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Löschian Spatial Competition in an Emerging Retail Industry

Löschian competition is traditionally thought to lead to a spatial equilibrium in which firms enter an industry and disperse across geographic space until each firm earns insufficient excess profit to attract net new entrants. This paper assesses the appropriateness of Löschian analysis using video (movie) rental establishments in Toronto as a case example. The video rental business, as we know it today, began to take shape around 1980 and has since seen much turnover. The paper describes the changing pattern of single-site and chain stores between 1982 and 1999. I use logistic regression to predict the survival of existing establishments. Using survivorship as a proxy for profit, the paper draws conclusions about the extent to which temporal changes in video store location correspond to the tenets of Löschian competition. The coexistence of chain and single-site stores suggests that there are distinct market niches and that single-site stores have used a "swarming" strategy to compete against chains. Conclusions are drawn about how the retail sector might evolve in the future because of the locational competition between chains and single-site stores.

In an industry characterized by a homogenous product, consumers spread uniformly across space, economies of scale, costless relocation, perfect information, nonzero transportation costs, and a finite range, the standard model of Löschian spatial competition predicts a spatial equilibrium of firms. For simplicity of exposition, suppose that consumers make single-purpose, home-based trips to firms to purchase at f.o.b. prices and that that they do not purchase from firms located outside the region. Imagine initially that there are few incumbents, widely dispersed across the region, with no overlaps in geographic market area (defined by the range of the good) among them. Further, suppose that incumbents are identical; each charges the same f.o.b. price and earns the same positive excess profit. Suppose further that these excess profits attract identical new entrants to the industry within the region. Because excess profit is a Ricardian rent that is site-based, the new firm wants to stay away from its competitors. However, as the total number of firms in the industry in the region increases, new firms eventually must choose locations that have market areas that overlap those of existent firms hence eroding profits for both. Löschian models vary in their assumptions about how a firm expects competitors to respond to its

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choice of f.o.b. price. Nonetheless, all Löschian models postulate that, in equilibrium, firms stop entering the industry when excess profits become nearly zero. In a simple version of the Löschian model, excess profit is monotonically related to the number of customers within range and closer to that firm than to any other. If the number of customers is large, the firm can earn at least normal profits. If not, the firm will, in the long run, quit the industry. In Löschian equilibrium, locational competition shrinks the number of customers and the market area for each firm down to the same (normal profit) level. Löschian models also suggest that the f.o.b. price charged by each firm declines as the density of firms (that is, the total number of firms within the geographic region) increases. However, this simple description of Löschian equilibrium ignores at least two essential considerations.[1]

• In reality, consumers typically are not spread evenly across the geographic region. This has implications for Löschian equilibrium. For one, firms need not all have a market area of the same geographic size. More important, firms need not have the same f.o.b. price; firms in sparsely populated areas may have higher f.o.b. prices than firms in populous areas. In the simple model envisaged here, monopoly advantage arises to a firm only because of transportation cost. The more firms cluster together, the less the monopoly advantage. At the same time, clustering increases the firm's sensitivity to price competition. In a sparsely populated area, the competitor who lowers price may gain customers only at the fringe of your market area; for the rest of your market area, transportation costs are too high to make the competitor's price attractive. However, in a densely populated area, the competitor who lowers price may easily undercut you everywhere in your market. Therefore, in this respect, a risk-averse firm might be drawn to a sparsely populated area while the risk-lover is drawn to densely populated areas.[2]

• Enterprises can and do compete by opening chains of stores. Chains make it possible to realize network and scale economies: a chain can advertise more efficiently, purchase in bulk, and attract customers who like its network structure and bandwagon image. Further, these network and scale economies may well imply that perhaps only one chain will ultimately survive. In this case, a simple strategy is to be the first to form a chain that saturates the market. With chains, a distinction can be drawn between strategic (network) and current (site) profitability. In the standard Löschian model, each firm occupies a single site, and hence its strategy is to maximize current (site) profitability. With a chain, however, sites that are unprofitable currently may well become profitable once the chain is complete, and competitors are driven out. Hence, to a chain, a site on its own can be unprofitable currently, and yet be strategically important.

These two considerations are connected. At first glance, Löschian competition would seem to describe the single-site firm better than the chain. After all, survival of the single-site firm depends on the demand within its market area. Chains may not value each store independently in the same way as the single-site firm.[3] However, at the same time, chains in some industries appear to space their store sites at regular intervals across the region, say, every four kilometers. In doing so, they "look" like Löschian competitors locating each store so as to avoid overlapping market areas with

1. Also ignored is the way in which stores can vary the quality of their services: for example, hours of service, convenient parking or helpful staff. Betancourt and Malanoski (1999) illustrate how such measures of store quality can be incorporated into an estimable model of store demand.

2. A classic example here is the retail banking industry. While capital markets are increasingly thought to be national if not international in scope, consumers still do appear to have a preference for banking locally and banks compete by varying interest rates to attract local depositors. Evidence presented by Berger and Hannan (1989) suggest that U.S. metropolitan areas with more bank competition (that is, less concentration in the industry) have higher interest rates on money market savings accounts.

