Spatial Competition and Agglomeration:  
An Application to Motion Pictures

Darlene C. Chisholm  
Department of Economics  
Suffolk University  
Boston, MA 02108

George Norman  
Department of Economics  
Tufts University  
Medford, MA 02155

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Abstract

This paper presents an empirical assessment of movie theatre attendance in two major metropolitan markets and provides strong support for the importance of spatial characteristics in determining attendance. We consider the hypothesis that attendance at a particular movie theatre reflects a tension between two effects: a competition effect and an agglomeration effect. We find evidence that the agglomeration effect dominates. Further, we identify a pattern of systematic spatial decay in the benefits deriving from agglomeration.

JEL Classifications: L11, D43, L82

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1. Introduction

There have been considerable advances in spatial economic theory since the seminal work of Hotelling (1929), culminating in the emergence of a “new economic geography”¹. Until recently, however, as Borenstein and Netz noted in their 1999 paper: “The (spatial) theory literature … has developed without the benefit of virtually any empirical investigation” (1999, p. 612).

Much has changed in the past decade, with the publication of a series of empirical analyses of spatial competition. This paper is one such investigation. Specifically, we use data drawn from two major metropolitan markets to analyze the spatial determinants of attendance at movie theatres in the U.S. first-run theatrical exhibition market.

Our study makes an important contribution to the empirical evidence on the significance of spatial factors in consumer choice. Specifically, we show that when the spatial and other characteristics of competing products, in our case movie theatres, are carefully measured, attendance at a given theatre is significantly and positively affected by the extent to which the theatre is part of an agglomeration of competing theatres. We further find that this result is robust to a number of alternative measures of relative distance between competing movie theatres.

These findings are consistent with the more general spatial competition phenomenon, characteristic of the new economic geography, that equilibrium outcomes are determined by a complex trade-off. First, an activity may wish to locate close to its competitors in order to attract the competitors’ consumers – what can be termed, as in Davis (2006a), a business-stealing effect, or a market-share effect. This lies at the heart

¹ The new economic geography is very ably synthesized in Fujita, Krugman and Venables (1999). See also Fujita and Thisse (2002).
of the seminal Hotelling (1929) analysis: competing duopolists are drawn together as they compete for the middle ground. Second, proximity might lead to intense price competition, giving an incentive to locate further from rivals to soften competition – the *market-power effect.*

The business-stealing and market-power effects implicitly assume that overall market size is given, an assumption that is characteristic of the majority of the post-Hotelling theoretical work. There is, however, a third effect that is central to economic geography but relatively neglected in the empirical literature on spatial competition. Competing activities that are more agglomerated may gain by creating an economic cluster that attracts consumers – what can be termed an *agglomeration effect.* Fujita *et al* (1999), for example, argue that the reason we find an agglomeration of secondhand booksellers in one region in London is that they want “(t)o be near each other” to give them access to “a large pool of potential customers” (p. 1). Kalnins (2006) suggests that “retail and service firms may purposely locate together because of agglomeration benefits” (p. 209).

There is no way, *a priori,* to tell which of these effects is dominant but there are at least two conditions that are likely to lead to the agglomeration effect being the strongest. First, if firms do not compete significantly on price, a feature of the movie exhibition market identified in Orbach and Einav (2007), we would expect to find both the business-stealing and market-power effects to be more muted. Second, in the simple Hotelling model, introducing additional firms and additional dimensions significantly weakens the

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2 See Pinks and Slade (1998) and Netz and Taylor (2002). Borenstein and Netz (*op. cit.*) refer to these two effects respectively as an “attraction” and “repulsion” effect.
business-stealing and market-power effects – moving closer to (further from) one rival typically involves moving further from (closer to) other rivals. Both conditions characterize the motion-pictures exhibition market.\(^4\)

As we have noted, there has been a considerable flowering in empirical analyses of spatial competition in the past decade. Borenstein and Netz (1999) use a spatial analogy to look at the impact of deregulation on the scheduling of airline departure times. While their results are mixed, they find some evidence that increased competition reduces departure time differentiation. Salvanes, Steen and Sorgard (2005) find similar clustering of departure times in Norway post-deregulation. Netz and Taylor (2002) analyze spatial competition in the retail gasoline market. They conclude that price competition in this market “is sufficiently strong to induce firms to spatially differentiate” (p. 162). Specifically, they find that spatial differentiation by retail gasoline stations is positively affected by competition, defined as the number of competing gasoline stations within a specified market area. They further find that this effect tends to be weaker when they use a broader definition of the market area.

Pinkse, Slade and Brett (2002) develop a semiparametric technique to investigate whether spatial competition is local or global. They apply this technique to analyze price competition in the U.S. wholesale gasoline market, concluding that in this market at least competition is “highly localized” (p. 1144).

Smith (2004) analyzes competition between supermarket chains in the United Kingdom, a sector in which the leading four firms have considerable market power. He

\(^4\) An extended discussion of these opposing effects is developed in Fujita and Thisse (2002). Tirole (1988, p. 286) refers to agglomeration as a desire to “be where the demand is,” implicit in which is the possibility that agglomeration might generate additional demand.
shows that further consolidation is likely to lead to significantly increased prices, while de-merger would have the opposite effect. Kalnins (2003, 2004) and Kalnins and Lafontaine (2004) analyze spatial competition in the lodging and fast-food sectors, looking both at price competition and location choices of franchised outlets. They show that there is a significant difference in the nature of spatial competition between franchised and company-owned outlets. Kalnins (2004), for example, finds that the approval of additional franchise outlets typically cannibalizes incumbents’ revenues, whereas establishing additional company-owned outlets is associated with an increase in incumbents’ revenues. This would appear to imply that the location decisions and the incentives to locate new outlets are significantly affected by ownership structure.

In two related papers, Peter Davis examines spatial aspects of the U.S. motion-pictures exhibition market and their relationship to entry, exit, and consumer demand. Davis (2006a) considers theatre entry patterns during the 1993-1997 period, and measures the impact of entry on the performance of same-owned and competing incumbent theatres. He finds evidence of both within-chain and across-chain business stealing, demonstrating that the latter effect is stronger, and that both effects are localized to within a 15-mile radial market. Further, he finds that entry by new (and typically high-quality) theatres has a significant market-expansion effect as measured by revenues. Davis (2006b) estimates movie-theatre demand assuming consumer heterogeneity, with both spatial and product-characteristic differentiation, using the generalized method of

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4 Firms may, however, seek locations that are, on average, more distant from or closer to their rivals: Netz and Taylor (2002).
moments (GMM). He finds additional evidence of, at most, a 15-mile geographic market boundary.

Our analysis is firmly within this developing empirical literature on spatial competition. We focus on identifying the presence and significance of contemporaneous attraction, repulsion, and agglomeration effects between and among movie theatres within the same markets and of the same type. That is, we group theatres by type classifications, specifically focusing on first-run theatres. Our analysis differs from the majority of the work cited above in two important respects. First, as we noted, price competition is all but absent in the first-run movie exhibition market. Second, we take the locations of the competing outlets – in our case movie theatres – as given. Our specific focus is on identifying empirically the relationship between the agglomeration of first-run movie theatres and market performance, controlling for physical product characteristics and relevant demographics. We identify specific hypotheses and predictions for the dominance of agglomeration versus competitive effects. We find strong evidence of an agglomeration effect on attendance, and further identify a pattern of spatial decay in its economic significance at increasing radial distances from focal theatres.

The remainder of the paper is organized as follows. Section 2 motivates the consumer-choice framework for movie-theatre attendance. Section 3 describes the data.

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5 For other approaches to the determinants of consumers’ demand for movies see, for example, Reinstein and Snyder (2005) and De Vany and Walls (2004).

6 Our data set excludes arthouse theatres that likely appear in the EDI data used in Davis (2006a). Details on the data and type classifications follow in Sections 3 and 4.

7 As we make clear in the empirical analysis, however, we need to instrument our measures of agglomeration to correct for possible endogeneity in the observed locations.
Section 4 presents the empirical implementation and results. Concluding remarks are presented in the final section.

2. Consumer Choice and Movie Attendance.

We begin with the primitive that a consumer chooses to view a particular movie. If movie theatres offer similar programming choices, then this primitive will be transformed into a choice of where to view the movie, that is, into the choice of which movie theatre to attend. We expect that the selection of which theatre to attend will in turn depend upon the location of one theatre relative to its nearest competitors, and on the physical attributes of the theatres.

The validity of our approach rests, of course, on the assumption that movie offerings are sufficiently similar across theatres. This is much more likely to be the case in the first-run movie exhibition market, as a result of which we focus our analysis on first-run theatres.\footnote{We classify theatres into three groupings: first-run (excluding arthouse theatres); arthouse; and second-run or discount. The present paper focuses on first-run theatres only.} In other work, Chisholm, McMillan, and Norman (2006) show that the average degree of programming similarity between first-run theatre pairs in a subset of our sample (in a close but different time period) is in excess of 80%. Thus, once a consumer chooses a particular movie to see, if the film is showing at one first-run theatre, the consumer will likely find it playing at other competing first-run theatres, lending support to the reasonableness of treating the consumer’s decision as one of choosing which theatre to attend.

2.1 Business-Stealing, Market-Power and Agglomeration Effects.

While we take the location decisions of the individual movie theatres as given, we can still draw on developments in location theory and economic geography to analyze
how consumers make decisions among the competing theatres. As noted in the introduction, the literature suggests the importance of three effects.

First, firms locate close to their immediate competitors in order to steal business from their rivals – the *business-stealing effect*. Second, firms have an incentive to distance themselves from their rivals in order to soften competition between them – the *market-power effect*. These two effects can be viewed as opposite sides of the same coin, referring to how firms compete for shares of a given market, thus together capturing a *competition effect*. The third effect is the *agglomeration effect*. Firms that are located reasonably close to each other create a desirable cluster of products that attracts consumers. This is one reason why we often find that “restaurants, movie theatres, or shops selling similar products are clustered within the same neighborhood” (Fujita and Thisse, 2002, p. 2). The main aim of this paper is to determine whether or not the data on movie attendance offers empirical support for the hypothesis that attendance at individual movie theatres, as measured by theatre revenues, is influenced by these effects.9

A particularly effective theoretical method for capturing the impact of these effects on theatre revenues is to use the two-stage nested process developed by Ben-Akiva (1973). Assume that the population of potential consumers can be partitioned into $J$ subsets according to some potentially observable demographic variables that influence their decision of whether to consume the product, in our application, attend a movie theatre: age, income and education are obvious candidates. Second, for consumers of a particular type, assume that their choice set (the set of movie theatres among which they are choosing) is one of $L$ subsets of the full set $M$ of products on offer (the full set of

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9 Given the relative uniformity and stability of price at first-run theatres, we treat revenue as a close approximation for attendance. See Section 2.2 for details on the price data.
theatres), determined by particular characteristics of these products: proximity to each other and theatre type are obvious characteristics on which we focus.

An individual consumer is assumed to follow a two-stage process. First, she chooses the subset from which she will consume (the set of theatres she is considering attending) with a probability determined by the attractiveness of the subset to her. She then chooses a particular alternative (theatre) from within that subset with a probability determined by the utility offered by that alternative relative to those of its competitors within the subset.

In both stages it is assumed that choice is based on a multinomial logit model. Suppose that a consumer of type $j$ has chosen subset $M_i$ in the first stage and that the utility she obtains from attending movie theatre $m$ in subset $M_i$ is:

$$\tilde{U}_{jm} = u_{jm} + \varepsilon_{jm} \quad (m \in M_i)$$

where the $\varepsilon_{jm}$ are i.i.d., following a double exponential distribution with mean zero and variance $\mu_2^2 \pi^2 / 6$. Then the probability that she will attend movie theatre $m$ in $M_i$ in the second stage is

$$pr_{M_i}^j(m) = \frac{\exp(u_{jm}) \mu_2}{\sum_{h \in M_i} \exp(u_{jh}) \mu_2} \quad (j \in J)$$

where $\mu_2$ is a positive constant.

