81
Mean	167		3649	2444
Median	116		2702	438

Table 4
Distances across the first three outlets where the second has a different identity from the first

District		m1b1 dist.	m2b/mb2 dist.	"same" dist.	
Mean		561.45	2476.88	2639.22	
s.d.		774.50	2450.80	2393.17	
median		252.74	1774.08	1776.09	
t test 1	Is prob of 20/23 chance?	$(1/3-20/3)/((20/23*3/23)/23)^{0.5}$= -7.64			No
t test 2	Diff between means	(561.45-2476.88)/535.9= -3.57			Yes

Table 5
Descriptive statistics on distances, 1994

Metres	minMP	MinMB	minBP	minMK	minMB	min KB	minMW	minBW	min MB
# of districts	**36**	**36**	**36**	**18**	**18**	**18**	**20**	**20**	**20**
median	181.69	218.71	299.00	198.28	525.88	405.29	234.19	305.90	181.55
mean	824.95	1174.10	2744.72	1432.84	1703.73	2467.08	705.80	2900.58	1511.12
sd	1849.15	3505.38	5307.21	2209.97	2852.08	3555.44	1392.98	5539.15	3032.42
Proportion	**minMW**	**minBW**	**minMB**	**minMP**	**minMK**	**minBP**	**min KB**	**min MM**	
# of districts	**20**	**20**	**57**	**36**	**18**	**36**	**18**	**51**	
median	0.017	0.021	0.022	0.014	0.018	0.024	0.034	0.197	
mean	0.074	0.242	0.091	0.075	0.148	0.195	0.183	0.225	
sd	0.160	0.413	0.176	0.164	0.248	0.337	0.242	0.158	

Note: M = McD , P = Pizza Hut, B = BK, K = KFC, W = Wimpy.

Table 6
Comparisons across successive outlet differences

	Outlets	1 and 2	2 and 3	1 and 3	Differences between means
mmm	**mean**	5250.69	4576.91	5284.55	All insignificant
	sd	5021.30	2893.19	4127.67	
mbm	**mean**	375.187	2666.46	2725.63	t=-4.08
	sd	492.34	2190.24	2225.34	at least

Note: 16 observations in each case, drawn from Table 3

Table 7
Regression results

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Time	-9587.19*** (3522.57)	-15068.36** (6314.07)	-9095.01** (4228.23)	-9200.87* (5150.26)	1232.704 (3281.13)	-15810.41** (7567.77)	-3.34** (1.40)	-2.56 (2.94)
Time sq.	-	2552.73** (1126.08)	-	3336.68*** (1240.88)	-	4820.30*** (1754.50)	-	-0.28 (0.58)
Rank	-3007.99*** (1085.62)	-1723.98 (1323.72)	-52.25* (27.69)	21.32 (38.11)	10.104 (15.53)	23.87** (11.17)	-0.95** (0.47)	-0.67 (0.79)
Market controls	No	Yes	No	Yes	No	Yes	No	Yes
Distance between McD outlets	Yes (+, sign.)	Yes (+, sign.)	Yes (+, sign.)	Yes (+, sign.)	Yes (+, sign.)	Yes (+, sign.)	Yes (+, sign.)	Yes (+, sign.)
# of McD outlets	Yes (insign.)	Yes (insign.)	Yes (insign.)	Yes (insign.)	Yes (insign.)	Yes (insign.)	Yes (insign.)	Yes (insign.)
Nobs.	38	38	38	38	38	38	38	38
R-sq.	0.71	0.84	0.67	0.83	0.63	0.82	0.40	0.61
F-test p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Dependent variable is distance between first McD outlet and the BK outlet (in meters) in Columns (1)-(6), and its natural logarithm in (7)-(8).

Reported numbers are coefficient and (standard error). Standard errors are robust to heteroskedasticity of unknown form.

***, **, and *, and denote significance at 1, 5 and 10 per cent levels.

The measure of signal (Time) is the natural log of time of the first McD outlet in the market prior to 1990 in Columns (1) and (2) and (7) and (8), and the same in linear form in Columns (3) and (4). In Columns (5) and (6) the measure is the natural logarithm between the time of entry of the first McD and BK outlets.