3. Thill (1997) and Chu and Lu (1998) discuss the multistore location problem in a simple spatial setting.

their other stores. Oddly though, such a strategy appears to ignore variations in the density of consumers across the region. In such an industry, single-site stores, in contrast, would appear to "swarm": proliferating at sites where the density of demand is high. Such swarming may well be consistent with Löschian competition. Further, where it is advantageous for single-site stores to swarm, but where chain stores either cannot or do not, a market niche opens up to the single-site stores.

The purpose of this paper is to look at retail competition in a case study of an emerging retail industry: the video (movie) rental business between 1982 and 1999. An empirical model is estimated to explain survivorship (here assumed to proxy profitability) of stores from one year to the next. The model is then used to predict survivorship (profitability) at potential new locations and these are then compared with survivorship at sites actually chosen by the firms. The video rental industry is well suited for study using a standard Löschian analysis. The commodity tends be standardized consumable: typically a "recent release" movie, but also including classic and foreign language films as well as adult, children's, and other specialty videos. Second, the rental price is typically f.o.b., and similarly low from site to site. Third, transportation cost tends to be high relative to f.o.b. rental price, largely because each rental involves two trips (pick-up and return) to the rental shop. The video rental business is thus susceptible to the spatial monopoly profit that is at the heart of the Löschian model. Fourth, while market data are scarce, video rentals appear to appeal to a broad range of consumers, singles and families, modest income as well and more affluent. Hence, demand is relatively simple to model.[4]

THE VIDEO RENTAL INDUSTRY: A BRIEF HISTORY

The video rental business got underway in North America during the late 1970s. Two new product innovations had recently appeared. The first was the modern home-oriented video cassette recorder (VCR), first introduced by Sony in Beta format in 1975 (eventually withdrawn from production in 1988), then by JVC in VHS format in 1976.[5] Cusumano, Mylonadis, and Rosenbloom (1992, p. 54) report that the annual output of VCRs in Japan reached 1 million units by 1978, 13 million units by 1982, and 44 million by 1985. In North America, market penetration increased dramatically through the 1980s. Klopfenstein (1989, p. 25) estimates that 65 percent of American households had a VCR at the outset of 1989, compared with just 3 percent at the outset of 1982. Canadian households show a similar trend but lagged a couple of years. The second product innovation was the videodisc player; it was first introduced by Philips and MCA in Discovision format in 1978, then by RCA in Selectavision (CED) format in 1981 (discontinued in 1984), later by Pioneer and others in LD format (Marlow and Secunda 1991, pp. 115–16). By the end of the 1990s, the newly introduced DVD player and disc were poised to take over much of the market.

The usage of home VCRs has changed dramatically since they were first introduced. Lindstrom (1989) argues that this reflects changes in the mix of VCR owners. Early VCR purchasers were mainly heavy television watchers, who used their VCRs to record television programs for later viewing (time shifting). As well, some purchasers used their VCRs to make or display home movies. However, Lindstrom argues that for VCR sales to penetrate a broader market, they had to appeal to households that were not heavy television watchers. Hence, as prerecorded movies

4. In a related study, Lindsey, Hohenbalken, and West (1991) assume that consumer demand for video rentals varies with price, but then assume that every consumer has the same demand curve: that is, demand does not vary with income or other household characteristics.

5. Cusumano, Mylonadis, and Rosenbloom (1992, p. 65) report that Philips continued to use its own formats in Europe (at first the N-1500 format, later the V-2000) for a decade more, but that this never seriously challenged the other two.

and other videos became more widely available in the 1980s, a third main purpose emerged: to play prerecorded tapes.

Movie videos in VHS and Beta formats began to appear in 1976. This represented a major change for Hollywood which largely had retained ownership of films and merely licensed exhibitors (movie theaters) to show them (Lardner 1987, pp. 169–86). In 1977, Magnetic Video, initially using only movies licensed from Twentieth Century Fox, became the first firm to sell videocassette copies of major motion pictures to retail stores and to consumers directly. The market here was collectors who were thought to be willing to pay $50 to $100 per movie for their home. Magnetic Video asserted that their cassettes were for home viewing only, and threatened to cut off supplies to retail stores that rented movies.

As these cassettes became available however, retailers quickly spotted the potential for video rentals. Lardner (1987, pp. 175–76) argues that what slowed development was that the early video rental operators did not know whether renting was even legal. In addition, movie producers had to be convinced that renting was a profitable complement to sales. The video rental club and buyback plan were two schemes invented to circumvent the question of legality. Eventually, however, the legal right of stores to rent movies was established (in the United States, this was clarified under the "First Sale Doctrine" of the Copyright Act), and movie producers came to realize the revenue possible from sales to such stores.

Contemporary distribution of first-rate movies is commonly argued to conform to "price tiering"; see Waterman (1985, pp. 231–33) and Cahill (1988, p. 157). Although practice may vary from one film to the next, in the first tier (more correctly, the first stage in a sequence), the new movie is usually released to best customers in first-run movie theatres at highest prices (in rare circumstances, the movie may also be re-released). Subsequently, the movie may be released in second-rank movie houses to customers who pay somewhat less. In the next tier, the movie is released on videocassette and disc for sale (and, indirectly, rental at a still-lower per-view price). In the remainder of this sequence, the move is released to pay-per-view, pay-cable, airline syndication, and broadcast television. Proceeding down the sequence, the revenue per viewer declines, and the sequencing of such releases facilitates price discrimination among tiers of customers. Tiering is important when we think about the competition in video rentals because video stores compete not only with each other but also with suppliers in other tiers.