The choice of subset $M_i$ in the first stage is determined by the utility offered by that subset as compared to its competing subsets. Ben-Akiva (1973) suggests that the appropriate evaluation is the expected value of the maximum of the utilities $\tilde{U}_{jm}$:

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10 See Anderson, de Palma and Thisse (1992, p. 40) for a more extensive discussion.
\[ S_j = \mu_2 \ln \sum_{h \in M_l} \exp(\mu_h \mu_2) \quad (3) \]

It follows that the probability of choosing the subset \( M_l \) from \( M \) is

\[ pr_M(M_l) = \frac{\exp(S_j \mu_1)}{\sum_{k=1}^{L} \exp(S_k \mu_1)} \quad (4) \]

where \( \mu_1 \) is a positive constant. Putting (2) and (4) together, we have that the probability of consumer of type \( j \) attending movie theatre \( m \in M_l \in M \) is

\[ pr_j(m) = pr_M(M_l) \cdot pr_{M_l}^{j}(m) = \frac{\exp(S_j \mu_1)}{\sum_{k=1}^{L} \exp(S_k \mu_1)} \frac{\exp(u_{jm} \mu_2)}{\sum_{h \in M_l} \exp(u_{jh} \mu_2)} \quad (5) \]

If there are \( N_j \) consumers of type \( j \) expected attendance at movie theatre \( m \) is:

\[ \tilde{X}_m = \sum_{j \in J} N_j pr_j(m) \quad (6) \]

and this movie’s expected revenues are \( p_m \tilde{X}_m \).

In (5) the agglomeration effect is captured by the first term, essentially by the attractiveness of a particular subset of theatres as a group, since \( \partial pr_M(M_l) / \partial S_j > 0 \). The interplay between business-stealing and market-power effects is captured by the second term, the relative attractiveness of a particular movie theatre within the relevant subset, since \( \partial pr_{M_l}^{j}(m) / \partial u_{jm} > 0 \). It is important to note that, while the impact of each of these effects on attendance at a particular movie theatre is unambiguous, their relative magnitude is not. Even if a product in subset \( M_l \) faces strong competition from other products in that subset, it might still have greater attendance and so revenues than a similar product in subset \( M_i \) if the latter subset is sufficiently less attractive than \( M_l \).

We can further refine this analysis if we assume that consumers behave according to a linear random utility model. Take a particular subset \( M_l \) and consumer type \( j \).
Assume that the characteristic distinguishing consumer types is income and that consumers of type $j$ have real income $y_j$. Further assume that the conditional indirect utility that a consumer of type $j$ obtains from attending movie theatre $m \in M_i$ is:

$$\tilde{V}_m^j = y_j - p_m + a_{jm} + \varepsilon_{jm} \quad \left( j \in J; m \in M_i \right)$$  \hspace{1cm} (7)

where the $a_{jm}$ provide observable indices of the attractiveness of theatre $m \in M_i$ to consumers of type $j$. Anderson et al. (op. cit.) show that we can recover the utility functions $u_{jm}$ from these indirect utility functions. With respect to expected attendance, (7) then implies that we can replace the terms $u_{jh}$ in equations (2), (3) and (5) with the terms $a_{jh} - p_h$. If price is not a strategic variable, as is the case in our application, consumer choice between products in a particular group is determined by the relative characteristics of the competing products (movie theatres).

This analysis suggests that we estimate a model of the following form:

$$ATTEND_i = \beta_0 + \beta_1 AGG_i + \beta_2 ATT_i + \beta_3 RELATT_i + \beta_4 DEMOG_i + \varepsilon_i$$ \hspace{1cm} (8)

In (8) for each theatre $i$, $ATTEND$ is a measure of attendance, $AGG$ is a measure of agglomeration, $ATT$ measures the theatre’s attributes, while $RELATT$ measures its attributes relative to its nearest neighbor, and $DEMOG$ measures demographic characteristics of the population within a defined radius of the theatre.

An obvious measure of both the competition and the agglomeration effect generated by a particular group of movie theatres is the group’s geographic extent. The more spread out they are, the less attractive they are as a group. “Geographical clustering … (is) a particular means by which firms can facilitate consumer search” increasing the probability that the consumer will find “a good match” (Fujita and Thissse, 2002, p. 243). On the other hand, the more spread out they are the less competition they offer to each
other. The direct implication is that the sign of $\beta_1$ will give us an indication of the relative strength of competition and agglomeration effects.

2.2 Price Competition in Theatrical Exhibition.

A complete study of factors influencing consumer choice should address the role of price in influencing consumers’ decisions. Further, price plays a particularly significant role in the spatial competition models that have been developed since Hotelling (1929). The implication is that if price competition is an important factor in the motion-pictures exhibition market, we might expect that theatres distant from their neighbors would charge higher prices than their co-located counterparts, taking advantage of their relatively isolated position in the market.

In the motion-pictures exhibition market, however, there is little variation in price across theatres and price remains remarkably stable over time. For example, the average ticket prices for first-run theatres in Boston and South Florida, the markets in our data set, are $8.19 and $7.55, respectively, with an overall average ticket price of $7.84 and standard deviation of $0.92, giving a coefficient of variation in price of only 11.7%.\(^{11}\)

Price stability in this industry can be difficult to explain using the usual models of price competition. In addition to the expectation that isolated theatres should charge higher prices than their co-located counterparts, standard demand analysis would suggest that movie theatres should charge different prices for different films, based on film popularity and critics’ reviews. However, theatres commonly charge the same price, irrespective of the films being shown (the present data set and industry practice support

\(^{11}\) For the price variable, we use individual theatre price for an adult ticket on Friday evening in 2002 prices, due to the stability of prices between 2000 and 2002, and due to the availability of price data.
this claim). Orbach and Einav (2007) provide a detailed analysis of the use of uniform pricing in movie theatres. In our empirical implementation we take price as given.

3. Data Description

The authors commissioned a market study of two major metropolitan markets: Boston and South Florida.12 Synergy Retail Group, a retail real estate market research services firm located in Boca Raton, Florida, collected the data used in the analysis. One of Synergy’s areas of expertise is creating detailed maps of retail markets based on precise longitude and latitude data for outlet locations. In addition to theatre location data, Synergy provided extensive demographic data within 3-, 5-, and 10-mile radii of each theatre, in each of the two markets, based on Census data reports prepared by Equifax National Decision Systems. For each market, Synergy computed the distance from each theatre to the first-, second-, and third-closest theatre of the same type (i.e., first-run, second-run, or arthouse) and of any type, for the period 1996 through 2000.

Further, Synergy provided data on the total annual revenue generated by each theatre, in each market, when available, from Nielsen EDI, an entertainment data collection firm. Synergy determined each theatre’s type and features (e.g., stadium seating, digital sound) by reviewing advertisements for theatres and, when necessary, by contacting theatres directly. Theatre openings and closings, along with significant theatre renovations and ownership changes during the 1996 through 2000 period, were also documented. The present analysis is limited to the year 2000, since data on theatre features and type could best be confirmed and verified for that year. In addition, we limit our empirical analysis to first-run theatres only, excluding arthouse theatres, to control for, and take advantage of, the relatively high average degree of similarity in film
programming between first-run theatre pairs as documented in Chisholm et al. (2006). In other words, we limit our study to theatres of similar type and offering similar films, thus allowing us to focus on the influence on market performance of differentiation in relative location, theatre attributes, and proximate demographics.

The specific boundaries of Boston and South Florida markets were established by Census Metropolitan and Surrounding Area (MSA) classifications. The estimated 2000 population of the Boston MSA was 5,927,382, with 2,269,608 households, and an average household income of $69,836. The population of the South Florida region was 4,726,491, with 1,841,057 households, and an average household income of $57,658. The South Florida region comprises the Fort Lauderdale, Miami, and West Palm Beach-Boca Raton MSAs. The Boston and South Florida markets were selected because of their similar population and household sizes, but regional demographic differences.

The two markets were also chosen because of similarities in their motion-pictures exhibition market characteristics. By the end of 2000, the Boston and South Florida markets comprised 63 and 67 movie theatres, respectively. In 2000, attendance per screen in Boston and South Florida was 40,754, and 38,063, respectively. Both Boston and South Florida movie exhibitors had committed significant capital to auditorium seating enhancements: by 2000, 36.7% of Boston screens and 53.9% of South Florida screens offered stadium seating.

4. Empirical Analysis

To estimate attendance at movie theatres, we use a straightforward reduced-form, cross-sectional linear specification based on equation (8) above, with revenues, as

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12 This market study was supported by a research grant from the DeSantis Center.
measured by annual boxoffice revenues in 2000, as our dependent variable.\textsuperscript{13} Since capacity decisions, especially the locations of movie theatres and screen capacity, are typically made over a longer time horizon than one year, we think that it is reasonable to treat such characteristics as exogenous in a cross-sectional analysis of annual attendance, provided that we use appropriate instrumentation for the initial location choice, with additional controls for any opening and closing events during the year under study. While this approach has some limitations, it nevertheless provides valuable evidence focused specifically on potential spatial competition and agglomeration effects.

We propose that attendance, and thus revenue, at movie theatre \textit{i} is determined by: a theatre’s spatial market characteristics, which capture the potential competition and agglomeration effects described above; demographic characteristics of the market surrounding the theatre\textsuperscript{14}; and the theatre’s physical characteristics, such as digital sound and stadium seating.

We test three measures of agglomeration for each theatre: (i) the distance from the theatre to its nearest neighbor, DISTANCE\textsubscript{1}; (ii) the difference between distance to the nearest neighbor and to the second-nearest neighbor, DISTANCE\textsubscript{DIFF12}; and (iii) the number of theatres within a defined radius \textit{R} of the theatre, THEATRE COUNT.\textsuperscript{15} Measures (i) and (ii) are inverse measures of agglomeration while (iii) is a direct measure. If the competition (agglomeration) effect dominates we would expect $\beta_1$ to be positive (negative) in specifications (i) and (ii) and negative (positive) in specification

\textsuperscript{13} An ideal additional revenue variable would measure revenue from concession sales. Such data are not available, although we expect the ratio of concession sales to ticket sales to be relatively stable across theatres.

\textsuperscript{14} We use the percentage of individuals with income levels over $35,000, $75,000, and $100,000, within a 5-mile radius of each theatre, to measure consumer ability and willingness to pay to attend movies, with income measures based on 2001 Census estimates.
(iii). Specification (iii) also allows us to test for a distance decay effect. The more broadly we define the market (the greater is R) the weaker the agglomeration effect should be.

Given the industry hypothesis that movie-going is a normal good, attendance should increase with income in the vicinity of a given theatre. We also anticipate a U-shaped relationship between age and attendance. Younger consumers are more likely to go out to movies, as are older consumers; consumers falling between these two groups are likely to be limited by the relatively more binding constraints on time and finances from career-building and child-rearing and thus be less likely to attend movies.\textsuperscript{16}

We expect that physical attributes of each theatre, such as stadium seating and digital sound, will also influence attendance, but precisely how is not clear-cut. On the one hand, these features might increase attendance overall by improving the quality of the movie-going experience. On the other hand, they might affect attendance at a particular theatre because of that theatre’s superior characteristics relative to its competitors\textsuperscript{17}.

We include the number of screens at a theatre (SCREENS) in our estimation to control for the direct effect of capacity on attendance: the greater the capacity, the greater the attendance potential. The ideal measure for theatre capacity would be the number of seats at a theatre. For the first-run theatres in our data set with known capacity (total number of seats), the average number of seats per screen is 210, with a standard deviation of 21, giving a coefficient of variation of 0.10, with the number of screens per theatre ranging from 4 to 24. Given the small degree of variation in seats per screen

\textsuperscript{15} The third measure is the one suggested by Netz and Taylor (2002); see also Davis (2006a and b).

\textsuperscript{16} We are grateful to an anonymous referee for suggesting this point.