In Columns (1)-(2) and (7)-(8) the measure of the rank of the first McD is a categorical variable increasing in value by 1 after each additional 50 outlets. In Columns (3)-(6) the measure of rank is the actual rank of the first McD outlet.

Market controls include the population and the geographic area of the market, the proportion of under-16 and over 65-year olds, an indicator for markets in London, and the number of McD (BK) outlets in neighboring districts as of beginning of the year of BK entry. Of these, youth and pension coefficients were usually significant and positive, population's negative and significant. Others' coefficients were never significant.

F-test p-value is the probability value of the F-test on the joint significance of all explanatory variables.

REFERENCES

Baum, J.A.C., Li, S.X., and Usher, J.M., 2000, "Making the Next Move: How Experiental and Vicarious Learning Shape the Locations of Firms Acquisitions", *Administrative Science Quarterly*, 45, pp.766-801.

Berry, S.T., 1992, "Estimation of a Model of Entry in the Airline Industry", *Econometrica*, 60, pp. 889-917.

Bresnahan, T.F., and Reiss, P.C., 1989, "Do Entry Conditions Vary Across Markets?", *Brookings Papers on Economic Activity*, 3, 883-871.

Bresnahan, T.F., and Reiss, P.C., 1990a, "Entry in Monopoly Markets", *Review of Economic Studies*, 57, 531-553.

Bresnahan, T.F., and Reiss, P.C., 1990b, "Empirical Models of Discrete Games", *Journal of Econometrics*, 48, 1-2, 57-81.

Bresnahan, T.F. and Reiss, P.C., 1991, "Entry and Competition in Concentrated Markets", *Journal of Political Economy*, 99, 977-1009.

Bresnahan, T.F., and Reiss, P.C., 1994, "Measuring the Importance of Sunk Costs", *Annales d'Economie et de Statistique*, 0, 181-217.

Caplin, A. and Leahy, J., 1998, "Miracle on Sixth Avenue: Information externalities and search," *Economic Journal*, 60-74.

Competition Commission, 2000, Supermarkets: A report on the supply of groceries from multiple stores in the United Kingdom, Cm 4842, HMSO, London.

Davis, P., 2002, The Effect of Local Competition on Retail Prices: The US Motion Picture Exhibition Market, mimeo, LSE.

DeGroot, M.H., 1970, *Optimal Statistical Decisions*, New York, McGraw-Hill.

Eaton, B.C. and Lipsey, R.G., 1979, The theory of market pre-emption: The persistence of excess capacity and monopoly in growing markets, *Economica*, 46, 149-158.

Ellison, G., and Glaeser, E., 1997, Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach, *Journal of Political Economy*, 105, 5, 889-927.

Ellison, G., and Gleaser, 1999, The Geographic Concentration of Industry::Does Natural Advantage Explain Agglomeration? *American Economic Review*, 89, 2, 311-316

Joseph, A., 2003, Spatial competition between franchisees, Mimeo, Tinbergen Institute. November.

Mazzeo, M., 2002, “Product Choice and Oligopoly Market Structure”, *RAND Journal of Economics*, 33, 221-242.

McKinsey, 1988, Driving productivity and growth in the UK economy, McKinsey Inc, London.

Mintel, 1998, Burger and chicken restaurants- UK- April 1998, Mintel International Group.

Petrin, A., 2002, Quantifying the Benefits of New Products: The Case of the Minivan, *Journal of Political Economy* , 110, 705-729.

Seim., K, 2002, An Empirical Model of Firm Entry with Endogenous Product-Type Choices, mimeo, GSB Stanford.

Toivanen, O., and Waterson, M., 2003, Market structure and Entry: Where’s the Beef? Mimeo, University of Warwick.

Trajtenberg, M., 1989, The Welfare Analysis of Product Innovations, with an Application to Computed Tomography Scanners, *Journal of Political Economy*, 97, 444-479.

West, D.S., 1981, Testing for market preemption using sequential location data, Bell Journal of Economics, 12, 129-143.