There has been much experimentation with the delivery of rental video. One early experiment, Cartrivision, even predated the introduction of VCRs. Cartrivision consisted of a nonrewindable videotape that the user rented for one view only. In 1976, Time-Life introduced cassette rentals via direct-mail distribution, just one example of this approach to video retailing. Another early approach was the video equipment retailer who maintained a stock of rental movies as a technique for selling video equipment. As VCR ownership became widespread, mass merchandising chains began to have a video sales and rental department. As well, rack jobbers got into the business installing video concessions and rental video vending machines in gas stations, convenience stores, and restaurants (Cahill 1988, p. 133). Some early retailers even offered telephone ordering and free home delivery and pickup. Another approach to retailing is the chain of video stores. Last, but not least, is the independent retail shop that sells or rents video movies; some may also have an adjunct function (ranging from sales of audiotapes to dry cleaning). In the last few years, there has been experimentation with new methods of delivering movie viewings to consumers; these include video-on-demand and DIVX by which the customer gets a one-view-only movie that can be played when and as it suits the customer's schedule.

By the early 1980s, the video rental industry had begun to assume the form that still largely characterizes it today. Video rentals are widely seen, in the industry, as an impulse, rather than a preplanned, purchase. The prominent display of video dust jackets, the variety of movies offered, and ease of access by customers are designed to feed that impulse. While theatrically released movies make up much of the video rental business, other video material (for example, movies made for television or otherwise not released to theatres, pornography, exercise videos, documentary videos, music videos, and how-to videos) are a growing sector. Video retailing operations range in scale from the video rack or vending machine, to the small video shop of about 100 square meters, often a single-site firm, to the video superstores (typically 400 square meters or more) commonly operated by chains.

Typically, the video retailer purchases one or more VHS/DVD copies of a title, collects revenue from consumers who then view it, and eventually re-sells the copy in the used video market. A major part of their business for many video retailers is the rental of recent-release hit-movie videos. Typically, demand is strong for a movie newly released to video but ebbs quickly. Profit depends critically on the ability of the store owner/manager to anticipate the scale and duration of demand for that movie. From the point of view of the chains, success in establishing themselves as the store of choice for video shoppers means market power with which to wrest lower prices from movie distributors. From the point of view of the studio that produces the movie, the production of VHS/DVD copies for the rental market is costly, time consuming, and difficult logistically. Ideally, to maximize sales in this tier of movie distribution, the studio would prefer a low-cost way of releasing the movie instantly to every home that wants to view it. Perhaps this will in time lead to widespread use of the Internet to deliver video on demand. At the same time, the video store remains a useful source of information (from visual clues to helpful clerks to the style of customer to the remarks of other patrons overheard) that helps consumers decide whether to rent a particular video.

THE TORONTO VIDEO STORE SAMPLE

The most recent census (1996) enumerated about 2.3 million persons in the new City of Toronto (before 1998, this was known as the Municipality of Metropolitan Toronto). See Figure 1. As early as the 1970s, new suburban development had become concentrated primarily outside the city in municipalities such as Mississauga, Vaughan, Richmond Hill, Markham, and Pickering. By the early 1980s, city land had been largely built-up. Therefore, from the outset of the period under study here (1982 through 1999), neighborhoods within the city were largely mature with new residential developments taking the forms mainly of infilling, intensification, and redevelopment.

As is true of much of the retail sector, information about video rental shops is difficult to obtain. Operation of any retail outlet in the province of Ontario requires a retail sales tax license, and usually entails either incorporation or registration of a business name. However, such sources of information do not indicate much about the nature of the retail enterprise, and video rentals stores cannot be separately identified here. Instead, this study makes use of printed Yellow Pages business telephone listings.[6] To the extent that video stores rely on phone inquiries as one source of new business, shop owners have an incentive to ensure that they are listed in the Yellow Pages and that address, name, and phone number are correct. An annual volume of

6. Mulho and Waterson (1989) use the Yellow Pages to study supermarket store locations across Great Britain. Buss, Lin, and Popovich (1991) compare the use of Yellow Pages to other sources (for example, Dun and Bradstreet records) and finds each has its own biases and shortcomings. Mixon (1995) discusses the strategies employed by firms in deciding when and how to advertise within the Yellow Pages. Bresnahan and Reiss (1991) also use phone listings to enumerate retail establishments.