\textsuperscript{17} A valuable extension of this study, with more detailed data on theatre attributes, would model the dynamic process of technology adoption at movie theatres during the late 1990s, following Seim (2006).
across a wide range of screen counts, we argue that *SCREENS* is a reasonable proxy for theatre capacity. The number of screens at a given theatre may also provide an indication of product quality: the greater the number of screens, the greater the variety of movie show times that is likely to be available.

One technical problem that might arise in our estimations is that the error term for one movie theatre might be correlated with that of another movie theatre if these theatres are located close to each other. Such theatres offer very similar products and have substantially overlapping potential markets. As a result, exogenous changes in the market environment not captured by the regressors may well appear in the error terms for the two theatres. In earlier tests, we adopted a method that is standard in the literature by applying a spatial error-correction model. We found no evidence of significant spatial autocorrelation in the error terms. Finally, we include controls for entry and exit during 2000.\footnote{Since data on ticket sales for each theatre are reported for the entire year, we must control for cases in which a theatre was operational for only part of the year. Without imposing undue structure on the estimation, we introduce two interaction variables: *OPEN*{*MONTHS*} and *CLOSE*{*MONTHS*}. The first variable interacts a dummy variable equal to 1 if a theatre experienced an opening event in 2000 with the total number of months of operation in 2000; the second variable is analogous and covers closing events. These two variables control for missing months of revenue data by identifying the events that would lead to a bias towards under-reported revenues.}

### 4.1 Location and Instrumental Variables

In a reduced-form estimation of theatre revenues, with a measure of relative location as an independent variable, the error term might be correlated with the regressor. In particular, unobservable factors that influence optimal theatre location choice might also positively affect the theatre’s revenues. Without further correction, such correlation between the regressor and the error term would introduce endogeneity into the estimation, with biased estimates resulting.
To adjust for potential endogeneity in location choice, we seek an instrument that determines the relative location of each theatre, that is correlated with the distance or theatre count measures, but that is uncorrelated with the unobserved heterogeneity across theatres. We propose that, at the time of location choice, anticipated market size, as measured by population, would increase the desirability of building capacity at a given location. Since other potential entrants might likewise choose to “be where the future demand is,” we would expect the distance measures to decline and the theatre count measure to increase the larger the expected market size. We thus instrument for our agglomeration measures using 1990 population levels within a 10-mile radius of the given theatre as a proxy for expected future market size. While this approach implicitly imposes a static equilibrium outcome in the spatial structure of the market, the instrumentation does give us an approximation of the expectations on which relative location choice might reasonably be based. Further, correcting for location endogeneity allows us to identify the contemporaneous influence of a given spatial market structure on revenue outcomes and thus test for the relative dominance of competition versus agglomeration effects following locational commitment.

To summarize, we use two-stage least squares to estimate theatre revenue as a linear function of spatial, physical, and demographic characteristics, with the correction for location endogeneity noted above. Table 1 presents descriptive statistics for our sample and Table 2 presents the estimation results.

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19 We considered alternative demographic instruments at varying radii and find that 1990 population at the 10-mile radius yields the best fit as documented below.
4.2 Empirical Results.

Our initial finding, presented in Table 2, is that the distance to the closest first-run theatre (DISTANCE1) has a negative and significant impact on revenues.\(^20\) That is, the closer the theatre’s nearest neighbor, the greater is the theatre’s revenues. This result is consistent with the hypothesis that the agglomeration effect dominates relative to the competition effect between a given theatre and its immediate neighbor.\(^21\)

The positive and significant coefficient on SCREENS is partly a function of the correlation between capacity and attendance. Further, it might capture, at least to some extent, the relationship between theatre quality and attendance for two reasons. First, consumers may value increased variety in show time selections. Second, SCREENS is potentially a proxy for superior theatre characteristics such as digital sound and stadium seating.\(^22\)

We include DIGITAL, an indicator variable for the presence of digital sound, and find a positive but statistically insignificant relationship between this theatre attribute and revenues. Digital sound was more widely adopted in 2000 than even two years earlier. Thus, as the innovation became more widespread, the strategic importance of the new technology likely diminished. Analogous results hold when we replace DIGITAL with STADIUM, an indicator variable for the presence of stadium seating.

\(^{20}\) In the first-stage estimation of relative location (DISTANCE1), for Regressions I-III in Table 2, the t-statistic on POP1990MILE10, R-squared values, and F statistics were, respectively: -4.00, 0.32, and 4.89; -4.08, 0.32, and 5.06; -4.19, 0.32, and 5.02. The consistently negative sign on POP1990MILE10 suggests that theatres locate closer to their neighbors (DISTANCE1 declines) as expected market size increases. In addition, 1990 population levels at 3- and 5-mile radii were considered for instruments, yielding qualitatively similar results, with population at a 10-mile radius offering the best fit. Further, 1990 household counts at 3-, 5-, and 10-mile radii were considered for instruments, with qualitatively similar results. The population measure yielded the best overall fit relative to the household counts.

\(^{21}\) Note that this interpretation implicitly treats the relevant market as radial in nature. See Ben-Akiva, De Palma, and Thissee (1989). Davis (op. cit.) also implicitly assumes radial markets for movie theatres.
To consider further the competitive significance of early adoption of digital sound, we constructed a new variable, *DIGITAL COMPARISON*. If the focal theatre offers digital sound and its neighbor does not, the comparison variable equals 1, reflecting a potentially positive competitive advantage from offering a product feature when the nearest competitor does not do the same. If both theatres offer digital sound or if neither offers digital sound, the comparison variable equals 0, reflecting neither a competitive advantage nor disadvantage on sound attribute. And if the focal theatre does not offer digital sound when its nearest neighbor does so, the comparison variable equals -1, capturing the focal theatre’s potential relative competitive disadvantage. When we replace *DIGITAL* with *DIGITAL COMPARISON* in Regression I, we find a positive but statistically insignificant effect. Analogous results hold when we replace *DIGITAL COMPARISON* with *STADIUM COMPARISON*. Thus, by 2000, the competitive advantage from offering new auditorium attributes appears to have perhaps diminished relative to the earlier period of introduction.

Our demographic data allow us to construct a detailed picture of how consumer characteristics, within varying radii of each theatre, influence movie revenues. We first consider the impact of income, using the percentage of the population whose income is above specific thresholds ($35,000, $75,000, and $100,000), at a 5-mile radius from each theatre. Our findings in Table 2 indicate that as the percentage of the population increases in any one of these three income classifications, movie attendance is positively and significantly affected. These results together provide evidence that movie theatre attendance is a normal good throughout the income distribution.

---

*22 Our finding is consistent with Davis’ (2006a) observation that, during the 1993-1997, entry comprised construction of theatres of generally higher quality than existing theatres.*
We next consider the impact of age on movie theatre attendance. As noted previously, we propose a U-shaped relationship between age and movie-theatre attendance, with teens and young adults more likely to attend movies, followed by a drop-off in attendance during prime child-rearing years, with an increase again among older patrons. Our data on demographics allow us to construct age variables that measure the percentage of the population in the 10-to-24, 25-to-39, and 40-plus year age ranges at a 5-mile radius from each theatre. Note that these age classifications combined cover a significant percentage of the population and thus have econometric properties similar to an exhaustive set of dummy variables.\(^23\) Therefore, we choose the 25-to-39 year age group as the omitted group. We find a positive and statistically significant relationship between the percentage of both the 10-to-24 and 40-plus year age groups and revenue.\(^24\) When we include the 25-to-39 year age group in place of the older group, we find a negative effect on revenue, as expected, although the result is statistically insignificant.\(^25\)

4.3 Extended Spatial Analysis.

The results in Table 2 suggest that in our first-run movie exhibition market the agglomeration effect dominates the competition effect(s). To explore the robustness of this finding, we consider two further extensions as proposed above.

\(^{23}\) The mean coverage of the three age classifications combined is 87.53%, with a range of 85.01% to 90.86%.

\(^{24}\) We find positive coefficients on the lower and higher age variables at 3- and 10-mile radii. The effects are statistically significant for Regression I and statistically insignificant for Regressions II and III.

\(^{25}\) We expect differences in theatre attendance to exist across the Boston and South Florida markets. As a first cut, when we run the main regression with no demographic controls, and include a dummy variable for the Boston market, we do find a significant market effect. Given the richness of detail in our data on demographics surrounding each theatre, we propose that better controls for market effects are the more precise demographics used in the present analysis. The high degree of correlation between the Boston market dummy and $\%AGE10TO24YRS$ suggests the potential for overfitting if both variables are included as regressors.
First, we replace \textit{DISTANCE1} with \textit{DISTANCEDIFF12}, which measures the difference between the distance to the closest first-run theatre and the distance to the second-closest first-run theatre. If the proximity of the second-closest theatre to the closest theatre creates a valuable “nest” of theatres, we would expect to see a negative relationship between \textit{DISTANCEDIFF12} and revenues. The closer the two nearest neighboring theatres in a radial market are to one another, the more desirable the group of three theatres becomes. The specific nature of the benefit from the cluster derives from, for example, the consumer facing an increased variety in movie times and/or the option to attend another theatre if one theatre has reached its capacity. Table 3 provides evidence strongly supportive of this hypothesis, with negative and significant coefficients on \textit{DISTANCEDIFF12}.$^{26}$

Second, we follow the approach of Netz and Taylor (2002), replacing the distance measure with the number of first-run theatres within a given radius of the focal theatre. Specifically, in our main regression, we replace \textit{DISTANCE1} with the number of first-run theatres within 5-, 10-, 15-, 20-, 25-, 30-, and 35-mile radii of each theatre. The results are presented in Table 4.$^{27}$

We find that the coefficients on the \textit{THEATRE COUNT} variables are consistently positive and statistically significant, providing further evidence in support of the dominance of the agglomeration effect. That is, for a given radial distance from the focal theatre, we find a positive relationship between the number of theatres of the same type

\hspace{1cm}$^{26}$ We continue to instrument the relative location measure, in this case \textit{DISTANCE DIFFERENCE12}, with 1990 population, within a 10-mile radius of a given theatre, following the earlier rationale. In the first-stage estimation of \textit{DISTANCE DIFFERENCE12}, for Regressions I-III in Table 3, the t-statistic on \textit{POP1990MILE10}. R-squared values, and F statistics are, respectively: -5.40, 0.34, and 5.50; -5.53, 0.34, and 5.52; -5.55, 0.34, and 5.53. The sign on \textit{POP1990MILE10} is consistently negative.

\hspace{1cm}$^{27}$ We use the same instrumentation as for \textit{DISTANCE1} and \textit{DISTANCEDIFF12} and find that the instrument is similarly robust with a consistently positive sign.
and the revenues earned by the focal theatre, once again suggestive of a positive clustering benefit that outweighs any potential negative competition effect.

Equally importantly, we note a steady decline in the estimated \textit{THEATRE COUNT} coefficients at increasing radii from the focal theater. Figure 1 plots the relationship between the coefficient estimates and the radial distance defining the cluster, illustrating that there is a steady decay in the agglomeration effect the more broadly we define the area over which we hypothesize the effect to be operative.\footnote{Our decay finding is consistent with similar findings in other empirical literature on spatial competition as noted in the introduction.}

5. Conclusion

Spatial economic theory suggests that market performance is determined by the interplay between business-stealing and market-share effects; taken together, by competition between activities offering consumers similar services. The new economic geography introduces the further possibility that market performance is determined by an agglomeration effect, with consumers being attracted to locations containing clusters of activities offering consumers similar services.

Using data from two major metropolitan motion-pictures exhibition markets, we find evidence that the benefits from agglomeration are important influences on attendance at movie theatres. Attendance at a theatre is shown to be positively affected by proximity to its nearest neighbor, and by compactness of the cluster of its two nearest neighbors. In addition, theatre revenues are found to be greater the greater the number of theatres within a defined radius of the focal theatre. However, we also find that the benefits from such clusters of economic activities (movie theatres in our application) are
greatest when the cluster is narrowly defined. In other words, the agglomeration effect is important but exhibits significant distance decay.

Our study points to promising avenues for future research. First, our analysis can be extended to wider markets within the motion-pictures industry and to other industries characterized by significant spatial differentiation, including the airline travel industry, the fast-food industry, and hospitality services. Second, our estimations of the determinants of movie theatre attendance can serve as a basis for explicitly modeling location choice. Finally, our results suggest that further study of differentiation within the motion-pictures theatrical market, looking explicitly at film-programming choice by exhibitors, will enhance our understanding of how relative and absolute product attributes influence consumer choice.
Table 1: Descriptive Statistics for All Open First-Run Theatres in 2000 Reporting Revenues to Nielsen E.D.I.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>REVENUE</td>
<td>2.73</td>
<td>2.56</td>
<td>0.02</td>
<td>11.07</td>
</tr>
<tr>
<td>DISTANCE1</td>
<td>3.05</td>
<td>2.35</td>
<td>0.33</td>
<td>12.00</td>
</tr>
<tr>
<td>SCREENS</td>
<td>11.78</td>
<td>5.58</td>
<td>1.00</td>
<td>24.00</td>
</tr>
<tr>
<td>DIGITAL</td>
<td>0.59</td>
<td>0.50</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>STADIUM</td>
<td>0.35</td>
<td>0.48</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>BOSTON</td>
<td>0.43</td>
<td>0.50</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>%INCOME 35,000+</td>
<td>63.52</td>
<td>11.79</td>
<td>28.46</td>
<td>85.59</td>
</tr>
<tr>
<td>%INCOME 75,000+</td>
<td>29.28</td>
<td>12.21</td>
<td>9.41</td>
<td>61.49</td>
</tr>
<tr>
<td>%INCOME 100,000+</td>
<td>17.55</td>
<td>9.34</td>
<td>5.64</td>
<td>47.44</td>
</tr>
<tr>
<td>%AGE10TO24YRS</td>
<td>17.23</td>
<td>3.08</td>
<td>8.06</td>
<td>22.73</td>
</tr>
<tr>
<td>%AGE40+</td>
<td>49.71</td>
<td>6.21</td>
<td>40.87</td>
<td>73.64</td>
</tr>
</tbody>
</table>

Revenue is measured in millions of 2000 dollars. Distances measure the distance to the nearest theatre of the same type (first-run). Digital and stadium are dummy variables equal to 1 if a theatre has an attribute; 0 otherwise. Boston equals 1 if the theatre is in the Boston market and 0 if it is in the South Florida market. Age and income demographics are within a 5-mile radius of each theatre. Total number of theatres is 94.
<table>
<thead>
<tr>
<th>Variable</th>
<th>(I)</th>
<th>(II)</th>
<th>(III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>-33.90</td>
<td>-24.21</td>
<td>-24.34</td>
</tr>
<tr>
<td></td>
<td>(-2.90)***</td>
<td>(-2.07)**</td>
<td>(-2.06)**</td>
</tr>
<tr>
<td>DISTANCE1</td>
<td>-0.525</td>
<td>-0.497</td>
<td>-0.449</td>
</tr>
<tr>
<td></td>
<td>(-2.23)**</td>
<td>(-2.30)**</td>
<td>(-2.19)**</td>
</tr>
<tr>
<td>SCREENS</td>
<td>0.358</td>
<td>0.362</td>
<td>0.359</td>
</tr>
<tr>
<td></td>
<td>(6.45)***</td>
<td>(6.71)***</td>
<td>(6.78)***</td>
</tr>
<tr>
<td>DIGITAL</td>
<td>0.654</td>
<td>0.622</td>
<td>0.620</td>
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<tr>
<td></td>
<td>(1.35)</td>
<td>(1.36)</td>
<td>(1.42)</td>
</tr>
<tr>
<td>%AGE10TO24YRS</td>
<td>0.785</td>
<td>0.559</td>
<td>0.587</td>
</tr>
<tr>
<td></td>
<td>(2.73)***</td>
<td>(1.93)*</td>
<td>(2.03)**</td>
</tr>
<tr>
<td>%AGE40+</td>
<td>0.355</td>
<td>0.253</td>
<td>0.254</td>
</tr>
<tr>
<td></td>
<td>(2.44)**</td>
<td>(1.74)*</td>
<td>(1.74)*</td>
</tr>
<tr>
<td>%INCOME 35,000+</td>
<td>0.041</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.70)*</td>
<td></td>
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<td>%INCOME 75,000+</td>
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<tr>
<td></td>
<td></td>
<td>(2.60)**</td>
<td></td>
</tr>
<tr>
<td>%INCOME 100,000+</td>
<td></td>
<td></td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.53)**</td>
</tr>
<tr>
<td>OPEN*MONTHS</td>
<td>-0.191</td>
<td>-0.178</td>
<td>-0.177</td>
</tr>
<tr>
<td></td>
<td>(-1.66)</td>
<td>(-1.51)</td>
<td>(-1.58)</td>
</tr>
<tr>
<td>CLOSE*MONTHS</td>
<td>-0.046</td>
<td>-0.035</td>
<td>-0.32</td>
</tr>
<tr>
<td></td>
<td>(-0.92)</td>
<td>(-0.67)</td>
<td>(-0.66)</td>
</tr>
<tr>
<td>F-Test for Model</td>
<td>10.75</td>
<td>11.32</td>
<td>11.87</td>
</tr>
</tbody>
</table>

Dependent variable is revenue measured in millions of 2000 dollars. Estimation with robust standard errors. Significance levels *.10, **.05, ***.01; t-values in parentheses. Sample size is 94. Results corrected for endogeneity of distance to nearest first-run theatre; instrument is population in 1990 within 10-mile radius of each theatre. Age and income demographics are within a 5-mile radius of each theatre. Open*months and close*months control for theatres with opening (7) and closing (9) events during 2000, interacted with number of months of operation.
Table 3: Two-Stage Least Squares Estimation of 2000 First-Run Movie Theatre Revenues With Distance Between First and Second Closest Theatre of Same Type

<table>
<thead>
<tr>
<th>Variable</th>
<th>(I)</th>
<th>(II)</th>
<th>(III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>-18.63</td>
<td>-12.89</td>
<td>-13.94</td>
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<td>(-2.08)**</td>
<td>(-1.31)</td>
<td>(-1.44)</td>
</tr>
<tr>
<td>DISTANCEDIFF12</td>
<td>-0.350</td>
<td>-0.329</td>
<td>-0.304</td>
</tr>
<tr>
<td></td>
<td>(-3.02)***</td>
<td>(-3.01)***</td>
<td>(-2.84)***</td>
</tr>
<tr>
<td>SCREENS</td>
<td>0.345</td>
<td>0.346</td>
<td>0.346</td>
</tr>
<tr>
<td></td>
<td>(7.08)***</td>
<td>(7.17)***</td>
<td>(7.16)***</td>
</tr>
<tr>
<td>DIGITAL</td>
<td>0.263</td>
<td>0.278</td>
<td>0.303</td>
</tr>
<tr>
<td></td>
<td>(0.67)</td>
<td>(0.72)</td>
<td>(0.81)</td>
</tr>
<tr>
<td>%AGE10TO24YRS</td>
<td>0.455</td>
<td>0.328</td>
<td>0.370</td>
</tr>
<tr>
<td></td>
<td>(2.01)***</td>
<td>(1.34)</td>
<td>(1.56)</td>
</tr>
<tr>
<td>%AGE40+</td>
<td>0.164</td>
<td>0.108</td>
<td>0.121</td>
</tr>
<tr>
<td></td>
<td>(1.43)</td>
<td>(0.89)</td>
<td>(1.02)</td>
</tr>
<tr>
<td>%INCOME 35,000+</td>
<td>0.034</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.77)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>%INCOME 75,000+</td>
<td></td>
<td>0.044</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.34)**</td>
<td></td>
</tr>
<tr>
<td>%INCOME 100,000+</td>
<td></td>
<td></td>
<td>0.049</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.25)***</td>
</tr>
<tr>
<td>OPEN*MONTHS</td>
<td>-0.141</td>
<td>-0.135</td>
<td>-0.138</td>
</tr>
<tr>
<td></td>
<td>(-2.17)**</td>
<td>(-2.00)**</td>
<td>(-2.06)**</td>
</tr>
<tr>
<td>CLOSE*MONTHS</td>
<td>-0.025</td>
<td>-0.017</td>
<td>-0.016</td>
</tr>
<tr>
<td></td>
<td>(-0.76)</td>
<td>(-0.53)</td>
<td>(-0.54)</td>
</tr>
<tr>
<td>F-Test for Model</td>
<td>16.47</td>
<td>17.70</td>
<td>18.46</td>
</tr>
</tbody>
</table>

Dependent variable is revenue measured in millions of 2000 dollars. Estimation with robust standard errors. Significance levels *, **, ***; t-values in parentheses. Sample size is 94. Results corrected for endogeneity of distance to nearest first-run theatre; instrument is population in 1990 within 10-mile radius of each theatre. Age and income demographics are within a 5-mile radius of each theatre. Open*months and close*months control for theatres with opening (7) and closing (9) events during 2000, interacted with number of months of operation.
Table 4: Two-Stage Least Squares Estimation of 2000 First-Run Movie Theatre Revenues
With Theatre Count of Same Type Within Varying Radii

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>THEATRE COUNT</td>
<td>0.921</td>
<td>0.353</td>
<td>0.201</td>
<td>0.134</td>
<td>0.116</td>
<td>0.104</td>
<td>0.097</td>
</tr>
<tr>
<td>SCREENS</td>
<td>0.350</td>
<td>0.335</td>
<td>0.332</td>
<td>0.335</td>
<td>0.340</td>
<td>0.339</td>
<td>0.341</td>
</tr>
<tr>
<td>DIGITAL</td>
<td>0.758</td>
<td>0.670</td>
<td>0.511</td>
<td>0.529</td>
<td>0.577</td>
<td>0.639</td>
<td>0.621</td>
</tr>
<tr>
<td>AGE10TO24YRS</td>
<td>0.426</td>
<td>0.410</td>
<td>0.399</td>
<td>0.389</td>
<td>0.382</td>
<td>0.387</td>
<td>0.367</td>
</tr>
<tr>
<td>AGE40+</td>
<td>0.177</td>
<td>0.176</td>
<td>0.157</td>
<td>0.161</td>
<td>0.157</td>
<td>0.160</td>
<td>0.148</td>
</tr>
<tr>
<td>INCOME 75,000+</td>
<td>0.046</td>
<td>0.053</td>
<td>0.054</td>
<td>0.050</td>
<td>0.047</td>
<td>0.041</td>
<td>0.041</td>
</tr>
<tr>
<td>OPEN*MONTHS</td>
<td>-0.165</td>
<td>-0.138</td>
<td>-0.112</td>
<td>-0.141</td>
<td>-0.108</td>
<td>-0.131</td>
<td>-0.134</td>
</tr>
<tr>
<td>CLOSE*MONTHS</td>
<td>-0.026</td>
<td>-0.054</td>
<td>-0.016</td>
<td>-0.011</td>
<td>-0.005</td>
<td>0.001</td>
<td>-0.002</td>
</tr>
<tr>
<td>F-Test for Model</td>
<td>12.74</td>
<td>13.47</td>
<td>13.34</td>
<td>14.00</td>
<td>13.83</td>
<td>14.57</td>
<td>14.17</td>
</tr>
</tbody>
</table>

Dependent variable is revenue measured in millions of 2000 dollars. Estimation with robust standard errors. Significance levels *.10, **.05, ***.01: t-values in parentheses. Sample size is 94. Results corrected for endogeneity of number of theatres within the given cluster radius; instrument is population in 1990 within 10-mile radius of each theatre. Age and income demographics are within a 5-mile radius of each theatre. Open*months and close*months control for theatres with opening (7) and closing (9) events during 2000, interacted with number of months of operation.
Figure 1: Coefficients on Number of Theatres within Cluster by Radius
REFERENCES


1. Introduction

There have been considerable advances in spatial economic theory since the seminal work of Hotelling (1929), culminating in the emergence of a “new economic geography”\(^1\). Until recently, however, as Borenstein and Netz noted in their 1999 paper: “The (spatial) theory literature … has developed without the benefit of virtually any empirical investigation” (1999, p. 612).