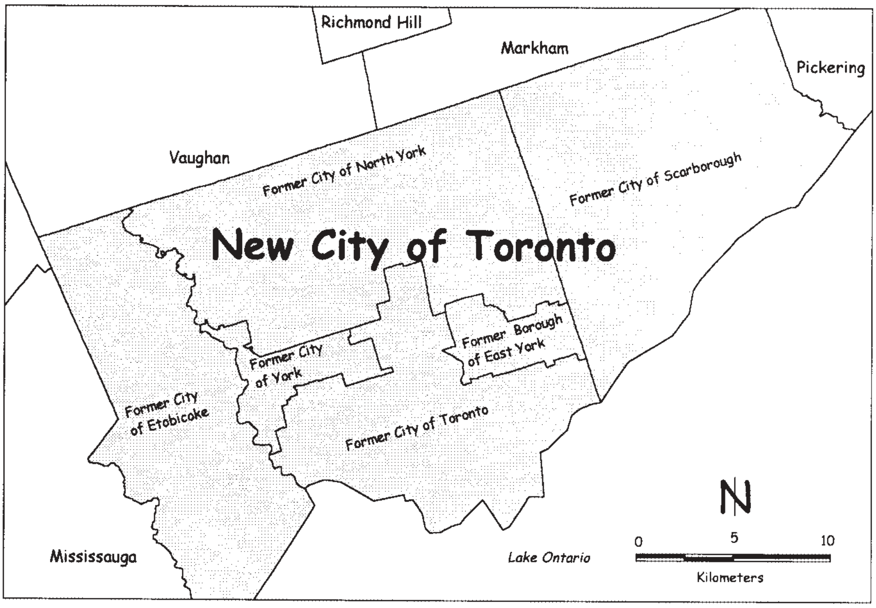

FIG. 1. The New City of Toronto and Its Environs, 2000

Yellow Pages (hereinafter YP) is published for each part of Toronto (one volume each for the communities of Etobicoke, North York, and Scarborough, plus one, later two, volume(s) that covered the former City of Toronto plus the communities of York and East York. As is common in YPs for other jurisdictions across North America, the volumes contain a basic line listing (name, address, and phone number) and optional bolding and advertising (either a supplementary lines attached to the listing or a nearby box insert containing text, and possibly graphics). In 1982, I found video rental shops listed in only one category, "Video disc and tape equipment and supplies." In subsequent years, video store listings were sometimes found also in a second category.

In this study, I assembled video store listings into 1,591 "histories."[7] A history is a unique name and address combination that appears in Toronto YPs in only one year, or in a sequence of two or more consecutive years.[8] Let $y_{it} = 1$ if the store in history i is present in year t at that site, and 0 otherwise. For example, history 212 is Startime Video at 2600 Eglinton Avenue East, telephone (416) 261-8656; this establishment appears only in the 1983 YP and 1984 YP. A history is initiated each time a new listing appears. Each establishment in a chain of video stores has its own history or histories.[9] In assembling histories, I garner information from both the store listings and optional advertising. I identify chain stores from their common name.[10] A "chain" here means any set of two or more stores sharing the same name in a given year.

7. This is a relatively large sample. In contrast, the sample in Lindsey, Von Hohenbalken, and West (1991) contains just 109 stores.

8. In rare cases where an establishment is missing in one volume of YP but reappears the following year with the same name, address, and phone number, its existence is imputed for the year in question.

9. Lerman and Liu (1984) distinguish between chain sites that are headquarters and those that are branch locations. This makes sense since they study employment at each store. Given our focus on the store as a place of purchase (not a place of employment), such a distinction is unnecessary.

10. I ignore differences in name that reflect only a different kind of store (for example, "Star Video" and "Star Video Superstore"). Stores that franchise a name, as in "Video 99" but operate under their own name are included in the chain.

While nearly all stores are included in the establishment listings, some video chains identify store locations only in optional advertising box inserts.

The Toronto video store sample omits some forms of video rental operations. Notably, it excludes video vending machine locations because these do not have telephone numbers. Also, the sample excludes small video concessions in stores primarily serving another purpose (for example, variety stores, gas stations) unless these specifically have a YP listing under a video retailing category shown in Table 1. The number of such instances is unknown. Also excluded are stores that do not list an address; this was the case for two businesses (active briefly during the early years of the study period) that offered free pickup and delivery of movies and did not list a business address.[11]

In the Toronto video store sample, histories are linked. If a business changes either its name or address between two consecutive YPs, but keeps the same telephone number, it becomes a new history in the sample, but at the same time is linked to the old history.[12] For example, Markville Video at 2600 Eglinton Avenue East, phone 261-8656 (history 211), was listed in a 1982 YP so this history is linked forward to history 212 (Startime Video) mentioned above: $f_{211} = 212$ and $b_{212} = 211$. This permits us to distinguish between stores that disappear and those that change address or name (hereinafter "move").[13] A history (store i) is said to "die" if the history terminates without linking to a new history: that is, $f_i = 0$. Correspondingly, store i is said to be born (after 1982 only) if there is no antecedent link: that is, $b_i = 0$. In the illustration above, Startime Video itself was linked forward (because of the telephone number in common) to history 213, Scarborough Videosquare (at 2639 Eglinton Avenue East), which itself survived only one year (1985). These three linked histories are represented in the Toronto video store sample as follows:

History(i)	y_{i82}	y_{i83}	y_{i84}	y_{i85}	y_{i86}	y_{i87}	y_{i88}	y_{i89}	y_{i90}	y_{i91}	y_{i92}	y_{i93}	y_{i94}	y_{i95}	y_{i96}	y_{i97}	y_{i98}	y_{i99}	f_i	b_i
211	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	212	0
212	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	214	211
214	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	212