Much has changed in the past decade, with the publication of a series of empirical analyses of spatial competition. This paper is one such investigation. Specifically, we use data drawn from two major metropolitan markets to analyze the spatial determinants of attendance at movie theatres in the U.S. first-run theatrical exhibition market.

Our study makes an important contribution to the empirical evidence on the significance of spatial factors in consumer choice. Specifically, we show that when the spatial and other characteristics of competing products, in our case movie theatres, are carefully measured, attendance at a given theatre is significantly and positively affected by the extent to which the theatre is part of an agglomeration of competing theatres. We further find that this result is robust to a number of alternative measures of relative distance between competing movie theatres.

These findings are consistent with the more general spatial competition phenomenon, characteristic of the new economic geography, that equilibrium outcomes are determined by a complex trade-off. First, an activity may wish to locate close to its competitors in order to attract the competitors’ consumers – what can be termed, as in Davis (2006a), a *business-stealing effect*, or a *market-share effect*. This lies at the heart

\(^1\) The new economic geography is very ably synthesized in Fujita, Krugman and Venables (1999). See also Fujita and Thisse (2002).
of the seminal Hotelling (1929) analysis: competing duopolists are drawn together as they compete for the middle ground. Second, proximity might lead to intense price competition, giving an incentive to locate further from rivals to soften competition – the *market-power effect.*

The business-stealing and market-power effects implicitly assume that overall market size is given, an assumption that is characteristic of the majority of the post-Hotelling theoretical work. There is, however, a third effect that is central to economic geography but relatively neglected in the empirical literature on spatial competition. Competing activities that are more agglomerated may gain by creating an economic cluster that attracts consumers – what can be termed an *agglomeration effect.* Fujita *et al* (1999), for example, argue that the reason we find an agglomeration of secondhand booksellers in one region in London is that they want “(t)o be near each other” to give them access to “a large pool of potential customers” (p. 1). Kalnins (2006) suggests that “retail and service firms may purposely locate together because of agglomeration benefits” (p. 209).

There is no way, *a priori,* to tell which of these effects is dominant but there are at least two conditions that are likely to lead to the agglomeration effect being the strongest. First, if firms do not compete significantly on price, a feature of the movie exhibition market identified in Orbach and Einav (2007), we would expect to find both the business-stealing and market-power effects to be more muted. Second, in the simple Hotelling model, introducing additional firms and additional dimensions significantly weakens the

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2 See Pinski and Slade (1998) and Netz and Taylor (2002). Borenstein and Netz (*op. cit.*) refer to these two effects respectively as an “attraction” and “repulsion” effect.
business-stealing and market-power effects – moving closer to (further from) one rival typically involves moving further from (closer to) other rivals. Both conditions characterize the motion-pictures exhibition market.  

As we have noted, there has been a considerable flowering in empirical analyses of spatial competition in the past decade. Borenstein and Netz (1999) use a spatial analogy to look at the impact of deregulation on the scheduling of airline departure times. While their results are mixed, they find some evidence that increased competition reduces departure time differentiation. Salvanes, Steen and Sorgard (2005) find similar clustering of departure times in Norway post-deregulation. Netz and Taylor (2002) analyze spatial competition in the retail gasoline market. They conclude that price competition in this market “is sufficiently strong to induce firms to spatially differentiate” (p. 162). Specifically, they find that spatial differentiation by retail gasoline stations is positively affected by competition, defined as the number of competing gasoline stations within a specified market area. They further find that this effect tends to be weaker when they use a broader definition of the market area.

Pinkse, Slade and Brett (2002) develop a semiparametric technique to investigate whether spatial competition is local or global. They apply this technique to analyze price competition in the U.S. wholesale gasoline market, concluding that in this market at least competition is “highly localized” (p. 1144).

Smith (2004) analyzes competition between supermarket chains in the United Kingdom, a sector in which the leading four firms have considerable market power. He

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3 An extended discussion of these opposing effects is developed in Fujita and Thisse (2002). Tirole (1988, p. 286) refers to agglomeration as a desire to “be where the demand is,” implicit in which is the possibility that agglomeration might generate additional demand.
shows that further consolidation is likely to lead to significantly increased prices, while de-merger would have the opposite effect. Kalnins (2003, 2004) and Kalnins and Lafontaine (2004) analyze spatial competition in the lodging and fast-food sectors, looking both at price competition and location choices of franchised outlets. They show that there is a significant difference in the nature of spatial competition between franchised and company-owned outlets. Kalnins (2004), for example, finds that the approval of additional franchise outlets typically cannibalizes incumbents’ revenues, whereas establishing additional company-owned outlets is associated with an increase in incumbents’ revenues. This would appear to imply that the location decisions and the incentives to locate new outlets are significantly affected by ownership structure.

In two related papers, Peter Davis examines spatial aspects of the U.S. motion-pictures exhibition market and their relationship to entry, exit, and consumer demand. Davis (2006a) considers theatre entry patterns during the 1993-1997 period, and measures the impact of entry on the performance of same-owned and competing incumbent theatres. He finds evidence of both within-chain and across-chain business stealing, demonstrating that the latter effect is stronger, and that both effects are localized to within a 15-mile radial market. Further, he finds that entry by new (and typically high-quality) theatres has a significant market-expansion effect as measured by revenues. Davis (2006b) estimates movie-theatre demand assuming consumer heterogeneity, with both spatial and product-characteristic differentiation, using the generalized method of

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4 Firms may, however, seek locations that are, on average, more distant from or closer to their rivals: Netz and Taylor (2002).
moments (GMM). He finds additional evidence of, at most, a 15-mile geographic market boundary.

Our analysis is firmly within this developing empirical literature on spatial competition. We focus on identifying the presence and significance of contemporaneous attraction, repulsion, and agglomeration effects between and among movie theatres within the same markets and of the same type. That is, we group theatres by type classifications, specifically focusing on first-run theatres. Our analysis differs from the majority of the work cited above in two important respects. First, as we noted, price competition is all but absent in the first-run movie exhibition market. Second, we take the locations of the competing outlets – in our case movie theatres – as given. Our specific focus is on identifying empirically the relationship between the agglomeration of first-run movie theatres and market performance, controlling for physical product characteristics and relevant demographics. We identify specific hypotheses and predictions for the dominance of agglomeration versus competitive effects. We find strong evidence of an agglomeration effect on attendance, and further identify a pattern of spatial decay in its economic significance at increasing radial distances from focal theatres.

The remainder of the paper is organized as follows. Section 2 motivates the consumer-choice framework for movie-theatre attendance. Section 3 describes the data.

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5 For other approaches to the determinants of consumers’ demand for movies see, for example, Reinstein and Snyder (2005) and De Vany and Walls (2004).
6 Our data set excludes arthouse theatres that likely appear in the EDI data used in Davis (2006a). Details on the data and type classifications follow in Sections 3 and 4.
7 As we make clear in the empirical analysis, however, we need to instrument our measures of agglomeration to correct for possible endogeneity in the observed locations.
Section 4 presents the empirical implementation and results. Concluding remarks are presented in the final section.

2. Consumer Choice and Movie Attendance.

We begin with the primitive that a consumer chooses to view a particular movie. If movie theatres offer similar programming choices, then this primitive will be transformed into a choice of where to view the movie, that is, into the choice of which movie theatre to attend. We expect that the selection of which theatre to attend will in turn depend upon the location of one theatre relative to its nearest competitors, and on the physical attributes of the theatres.

The validity of our approach rests, of course, on the assumption that movie offerings are sufficiently similar across theatres. This is much more likely to be the case in the first-run movie exhibition market, as a result of which we focus our analysis on first-run theatres. In other work, Chisholm, McMillan, and Norman (2006) show that the average degree of programming similarity between first-run theatre pairs in a subset of our sample (in a close but different time period) is in excess of 80%. Thus, once a consumer chooses a particular movie to see, if the film is showing at one first-run theatre, the consumer will likely find it playing at other competing first-run theatres, lending support to the reasonableness of treating the consumer’s decision as one of choosing which theatre to attend.

2.1 Business-Stealing, Market-Power and Agglomeration Effects.

While we take the location decisions of the individual movie theatres as given, we can still draw on developments in location theory and economic geography to analyze

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8 We classify theatres into three groupings: first-run (excluding arthouse theatres); arthouse; and second-run or discount. The present paper focuses on first-run theatres only.
how consumers make decisions among the competing theatres. As noted in the introduction, the literature suggests the importance of three effects.

First, firms locate close to their immediate competitors in order to steal business from their rivals – the *business-stealing effect*. Second, firms have an incentive to distance themselves from their rivals in order to soften competition between them – the *market-power effect*. These two effects can be viewed as opposite sides of the same coin, referring to how firms compete for shares of a given market, thus together capturing a *competition effect*. The third effect is the *agglomeration effect*. Firms that are located reasonably close to each other create a desirable cluster of products that attracts consumers. This is one reason why we often find that “restaurants, movie theatres, or shops selling similar products are clustered within the same neighborhood” (Fujita and Thisse, 2002, p. 2). The main aim of this paper is to determine whether or not the data on movie attendance offers empirical support for the hypothesis that attendance at individual movie theatres, as measured by theatre revenues, is influenced by these effects.9

A particularly effective theoretical method for capturing the impact of these effects on theatre revenues is to use the two-stage nested process developed by Ben-Akiva (1973). Assume that the population of potential consumers can be partitioned into $J$ subsets according to some potentially observable demographic variables that influence their decision of whether to consume the product, in our application, attend a movie theatre: age, income and education are obvious candidates. Second, for consumers of a particular type, assume that their choice set (the set of movie theatres among which they are choosing) is one of $L$ subsets of the full set $M$ of products on offer (the full set of

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9 Given the relative uniformity and stability of price at first-run theatres, we treat revenue as a close approximation for attendance. See Section 2.2 for details on the price data.
theatres), determined by particular characteristics of these products: proximity to each other and theatre type are obvious characteristics on which we focus.

An individual consumer is assumed to follow a two-stage process. First, she chooses the subset from which she will consume (the set of theatres she is considering attending) with a probability determined by the attractiveness of the subset to her. She then chooses a particular alternative (theatre) from within that subset with a probability determined by the utility offered by that alternative relative to those of its competitors within the subset.

In both stages it is assumed that choice is based on a multinomial logit model. Suppose that a consumer of type $j$ has chosen subset $M_l$ in the first stage and that the utility she obtains from attending movie theatre $m$ in subset $M_l$ is:

$$\tilde{U}_{jm} = u_{jm} + \varepsilon_{jm} \quad (m \in M_l)$$

(1)

where the $\varepsilon_{jm}$ are i.i.d., following a double exponential distribution with mean zero and variance $\mu_2^2 \pi^2 / 6$. Then the probability that she will attend movie theatre $m$ in $M_l$ in the second stage is

$$p_{r_{M_l}}(m) = \frac{\exp(u_{jm} / \mu_2)}{\sum_{h \in M_l} \exp(u_{jh} / \mu_2)} \quad (j \in J)$$

(2)

where $\mu_2$ is a positive constant.