In constructing this sample, two categories of errors of inclusion are possible. First, a sample generated from the Toronto YPs will include stores outside Toronto (for example, in Mississauga, Vaughan, Markham, and Pickering) that advertise in Toronto area YPs. In other cases, video stores are specialized (for example, in Italian or Cantonese movies), and thus may draw customers from outside the city. In this study, only stores and populations that are within the new City of Toronto are considered. Second, the sample may well include stores not involved in movie rentals at all. The relevant YP categories include firms that we do not want to consider here, for example, video hardware (VCRs, videodisc players, TVs) sales, repair, and rental; videotape and videodisc production, importing, and sales; production and sales of educational, promotional, and training videotapes. Where the optional advertising makes it clear that a store is not in the movie rental business, it is excluded from our sample. Less frequently, we may also be able to discern from its name that a store is not in the movie rental business (for example, names that include the words "electronics," "audio," or "stereo"); I exclude such stores from the sample.

11. In their study, Lindsey, Von Hohenbalken, and West (1991) also exclude video concessions within convenience stores. In addition, however, that study excludes any store that (1) had fewer than 375 video titles, (2) did not allow customers to reserve videos, or (3) placed restrictions ((for example, prior purchase of a VCR from the store). In the present study, such restrictions are neither possible nor well justified.

12. In the Toronto video store sample, there was one exception to this rule: a chain operator who used the same phone number for all branch sites.

13. In some cases, a store that moves may be accidentally be listed at both the old and new site in the YP. These are easy to spot because they share the same phone number and the old site disappears from the YP in the following year. In such cases, I assume that the history for the old site terminated the previous year.

TABLE 1
Video Stores by Transition Status Showing Number of Stores, Toronto, Canada, 1982–1999

	Surviving from previous year				Not surviving from previous year		Store births this year		Stores listed in Yellow Pages
	Nonmovers		Movers						
	Number	percent	Number	percent	Number	percent	Number	percent	Number
1982									117
1983	85	73	6	5	26	22	125	107	216
1984	166	77	11	5	39	18	77	36	254
1985	192	76	13	5	49	19	59	23	264
1986	200	76	15	6	49	19	82	31	297
1987	234	79	12	4	51	17	60	20	306
1988	248	81	15	5	43	14	74	24	337
1989	247	73	31	9	59	18	65	19	343
1990	252	73	26	8	65	19	78	23	356
1991	291	82	15	4	50	14	81	23	387
1992	297	77	17	4	73	19	83	21	397
1993	311	78	17	4	69	17	73	18	401
1994	313	78	14	3	74	18	63	16	390
1995	298	76	20	5	72	18	65	17	383
1996	289	75	13	3	81	21	56	15	358
1997	249	70	34	9	75	21	67	19	350
1998	292	83	13	4	45	13	41	12	346
1999	324	94	10	3	12	3	43	12	377

NOTES: Survivors includes all stores from the previous year that also appear in this year's Yellow Pages. Nonmovers are firms that have the same name and address as last year. Movers include firms that have changed address or name since last year. Births include all stores in this year's Yellow Pages that were not listed in previous year. Percent shows count as percentage of previous year's total number of stores. "—" indicates data not available.
SOURCE: Toronto video store sample: calculations by the author.

To complement store location data, this kind of study also needs information on the geography of consumers. Starting with the 1961 Census, Statistics Canada has provided quinquennial counts of private households by Enumeration Areas (EAs) across Canada. Traditionally, the enumeration area is the finest geographic scale for published census data. Since 1971, Statistics Canada has also published quinquennially a "Geography Tape" that gives geographic coordinates for each Enumeration Area (EA) centroid. The Enumeration Area—akin to a block group in the U.S. Census—is the geographic area assigned to one census representative (enumerator) and contains typically 200 to 300 dwellings. In this study, I use the number of private households counted at EA centroids near a store to proxy customer demand. From the UTM coordinates of the store, I calculate straight-line distances (not route mileage) to each centroid, and then to assign centroids (that is, entire EAs) to the stores within a prescribed radius.[14]

In the Toronto video store sample, I geocode sites using street addresses listed in the YP volumes. Statistics Canada published a 1991 Street Network File (SNF) for the new City of Toronto. In the SNF, streets are partitioned into segments, a segment being the section between two intersections, or an intersection and a cul-de-sac. Each segment is represented by a polyline thought to trace out the centerline of the street. Attached to each segment is the address range to the left and to the right. UTM coordinates for the store are then interpolated from the relevant address range, and an arbitrary assumption is made about the store's setback from the street centerline. The geocoding of store site will be inaccurate if (1) addresses are not spread uniformly along that side of the blockface, or (2) an inappropriate estimate is used of the setback of store from street centerline. In cases where the given address does not conform to SNF address ranges, a store is assigned to the nearest intersection. In this

14. In this study, knowing the density of consumers is critical to the question of store location. In contrast, Lindsey, Von Hohenbalken, and West (1991) undertake a spatial price equilibrium analysis of vide stores that ignores store location and the geography of households.

method of store positioning, two units with the same street address, say Unit 100 and Unit 205 at "100 North Street," are geocoded as the same point. Since stores in a shopping center all share the same address in the YPs, this method also assigns each of these to the same point. However, in my examination of each volume (year and locale) of the YP, I rarely found two video stores concurrently sharing the same street address.