The choice of subset $M_l$ in the first stage is determined by the utility offered by that subset as compared to its competing subsets. Ben-Akiva (1973) suggests that the appropriate evaluation is the expected value of the maximum of the utilities $\tilde{U}_{jm}$:

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10 See Anderson, de Palma and Thisse (1992, p. 40) for a more extensive discussion.
\[ S_t = \mu_2 \ln \sum_{h \in M_l} \exp(u_{jh}/\mu_2) \]  

(3)

It follows that the probability of choosing the subset \( M_l \) from \( M \) is

\[ pr_{M_l}(M_l) = \frac{\exp(S_l/\mu_1)}{\sum_{k=1}^{L} \exp(S_k/\mu_1)} \]  

(4)

where \( \mu_1 \) is a positive constant. Putting (2) and (4) together, we have that the probability of consumer of type \( j \) attending movie theatre \( m \in M_l \in M \) is

\[ pr_j(m) = pr_{M_l}(M_l) \cdot pr_{M_l}'(m) = \frac{\exp(S_l/\mu_1)}{\sum_{k=1}^{L} \exp(S_k/\mu_1)} \frac{\exp(u_{jm}/\mu_2)}{\sum_{h \in M_l} \exp(u_{jh}/\mu_2)} \]  

(5)

If there are \( N_j \) consumers of type \( j \) expected attendance at movie theatre \( m \) is:

\[ \tilde{X}_m = \sum_{j \in J} N_j pr_j(m) \]  

(6)

and this movie's expected revenues are \( p_m \tilde{X}_m \).

In (5) the agglomeration effect is captured by the first term, essentially by the attractiveness of a particular subset of theatres as a group, since \( \partial pr_{M_l}(M_l)/\partial S_l > 0 \). The interplay between business-stealing and market-power effects is captured by the second term, the relative attractiveness of a particular movie theatre within the relevant subset, since \( \partial pr_{M_l}'(m)/\partial u_{jm} > 0 \). It is important to note that, while the impact of each of these effects on attendance at a particular movie theatre is unambiguous, their relative magnitude is not. Even if a product in subset \( M_l \) faces strong competition from other products in that subset, it might still have greater attendance and so revenues than a similar product in subset \( M_i \) if the latter subset is sufficiently less attractive than \( M_l \).

We can further refine this analysis if we assume that consumers behave according to a linear random utility model. Take a particular subset \( M_l \) and consumer type \( j \).
Assume that the characteristic distinguishing consumer types is income and that consumers of type $j$ have real income $y_j$. Further assume that the conditional indirect utility that a consumer of type $j$ obtains from attending movie theatre $m \in M_l$ is:

$$\bar{V}^j_m = y_j - p_m + a_{jm} + \epsilon_{jm} \quad (j \in J; m \in M_l)$$

(7)

where the $a_{jm}$ provide observable indices of the attractiveness of theatre $m \in M_l$ to consumers of type $j$. Anderson et al. (op. cit.) show that we can recover the utility functions $u_{jm}$ from these indirect utility functions. With respect to expected attendance, (7) then implies that we can replace the terms $u_{jh}$ in equations (2), (3) and (5) with the terms $a_{jh} - p_h$. If price is not a strategic variable, as is the case in our application, consumer choice between products in a particular group is determined by the relative characteristics of the competing products (movie theatres).

This analysis suggests that we estimate a model of the following form:

$$ATTEND_i = \beta_0 + \beta_1 AGG_i + \beta_2 ATTS_i + \beta_3 RELATTS_i + \beta_4 DEMOG_i + \epsilon_i$$

(8)

In (8) for each theatre $i$, $ATTEND$ is a measure of attendance, $AGG$ is a measure of agglomeration, $ATTS$ measures the theatre’s attributes, while $RELATTS$ measures its attributes relative to its nearest neighbor, and $DEMOG$ measures demographic characteristics of the population within a defined radius of the theatre.

An obvious measure of both the competition and the agglomeration effect generated by a particular group of movie theatres is the group’s geographic extent. The more spread out they are, the less attractive they are as a group. “Geographical clustering … (is) a particular means by which firms can facilitate consumer search” increasing the probability that the consumer will find “a good match” (Fujita and Thisse, 2002, p. 243). On the other hand, the more spread out they are the less competition they offer to each
other. The direct implication is that the sign of $\beta_1$ will give us an indication of the relative strength of competition and agglomeration effects.

2.2 Price Competition in Theatrical Exhibition.

A complete study of factors influencing consumer choice should address the role of price in influencing consumers’ decisions. Further, price plays a particularly significant role in the spatial competition models that have been developed since Hotelling (1929). The implication is that if price competition is an important factor in the motion-pictures exhibition market, we might expect that theatres distant from their neighbors would charge higher prices than their co-located counterparts, taking advantage of their relatively isolated position in the market.

In the motion-pictures exhibition market, however, there is little variation in price across theatres and price remains remarkably stable over time. For example, the average ticket prices for first-run theatres in Boston and South Florida, the markets in our data set, are $8.19 and $7.55, respectively, with an overall average ticket price of $7.84 and standard deviation of $0.92, giving a coefficient of variation in price of only 11.7%.\footnote{For the price variable, we use individual theatre price for an adult ticket on Friday evening in 2002 prices, due to the stability of prices between 2000 and 2002, and due to the availability of price data.}

Price stability in this industry can be difficult to explain using the usual models of price competition. In addition to the expectation that isolated theatres should charge higher prices than their co-located counterparts, standard demand analysis would suggest that movie theatres should charge different prices for different films, based on film popularity and critics’ reviews. However, theatres commonly charge the same price, irrespective of the films being shown (the present data set and industry practice support
this claim). Orbach and Einav (2007) provide a detailed analysis of the use of uniform pricing in movie theatres. In our empirical implementation we take price as given.

3. Data Description

The authors commissioned a market study of two major metropolitan markets: Boston and South Florida. Synergy Retail Group, a retail real estate market research services firm located in Boca Raton, Florida, collected the data used in the analysis. One of Synergy’s areas of expertise is creating detailed maps of retail markets based on precise longitude and latitude data for outlet locations. In addition to theatre location data, Synergy provided extensive demographic data within 3-, 5-, and 10-mile radii of each theatre, in each of the two markets, based on Census data reports prepared by Equifax National Decision Systems. For each market, Synergy computed the distance from each theatre to the first-, second-, and third-closest theatre of the same type (i.e., first-run, second-run, or arthouse) and of any type, for the period 1996 through 2000.

Further, Synergy provided data on the total annual revenue generated by each theatre, in each market, when available, from Nielsen EDI, an entertainment data collection firm. Synergy determined each theatre’s type and features (e.g., stadium seating, digital sound) by reviewing advertisements for theatres and, when necessary, by contacting theatres directly. Theatre openings and closings, along with significant theatre renovations and ownership changes during the 1996 through 2000 period, were also documented. The present analysis is limited to the year 2000, since data on theatre features and type could best be confirmed and verified for that year. In addition, we limit our empirical analysis to first-run theatres only, excluding arthouse theatres, to control for, and take advantage of, the relatively high average degree of similarity in film
programming between first-run theatre pairs as documented in Chisholm et al. (2006). In other words, we limit our study to theatres of similar type and offering similar films, thus allowing us to focus on the influence on market performance of differentiation in relative location, theatre attributes, and proximate demographics.

The specific boundaries of Boston and South Florida markets were established by Census Metropolitan and Surrounding Area (MSA) classifications. The estimated 2000 population of the Boston MSA was 5,927,382, with 2,269,608 households, and an average household income of $69,836. The population of the South Florida region was 4,726,491, with 1,841,057 households, and an average household income of $57,658. The South Florida region comprises the Fort Lauderdale, Miami, and West Palm Beach-Boca Raton MSAs. The Boston and South Florida markets were selected because of their similar population and household sizes, but regional demographic differences.

The two markets were also chosen because of similarities in their motion-pictures exhibition market characteristics. By the end of 2000, the Boston and South Florida markets comprised 63 and 67 movie theatres, respectively. In 2000, attendance per screen in Boston and South Florida was 40,754, and 38,063, respectively. Both Boston and South Florida movie exhibitors had committed significant capital to auditorium seating enhancements: by 2000, 36.7% of Boston screens and 53.9% of South Florida screens offered stadium seating.

4. Empirical Analysis

To estimate attendance at movie theatres, we use a straightforward reduced-form, cross-sectional linear specification based on equation (8) above, with revenues, as

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12 This market study was supported by a research grant from the DeSantis Center.
measured by annual boxoffice revenues in 2000, as our dependent variable. Since capacity decisions, especially the locations of movie theatres and screen capacity, are typically made over a longer time horizon than one year, we think that it is reasonable to treat such characteristics as exogenous in a cross-sectional analysis of annual attendance, provided that we use appropriate instrumentation for the initial location choice, with additional controls for any opening and closing events during the year under study. While this approach has some limitations, it nevertheless provides valuable evidence focused specifically on potential spatial competition and agglomeration effects.

We propose that attendance, and thus revenue, at movie theatre $i$ is determined by: a theatre’s spatial market characteristics, which capture the potential competition and agglomeration effects described above; demographic characteristics of the market surrounding the theatre; and the theatre’s physical characteristics, such as digital sound and stadium seating.

We test three measures of agglomeration for each theatre: (i) the distance from the theatre to its nearest neighbor, $DISTANCE_1$; (ii) the difference between distance to the nearest neighbor and to the second-nearest neighbor, $DISTANCE_{DIFF1_2}$; and (iii) the number of theatres within a defined radius $R$ of the theatre, $THEATRE\ COUNT$. Measures (i) and (ii) are inverse measures of agglomeration while (iii) is a direct measure. If the competition (agglomeration) effect dominates we would expect $\beta_1$ to be positive (negative) in specifications (i) and (ii) and negative (positive) in specification

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13 An ideal additional revenue variable would measure revenue from concession sales. Such data are not available, although we expect the ratio of concession sales to ticket sales to be relatively stable across theatres.

14 We use the percentage of individuals with income levels over $35,000, $75,000, and $100,000, within a 5-mile radius of each theatre, to measure consumer ability and willingness to pay to attend movies, with income measures based on 2001 Census estimates.
(iii). Specification (iii) also allows us to test for a distance decay effect. The more broadly we define the market (the greater is R) the weaker the agglomeration effect should be.

Given the industry hypothesis that movie-going is a normal good, attendance should increase with income in the vicinity of a given theatre. We also anticipate a U-shaped relationship between age and attendance. Younger consumers are more likely to go out to movies, as are older consumers; consumers falling between these two groups are likely to be limited by the relatively more binding constraints on time and finances from career-building and child-rearing and thus be less likely to attend movies.16

We expect that physical attributes of each theatre, such as stadium seating and digital sound, will also influence attendance, but precisely how is not clear-cut. On the one hand, these features might increase attendance overall by improving the quality of the movie-going experience. On the other hand, they might affect attendance at a particular theatre because of that theatre’s superior characteristics relative to its competitors.17

We include the number of screens at a theatre (SCREENS) in our estimation to control for the direct effect of capacity on attendance: the greater the capacity, the greater the attendance potential. The ideal measure for theatre capacity would be the number of seats at a theatre. For the first-run theatres in our data set with known capacity (total number of seats), the average number of seats per screen is 210, with a standard deviation of 21, giving a coefficient of variation of 0.10, with the number of screens per theatre ranging from 4 to 24. Given the small degree of variation in seats per screen

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15 The third measure is the one suggested by Netz and Taylor (2002): see also Davis (2006a and b).
16 We are grateful to an anonymous referee for suggesting this point.
17 A valuable extension of this study, with more detailed data on theatre attributes, would model the dynamic process of technology adoption at movie theatres during the late 1990s, following Seim (2006).
across a wide range of screen counts, we argue that SCREENS is a reasonable proxy for theatre capacity. The number of screens at a given theatre may also provide an indication of product quality: the greater the number of screens, the greater the variety of movie show times that is likely to be available.

One technical problem that might arise in our estimations is that the error term for one movie theatre might be correlated with that of another movie theatre if these theatres are located close to each other. Such theatres offer very similar products and have substantially overlapping potential markets. As a result, exogenous changes in the market environment not captured by the regressors may well appear in the error terms for the two theatres. In earlier tests, we adopted a method that is standard in the literature by applying a spatial error-correction model. We found no evidence of significant spatial autocorrelation in the error terms. Finally, we include controls for entry and exit during 2000.18

4.1 Location and Instrumental Variables

In a reduced-form estimation of theatre revenues, with a measure of relative location as an independent variable, the error term might be correlated with the regressor. In particular, unobservable factors that influence optimal theatre location choice might also positively affect the theatre’s revenues. Without further correction, such correlation between the regressor and the error term would introduce endogeneity into the estimation, with biased estimates resulting.