There are important limitations to this data set. One is the absence of price data. Lindsey, Von Hohenbalken, and West (1991) illustrate the importance of spatial price equilibrium in the video rental market in Edmonton in 1987; unfortunately, such price data are not available for the longer period covered by this study. However, incorporating pricing strategy would be problematic. Video rental pricing schemes vary widely: some stores have membership fees, others do not; rates vary with type of title (for example, adult, child, recent release, and oldie), from week-day to weekend; and quantity discounts are common. Modern-day location theorists might also take exception to the absence of other data in this sample, for example, variety of product, quality of service provided, submarkets served, site accessibility and convenience, and rent charged by landlords at the site. For each of these variables, we simply lack adequate data covering each firm and site over the period from 1982 to 1999. In terms of product variety, for example, while we may be able to guess, from names and/or advertising, which stores deal exclusively in pornography, it is not possible to determine which other stores also have adult video sections that compete. Nonetheless, this is a useful sample. Since YP volumes appear annually, they provide an ongoing time series of data on store location. Further, since a remembered (or memorable) telephone number is an important asset in retailing, tracking by telephone numbers is useful in identifying transitions where a firm changes name or location.

NUMBER AND LOCATION OF STORES

Let us begin with some annual store counts in order to characterize the Toronto video store sample. Let N_t be the total number of stores operating in year t in the sample.

$$N_t = \sum_{i=1}^{1591} y_{it} \ .$$

Overall, N_t increased rapidly from just 117 stores in 1982. It peaked at 401 stores in 1993, then fell off slowly through 1998 before recovering to 377 stores in 1999. See Table 1 and Figure 2. From year t to $t+1$, let us define four categories: nonmovers (surviving), movers (including stores that change only their name), deaths, and births. At year $t+1$, these are defined as follows:

nonmovers: $y_{it+1} = 1 \cap y_{it} = 1$
movers: $y_{jt+1} = 1 \cap y_{it+1} = 0 \cap y_{it} = 1 \cap f_i = j$
deaths: $y_{it+1} = 0 \cap \ y_{it} = 1 \cap f_i = 0$
births: $y_{it+1} = 1 \cap y_{it} = 0 \cap b_i = 0$

In the Toronto video store sample, starting from the 117 firms in 1982, there were subsequently much turnover: 1,192 births of new stores in the sample, and 932 deaths of existing stores. Thus, the number of stores present at the end of the study (1999) is 117 + 1192 − 932 = 377. Over the period from 1982 to 1999, there were also 282 movers in total. Table 1 provides evidence that transition rates (expressed relative to the number of stores in the previous year) were generally stable over much

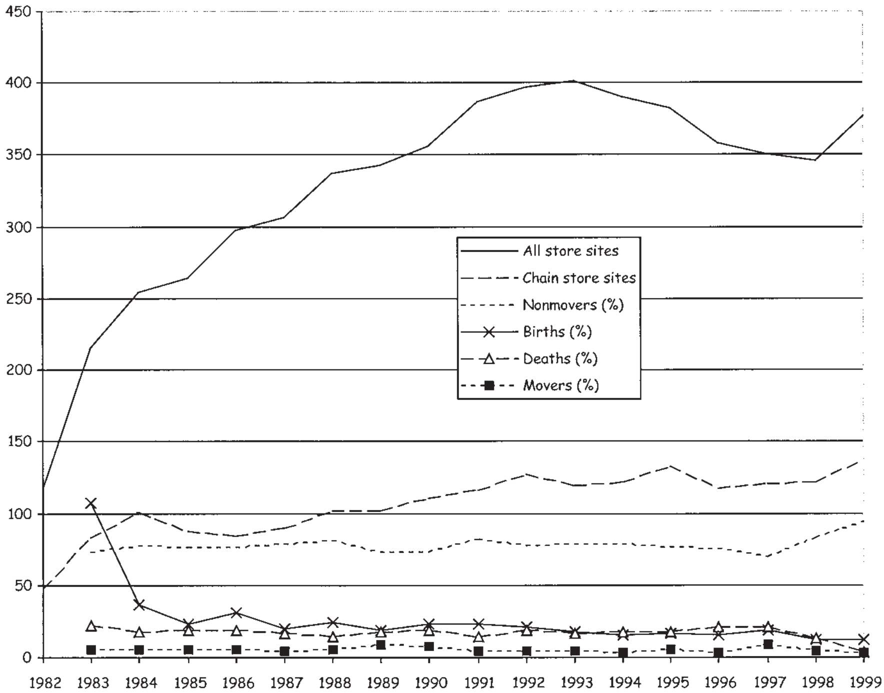

FIG. 2. Store Sites and Their Characteristics, Toronto Video Store Sample, 1982–1999. Source: Calculations by author. See Tables 1 and 2.

of this period. Typically, 70 to 80 percent of stores were nonmovers in any given year, about 5 to 10 percent were movers, and 15 to 20 percent of stores disappeared. After about 1985, the number of births also tends to be relatively constant at about 15–20 percent of the number of stores present at the start of the year. In such comparisons, 1999 is unusual in that there are relatively more nonmovers, fewer movers, fewer deaths, and fewer births compared to earlier years.

Among chain stores, there has been considerable turnover over the years. See Table 2. Nearly all the chains established in the early 1980s (for example, Video Station, National Video, TV Movie Center, Captain Video, Mr. Video, Consumers Video, Movie Movie, Videotrend, Haullywood Video Rentals, Future Island, and Videoflicks) have fallen by the wayside. Of the dozen early large chains, only three were still operating any stores in 1999 and only one of these (Videoflicks) was still operating more than a single store in the sample.[15] Among chains that started up after 1986, the survival rate is better. Of these, Video 99, Rogers, and Blockbuster were the three main competitors in 1999. Video 99 began as a rack jobber, developed into a mix of large and small franchised video stores, and at present is retrenching. Blockbuster Video Canada, like its U.S. parent, operates stores that are large and have a big inventory of recent-release movies. In the last few years of the sample, Blockbuster had not added any new stores in Toronto. Rogers Video is a well-financed arm of a Canadian wireless and cable giant that has been aggressively building large stores to compete with Blockbuster.

15. Lindsey, Von Hohenbalken, and West (1991, p. 902) also report substantial turnover of video rental firms in Edmonton in the mid-1980s.

TABLE 2
Chain and Single-Site Video Stores, Showing Major Chains, Toronto, 1982–1999

Year	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99
All store sites	117	216	254	264	297	306	337	343	356	387	397	401	390	383	358	350	346	377
Single-site stores	69	133	153	177	213	216	235	241	245	271	270	282	268	250	241	230	224	240
Chain stores	48	83	101	87	84	90	102	102	111	116	127	119	122	133	117	120	122	137
Blockbuster Video											7	12	18	25	30	34	34	34
Adults Only Video										7	8	12	12	12	3	3	4	4
Rogers Video								5	8	10	10	8	7	7	12	16	24	29
Major Video							3	7	8	8								
Profekta International Inc							2	2	4	4	4	5	6	6	5	4	4	4
Video 99					6	12	16	16	23	24	28	32	34	33	29	26	26	27
Haullywood Video Rentals				6														
Future Island		2	5	5	2													
Video Station The	7	13	13	14	14	14	13	11	9	6	4	3	3	2	2	2		
Captain Video	3	4	4	5	5	6	5	4	4	4	4	4	3					
National Video	3	4	10	12	9	8	3	2										
Videotrend Inc	4	4	5	6	6	3	3											
Consumers Video Ltd	2	6	6	4	4	3	3	3										
Videoland Home E C	5	6	6	2														
Movie Movie Inc	2	6	5	3	3	3												
TV Movie Center	5	8	7	4	3	2	2											
Mr Video	6	3	2	2	2	2	4	5	3	3	3	2						
Videoflicks Ltd	5	5	4	5	4	4	2	3	4	4	3	3	3	3	3	3	3	3

SOURCE: Toronto video store sample: calculations by the author.

By 1999, these video chains had arranged their stores systematically across much of Toronto. See Figure 3. The clustering of EA centroids in Figure 3 indicates areas of high population density. Rogers Video began in the East End of Toronto and expanded rapidly across Toronto in the later years of the sample. Blockbuster began in the south-central area (squares I10 and J10) in and near the CBD and then spread to the east and west. Evident in Figure 3 is an overall regularity in the spacing of chain stores. For each of these three chains, store spacing is similar. Chains tend to place their own stores about 3 to 4 kilometers apart in densely populated (gray) areas in Figure 3, suggesting that consumers can be expected to travel only as far as 2 kilometers to the nearest store. The exception is a tighter spacing of stores by Blockbuster in the south-central area of the city. Finally, Figure 3 indicates that the major chains tend to locate stores away from the sites of their competitors. This is consistent with the Löschian notion of the profitability of spatial monopoly. However, for any one chain shown, Figure 3 is not entirely consistent with the idea that the density of consumers is varying across Toronto, and raises the possibility that single-store sites can in fact successfully compete by swarming.

An empirical measure of this regularity in spacing is possible. In Figure 3, Toronto is divided into ninety-six squares each of which (ignoring the irregular boundary squares) is 2.8 kilometers to a side. If a chain put a store at the center of each square, no customer would ever be more than 2 kilometers from the nearest chain site. I can now count the number of sites (0,1,2,…) in each square. I can also sum the population in each square. Suppose that population is the only relevant factor shaping site profitability: in other words, let me ignore income, demographic characteristics, the positions of competitors, and so on for the moment. If a chain chooses sites regularly across the figure, the expected number of stores in a square should rise from zero when the population nearby is negligible up to a value near 1 where the square's population density is sufficient to make the store site minimally profitable for the chain. If the chain is indeed positioning its stores regularly, the expected number of stores in the square should not increase still further with population density above this threshold.