18 Since data on ticket sales for each theatre are reported for the entire year, we must control for cases in which a theatre was operational for only part of the year. Without imposing undue structure on the estimation, we introduce two interaction variables: OPEN*MONTHS and CLOSE*MONTHS. The first variable interacts a dummy variable equal to 1 if a theatre experienced an opening event in 2000 with the total number of months of operation in 2000; the second variable is analogous and covers closing events. These two variables control for missing months of revenue data by identifying the events that would lead to a bias towards under-reported revenues.
To adjust for potential endogeneity in location choice, we seek an instrument that determines the relative location of each theatre, that is correlated with the distance or theatre count measures, but that is uncorrelated with the unobserved heterogeneity across theatres. We propose that, at the time of location choice, anticipated market size, as measured by population, would increase the desirability of building capacity at a given location. Since other potential entrants might likewise choose to “be where the future demand is,” we would expect the distance measures to decline and the theatre count measure to increase the larger the expected market size. We thus instrument for our agglomeration measures using 1990 population levels within a 10-mile radius of the given theatre as a proxy for expected future market size. While this approach implicitly imposes a static equilibrium outcome in the spatial structure of the market, the instrumentation does give us an approximation of the expectations on which relative location choice might reasonably be based. Further, correcting for location endogeneity allows us to identify the contemporaneous influence of a given spatial market structure on revenue outcomes and thus test for the relative dominance of competition versus agglomeration effects following locational commitment.

To summarize, we use two-stage least squares to estimate theatre revenue as a linear function of spatial, physical, and demographic characteristics, with the correction for location endogeneity noted above. Table 1 presents descriptive statistics for our sample and Table 2 presents the estimation results.

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19 We considered alternative demographic instruments at varying radii and find that 1990 population at the 10-mile radius yields the best fit as documented below.
4.2 Empirical Results.

Our initial finding, presented in Table 2, is that the distance to the closest first-run theatre (DISTANCE1) has a negative and significant impact on revenues. That is, the closer the theatre’s nearest neighbor, the greater is the theatre’s revenues. This result is consistent with the hypothesis that the agglomeration effect dominates relative to the competition effect between a given theatre and its immediate neighbor.

The positive and significant coefficient on SCREENS is partly a function of the correlation between capacity and attendance. Further, it might capture, at least to some extent, the relationship between theatre quality and attendance for two reasons. First, consumers may value increased variety in show time selections. Second, SCREENS is potentially a proxy for superior theatre characteristics such as digital sound and stadium seating.

We include DIGITAL, an indicator variable for the presence of digital sound, and find a positive but statistically insignificant relationship between this theatre attribute and revenues. Digital sound was more widely adopted in 2000 than even two years earlier. Thus, as the innovation became more widespread, the strategic importance of the new technology likely diminished. Analogous results hold when we replace DIGITAL with STADIUM, an indicator variable for the presence of stadium seating.

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20 In the first-stage estimation of relative location (DISTANCE1), for Regressions I-III in Table 2, the t-statistic on POP1990MILE10, R-squared values, and F statistics were, respectively: -4.00, 0.32, and 4.89; -4.08, 0.32, and 5.06; -4.19, 0.32, and 5.02. The consistently negative sign on POP1990MILE10 suggests that theatres locate closer to their neighbors (DISTANCE1 declines) as expected market size increases. In addition, 1990 population levels at 3- and 5-mile radii were considered for instruments, yielding qualitatively similar results, with population at a 10-mile radius offering the best fit. Further, 1990 household counts at 3-, 5-, and 10-mile radii were considered for instruments, with qualitatively similar results. The population measure yielded the best overall fit relative to the household counts.

21 Note that this interpretation implicitly treats the relevant market as radial in nature. See Ben-Akiva, De Palma, and Thisse (1989). Davis (op. cit.) also implicitly assumes radial markets for movie theatres.
To consider further the competitive significance of early adoption of digital sound, we constructed a new variable, \textit{DIGITAL COMPARISON}. If the focal theatre offers digital sound and its neighbor does not, the comparison variable equals 1, reflecting a potentially positive competitive advantage from offering a product feature when the nearest competitor does not do the same. If both theatres offer digital sound or if neither offers digital sound, the comparison variable equals 0, reflecting neither a competitive advantage nor disadvantage on sound attribute. And if the focal theatre does not offer digital sound when its nearest neighbor does so, the comparison variable equals -1, capturing the focal theatre’s potential relative competitive disadvantage. When we replace \textit{DIGITAL} with \textit{DIGITAL COMPARISON} in Regression I, we find a positive but statistically insignificant effect. Analogous results hold when we replace \textit{DIGITAL COMPARISON} with \textit{STADIUM COMPARISON}. Thus, by 2000, the competitive advantage from offering new auditorium attributes appears to have perhaps diminished relative to the earlier period of introduction.

Our demographic data allow us to construct a detailed picture of how consumer characteristics, within varying radii of each theatre, influence movie revenues. We first consider the impact of income, using the percentage of the population whose income is above specific thresholds ($35,000, $75,000, and $100,000), at a 5-mile radius from each theatre. Our findings in Table 2 indicate that as the percentage of the population increases in any one of these three income classifications, movie attendance is positively and significantly affected. These results together provide evidence that movie theatre attendance is a normal good throughout the income distribution.

\footnote{Our finding is consistent with Davis’ (2006a) observation that, during the 1993-1997, entry comprised construction of theatres of generally higher quality than existing theatres.}
We next consider the impact of age on movie theatre attendance. As noted previously, we propose a U-shaped relationship between age and movie-theatre attendance, with teens and young adults more likely to attend movies, followed by a drop-off in attendance during prime child-rearing years, with an increase again among older patrons. Our data on demographics allow us to construct age variables that measure the percentage of the population in the 10-to-24, 25-to-39, and 40-plus year age ranges at a 5-mile radius from each theatre. Note that these age classifications combined cover a significant percentage of the population and thus have econometric properties similar to an exhaustive set of dummy variables.\(^{23}\) Therefore, we choose the 25-to-39 year age group as the omitted group. We find a positive and statistically significant relationship between the percentage of both the 10-to-24 and 40-plus year age groups and revenue.\(^{24}\) When we include the 25-to-39 year age group in place of the older group, we find a negative effect on revenue, as expected, although the result is statistically insignificant.\(^{25}\)

4.3 Extended Spatial Analysis.

The results in Table 2 suggest that in our first-run movie exhibition market the agglomeration effect dominates the competition effect(s). To explore the robustness of this finding, we consider two further extensions as proposed above.

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\(^{23}\) The mean coverage of the three age classifications combined is 87.53%, with a range of 85.01% to 90.86%.

\(^{24}\) We find positive coefficients on the lower and higher age variables at 3- and 10-mile radii. The effects are statistically significant for Regression I and statistically insignificant for Regressions II and III.

\(^{25}\) We expect differences in theatre attendance to exist across the Boston and South Florida markets. As a first cut, when we run the main regression with no demographic controls, and include a dummy variable for the Boston market, we do find a significant market effect. Given the richness of detail in our data on demographics surrounding each theatre, we propose that better controls for market effects are the more precise demographics used in the present analysis. The high degree of correlation between the Boston market dummy and \(\%AGE10TO24YRS\) suggests the potential for overfitting if both variables are included as regressors.
First, we replace \textit{DISTANCE1} with \textit{DISTANCEDIFF12}, which measures the difference between the distance to the closest first-run theatre and the distance to the second-closest first-run theatre. If the proximity of the second-closest theatre to the closest theatre creates a valuable “nest” of theatres, we would expect to see a negative relationship between \textit{DISTANCEDIFF12} and revenues. The closer the two nearest neighboring theatres in a radial market are to one another, the more desirable the group of three theatres becomes. The specific nature of the benefit from the cluster derives from, for example, the consumer facing an increased variety in movie times and/or the option to attend another theatre if one theatre has reached its capacity. Table 3 provides evidence strongly supportive of this hypothesis, with negative and significant coefficients on \textit{DISTANCEDIFF12}.\textsuperscript{26}

Second, we follow the approach of Netz and Taylor (2002), replacing the distance measure with the number of first-run theatres within a given radius of the focal theatre. Specifically, in our main regression, we replace \textit{DISTANCE1} with the number of first-run theatres within 5-, 10-, 15-, 20-, 25-, 30-, and 35-mile radii of each theatre. The results are presented in Table 4.\textsuperscript{27}

We find that the coefficients on the \textit{THEATRE COUNT} variables are consistently positive and statistically significant, providing further evidence in support of the dominance of the agglomeration effect. That is, for a given radial distance from the focal theatre, we find a positive relationship between the number of theatres of the same type

\textsuperscript{26} We continue to instrument the relative location measure, in this case \textit{DISTANCE DIFFERENCE12}, with 1990 population, within a 10-mile radius of a given theatre, following the earlier rationale. In the first-stage estimation of \textit{DISTANCE DIFFERENCE12}, for Regressions I-III in Table 3, the t-statistic on \textit{POP1990MILE10}, R-squared values, and F statistics are, respectively: -5.40, 0.34, and 5.50; -5.53, 0.34, and 5.52; -5.55, 0.34, and 5.53. The sign on \textit{POP1990MILE10} is consistently negative.

\textsuperscript{27} We use the same instrumentation as for \textit{DISTANCE1} and \textit{DISTANCEDIFF12} and find that the instrument is similarly robust with a consistently positive sign.
and the revenues earned by the focal theatre, once again suggestive of a positive clustering benefit that outweighs any potential negative competition effect.

Equally importantly, we note a steady decline in the estimated THEATRE COUNT coefficients at increasing radii from the focal theater. Figure 1 plots the relationship between the coefficient estimates and the radial distance defining the cluster, illustrating that there is a steady decay in the agglomeration effect the more broadly we define the area over which we hypothesize the effect to be operative.28

5. Conclusion

Spatial economic theory suggests that market performance is determined by the interplay between business-stealing and market-share effects; taken together, by competition between activities offering consumers similar services. The new economic geography introduces the further possibility that market performance is determined by an agglomeration effect, with consumers being attracted to locations containing clusters of activities offering consumers similar services.

Using data from two major metropolitan motion-pictures exhibition markets, we find evidence that the benefits from agglomeration are important influences on attendance at movie theatres. Attendance at a theatre is shown to be positively affected by proximity to its nearest neighbor, and by compactness of the cluster of its two nearest neighbors. In addition, theatre revenues are found to be greater the greater the number of theatres within a defined radius of the focal theatre. However, we also find that the benefits from such clusters of economic activities (movie theatres in our application) are

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28 Our decay finding is consistent with similar findings in other empirical literature on spatial competition as noted in the introduction.
greatest when the cluster is narrowly defined. In other words, the agglomeration effect is important but exhibits significant distance decay.

Our study points to promising avenues for future research. First, our analysis can be extended to wider markets within the motion-pictures industry and to other industries characterized by significant spatial differentiation, including the airline travel industry, the fast-food industry, and hospitality services. Second, our estimations of the determinants of movie theatre attendance can serve as a basis for explicitly modeling location choice. Finally, our results suggest that further study of differentiation within the motion-pictures theatrical market, looking explicitly at film-programming choice by exhibitors, will enhance our understanding of how relative and absolute product attributes influence consumer choice.
Table 1: Descriptive Statistics for All Open First-Run Theatres in 2000 Reporting Revenues to Nielsen E.D.I.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>REVENUE</td>
<td>2.73</td>
<td>2.56</td>
<td>0.02</td>
<td>11.07</td>
</tr>
<tr>
<td>DISTANCE1</td>
<td>3.05</td>
<td>2.35</td>
<td>0.33</td>
<td>12.00</td>
</tr>
<tr>
<td>SCREENS</td>
<td>11.78</td>
<td>5.58</td>
<td>1.00</td>
<td>24.00</td>
</tr>
<tr>
<td>DIGITAL</td>
<td>0.59</td>
<td>0.50</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>STADIUM</td>
<td>0.35</td>
<td>0.48</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>BOSTON</td>
<td>0.43</td>
<td>0.50</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>%INCOME 35,000+</td>
<td>63.52</td>
<td>11.79</td>
<td>28.46</td>
<td>85.59</td>
</tr>
<tr>
<td>%INCOME 75,000+</td>
<td>29.28</td>
<td>12.21</td>
<td>9.41</td>
<td>61.49</td>
</tr>
<tr>
<td>%INCOME 100,000+</td>
<td>17.55</td>
<td>9.34</td>
<td>5.64</td>
<td>47.44</td>
</tr>
<tr>
<td>%AGE10TO24YRS</td>
<td>17.23</td>
<td>3.08</td>
<td>8.06</td>
<td>22.73</td>
</tr>
<tr>
<td>%AGE40+</td>
<td>49.71</td>
<td>6.21</td>
<td>40.87</td>
<td>73.64</td>
</tr>
</tbody>
</table>

Revenue is measured in millions of 2000 dollars. Distances measure the distance to the nearest theatre of the same type (first-run). Digital and stadium are dummy variables equal to 1 if a theatre has an attribute; 0 otherwise. Boston equals 1 if the theatre is in the Boston market and 0 if it is in the South Florida market. Age and income demographics are within a 5-mile radius of each theatre. Total number of theatres is 94.
Table 2: Two-Stage Least Squares Estimation of 2000 First-Run Movie Theatre Revenues
Distance Based on Closest Theatre of Same Type

<table>
<thead>
<tr>
<th>Variable</th>
<th>(I)</th>
<th>(II)</th>
<th>(III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>-33.90</td>
<td>-24.21</td>
<td>-24.34</td>
</tr>
<tr>
<td></td>
<td>(-2.90)***</td>
<td>(-2.07)**</td>
<td>(-2.06)**</td>
</tr>
<tr>
<td>DISTANCE1</td>
<td>-0.525</td>
<td>-0.497</td>
<td>-0.449</td>
</tr>
<tr>
<td></td>
<td>(-2.23)**</td>
<td>(-2.30)**</td>
<td>(-2.19)**</td>
</tr>
<tr>
<td>SCREENS</td>
<td>0.358</td>
<td>0.362</td>
<td>0.359</td>
</tr>
<tr>
<td></td>
<td>(6.45)***</td>
<td>(6.71)***</td>
<td>(6.78)***</td>
</tr>
<tr>
<td>DIGITAL</td>
<td>0.654</td>
<td>0.622</td>
<td>0.620</td>
</tr>
<tr>
<td></td>
<td>(1.35)</td>
<td>(1.36)</td>
<td>(1.42)</td>
</tr>
<tr>
<td>%AGE10TO24YRS</td>
<td>0.785</td>
<td>0.559</td>
<td>0.587</td>
</tr>
<tr>
<td></td>
<td>(2.73)***</td>
<td>(1.93)*</td>
<td>(2.03)**</td>
</tr>
<tr>
<td>%AGE40+</td>
<td>0.355</td>
<td>0.253</td>
<td>0.254</td>
</tr>
<tr>
<td></td>
<td>(2.44)**</td>
<td>(1.74)*</td>
<td>(1.74)*</td>
</tr>
<tr>
<td>%INCOME 35,000+</td>
<td>0.041</td>
<td>0.059</td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td>(1.70)*</td>
<td></td>
<td>(2.53)**</td>
</tr>
<tr>
<td>%INCOME 75,000+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%INCOME 100,000+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPEN*MONTHS</td>
<td>-0.191</td>
<td>-0.178</td>
<td>-0.177</td>
</tr>
<tr>
<td></td>
<td>(-1.66)</td>
<td>(-1.51)</td>
<td>(-1.58)</td>
</tr>
<tr>
<td>CLOSE*MONTHS</td>
<td>-0.046</td>
<td>-0.035</td>
<td>-0.32</td>
</tr>
<tr>
<td></td>
<td>(-0.92)</td>
<td>(-0.67)</td>
<td>(-0.66)</td>
</tr>
<tr>
<td>F-Test for Model</td>
<td>10.75</td>
<td>11.32</td>
<td>11.87</td>
</tr>
</tbody>
</table>

Dependent variable is revenue measured in millions of 2000 dollars. Estimation with robust standard errors. Significance levels * .10, ** .05, *** .01; t-values in parentheses. Sample size is 94. Results corrected for endogeneity of distance to nearest first-run theatre; instrument is population in 1990 within 10-mile radius of each theatre. Age and income demographics are within a 5-mile radius of each theatre. Open*months and close*months control for theatres with opening (7) and closing (9) events during 2000, interacted with number of months of operation.
Table 3: Two-Stage Least Squares Estimation of 2000 First-Run Movie Theatre Revenues With Distance Between First and Second Closest Theatre of Same Type

<table>
<thead>
<tr>
<th>Variable</th>
<th>(I)</th>
<th>(II)</th>
<th>(III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>-18.63</td>
<td>-12.89</td>
<td>-13.94</td>
</tr>
<tr>
<td></td>
<td>(-2.08)**</td>
<td>(-1.31)</td>
<td>(-1.44)</td>
</tr>
<tr>
<td>DISTANCEDIFF12</td>
<td>-0.350</td>
<td>-0.329</td>
<td>-0.304</td>
</tr>
<tr>
<td></td>
<td>(-3.02)***</td>
<td>(-3.01)***</td>
<td>(-2.84)***</td>
</tr>
<tr>
<td>SCREENS</td>
<td>0.345</td>
<td>0.346</td>
<td>0.346</td>
</tr>
<tr>
<td></td>
<td>(7.08)***</td>
<td>(7.17)***</td>
<td>(7.16)***</td>
</tr>
<tr>
<td>DIGITAL</td>
<td>0.263</td>
<td>0.278</td>
<td>0.303</td>
</tr>
<tr>
<td></td>
<td>(0.67)</td>
<td>(0.72)</td>
<td>(0.81)</td>
</tr>
<tr>
<td>%AGE10TO24YRS</td>
<td>0.455</td>
<td>0.328</td>
<td>0.370</td>
</tr>
<tr>
<td></td>
<td>(2.01)**</td>
<td>(1.34)</td>
<td>(1.56)</td>
</tr>
<tr>
<td>%AGE40+</td>
<td>0.164</td>
<td>0.108</td>
<td>0.121</td>
</tr>
<tr>
<td></td>
<td>(1.43)</td>
<td>(0.89)</td>
<td>(1.02)</td>
</tr>
<tr>
<td>%INCOME 35,000+</td>
<td>0.034</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.77)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>%INCOME 75,000+</td>
<td></td>
<td>0.044</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.34)**</td>
<td></td>
</tr>
<tr>
<td>%INCOME 100,000+</td>
<td></td>
<td></td>
<td>0.049</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.25)**</td>
</tr>
<tr>
<td>OPEN*MONTHS</td>
<td>-0.141</td>
<td>-0.135</td>
<td>-0.138</td>
</tr>
<tr>
<td></td>
<td>(-2.17)**</td>
<td>(-2.00)***</td>
<td>(-2.06)***</td>
</tr>
<tr>
<td>CLOSE*MONTHS</td>
<td>-0.025</td>
<td>-0.017</td>
<td>-0.016</td>
</tr>
<tr>
<td></td>
<td>(-0.76)</td>
<td>(-0.53)</td>
<td>(-0.54)</td>
</tr>
<tr>
<td>F-Test for Model</td>
<td>16.47</td>
<td>17.70</td>
<td>18.46</td>
</tr>
</tbody>
</table>

Dependent variable is revenue measured in millions of 2000 dollars. Estimation with robust standard errors. Significance levels *.10, **.05, ***.01; t-values in parentheses. Sample size is 94. Results corrected for endogeneity of distance to nearest first-run theatre; instrument is population in 1990 within 10-mile radius of each theatre. Age and income demographics are within a 5-mile radius of each theatre. Open*months and close*months control for theatres with opening (7) and closing (9) events during 2000, interacted with number of months of operation.
Table 4: Two-Stage Least Squares Estimation of 2000 First-Run Movie Theatre Revenues
With Theatre Count of Same Type Within Varying Radii

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>-20.29 (-1.87)*</td>
<td>-20.12 (-1.97)*</td>
<td>-19.08 (-1.97)*</td>
<td>-18.97 (-1.89)*</td>
<td>-18.94 (-1.98)*</td>
<td>-19.18 (-1.94)*</td>
<td>-18.47 (0.97)*</td>
</tr>
<tr>
<td>THEATRE COUNT</td>
<td>0.921 (2.56)**</td>
<td>0.353 (2.82)**</td>
<td>0.201 (3.02)**</td>
<td>0.134 (2.95)**</td>
<td>0.116 (3.02)**</td>
<td>0.104 (3.06)**</td>
<td>0.097 (3.04)**</td>
</tr>
<tr>
<td>SCREENS</td>
<td>0.350 (7.10)**</td>
<td>0.335 (6.88)**</td>
<td>0.332 (6.71)**</td>
<td>0.335 (6.70)**</td>
<td>0.340 (6.83)**</td>
<td>0.339 (6.77)**</td>
<td>0.341 (6.77)**</td>
</tr>
<tr>
<td>DIGITAL</td>
<td>0.758 (1.76)*</td>
<td>0.670 (1.84)*</td>
<td>0.511 (1.45)</td>
<td>0.529 (1.54)</td>
<td>0.577 (1.72)*</td>
<td>0.639 (1.66)</td>
<td>0.621 (1.66)</td>
</tr>
<tr>
<td>%AGE10TO24YRS</td>
<td>0.426 (1.56)</td>
<td>0.410 (1.64)</td>
<td>0.399 (1.68)*</td>
<td>0.389 (1.64)</td>
<td>0.382 (1.61)</td>
<td>0.387 (1.55)</td>
<td>0.367 (1.55)</td>
</tr>
<tr>
<td>%AGE40+</td>
<td>0.177 (1.33)</td>
<td>0.176 (1.41)</td>
<td>0.157 (1.33)</td>
<td>0.161 (1.36)</td>
<td>0.157 (1.29)</td>
<td>0.160 (1.27)</td>
<td>0.148 (1.27)</td>
</tr>
<tr>
<td>%INCOME 75,000+</td>
<td>0.046 (2.19)**</td>
<td>0.053 (2.66)**</td>
<td>0.054 (2.75)**</td>
<td>0.050 (2.66)**</td>
<td>0.047 (2.46)**</td>
<td>0.041 (2.19)**</td>
<td>0.041 (2.24)**</td>
</tr>
<tr>
<td>OPEN*MONTHS</td>
<td>-0.165 (-1.29)</td>
<td>-0.138 (-1.48)</td>
<td>-0.112 (-1.78)*</td>
<td>-0.141 (-1.88)</td>
<td>-0.108 (-1.95)*</td>
<td>-0.131 (-1.95)*</td>
<td>-0.134 (0.97)</td>
</tr>
<tr>
<td>CLOSE*MONTHS</td>
<td>-0.026 (-0.45)</td>
<td>-0.054 (-0.39)</td>
<td>-0.016 (-0.29)</td>
<td>-0.011 (0.02)</td>
<td>-0.005 (0.04)</td>
<td>0.001 (0.04)</td>
<td>-0.002 (0.04)</td>
</tr>
</tbody>
</table>

F-Test for Model       | 12.74 13.47 13.34 14.00 13.83 14.57 14.17

Dependent variable is revenue measured in millions of 2000 dollars. Estimation with robust standard errors. Significance levels *.10, **.05, ***.01; t-values in parentheses. Sample size is 94. Results corrected for endogeneity of number of theatres within the given cluster radius; instrument is population in 1990 within 10-mile radius of each theatre. Age and income demographics are within a 5-mile radius of each theatre. Open*months and close*months control for theatres with opening (7) and closing (9) events during 2000, interacted with number of months of operation.
Figure 1: Coefficients on Number of Theatres within Cluster by Radius
REFERENCES