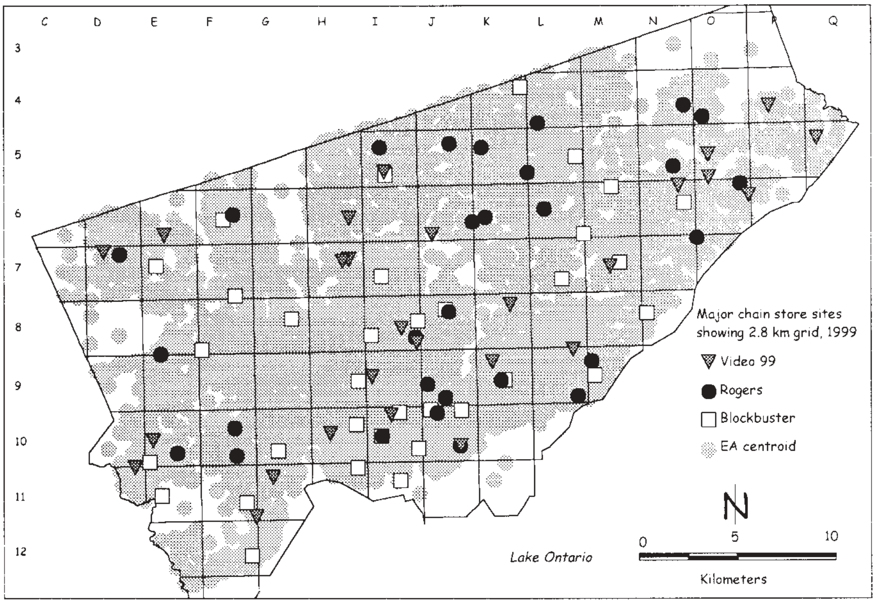

FIG. 3. Blockbuster Video, Rogers Video, and Video 99 Chain Store Sites, Toronto, 1999

To test this idea, I fitted a linear spline function to count data for each of the three main chains in 1999. Let us define the following terms:

Y_j = number of stores that the chain has in square j in 1999 (dependent variable);
x_j = population in square (thousands of persons) in 1996, the latest year available (independent variable);
t = threshold population density (parameter);
b = intercept (parameter);
s_1 = slope coefficient when $xj < t$ (parameter);
s_2 = slope coefficient when $xj \geq t$ (parameter).

The model then takes the following form:

$$y_j = \begin{bmatrix} b + s_1 X_j & X_j < t \\ b + s_1 t + s_2 (X_j - t) & X_j \geq t \end{bmatrix}.$$

The descriptive statistics, least-squares estimates, and fit for this model are shown in Table 3 for the three main chains in 1999. For Rogers, the estimated intercept (b) is close to zero; the estimated threshold (t), at just over 24 thousand persons, is close to the average density of a square in Toronto; the estimated above-threshold slope coefficient (s_2), while not zero, is only about one-half the size of the estimated below-threshold slope coefficient (s_1). Put differently, Rogers' choice of sites is more sensitive to variations in population density below the threshold than above. This is consistent with the idea that Rogers spaces its stores regularly in areas of sufficient population density. However, the evidence is weak in that the difference between s_1 and s_2 is statistically insignificant (as measured by the F-test statistic). The results are similar if we focus instead on Video 99. In contrast, the results for Blockbuster are contrary to our expectation. Here $s_2 > s_1$; perhaps not surprisingly, given that it is the most concentrated of

TABLE 3

Spline Function Estimates of Number of Sites per Square, Three Main Chains, Toronto Video Store Sample, 1999

	Rogers	Video 99	Blockbuster
Least –squares estimates			
b (intercept)	−0.0684	0.0019	0.0492
t (threshold)	24.4	19.5	25.9
s_1 (slope below threshold)	0.0170	0.0128	0.0092
s_2 (slope above threshold)	0.0094	0.0087	0.0212
Fit			
Sample size	96	96	96
R-squared	0.164	0.115	0.269
F-test (s_1=s_2, df_1=1, df_2=92)	1.6	0.5	2.2
Y: number of sites in square			
Mean	0.31	0.28	0.36
Minimum	0	0	0
Maximum	2	2	3
X: population in square (000s)			
Mean	25.1	25.1	25.1
Minimum	0.04	0.04	0.04
Maximum	76.2	76.2	76.2

SOURCE: Toronto video store sample: calculations by the author.

the three chains (seven of the thirty-four Blockbusters are to be found in just three squares in Figure 3). These mixed results, built as they are on the simplistic notion that population density alone shapes store location, should not be surprising. They simply indicate the need for a careful approach to modeling store behavior.

In the remainder of this paper, I present and estimate a model of store behavior that focuses on store survivorship. I begin from the perspective that two factors that shape survivorship are the population living nearby and their average income. To illustrate the spatial patterns in these two variables, I present maps of census data for 1996 aggregated to the ninety-six squares used above. Figure 4 shows the estimated average income of households (as reported in the 1996 Census) living in EAs whose centroids are contained within the grid square. Average household income is high along a corridor centered along the entire length of Yonge Street running north from the intersection with Bloor Street. Incomes are also high in much of the southern end of the former Etobicoke (south of Eglinton Avenue), the southeast corner of the former Scarborough (near the intersection of Kingston Road and Ellesmere Road, and other small pockets. Figure 5 shows the total population living in each grid square in

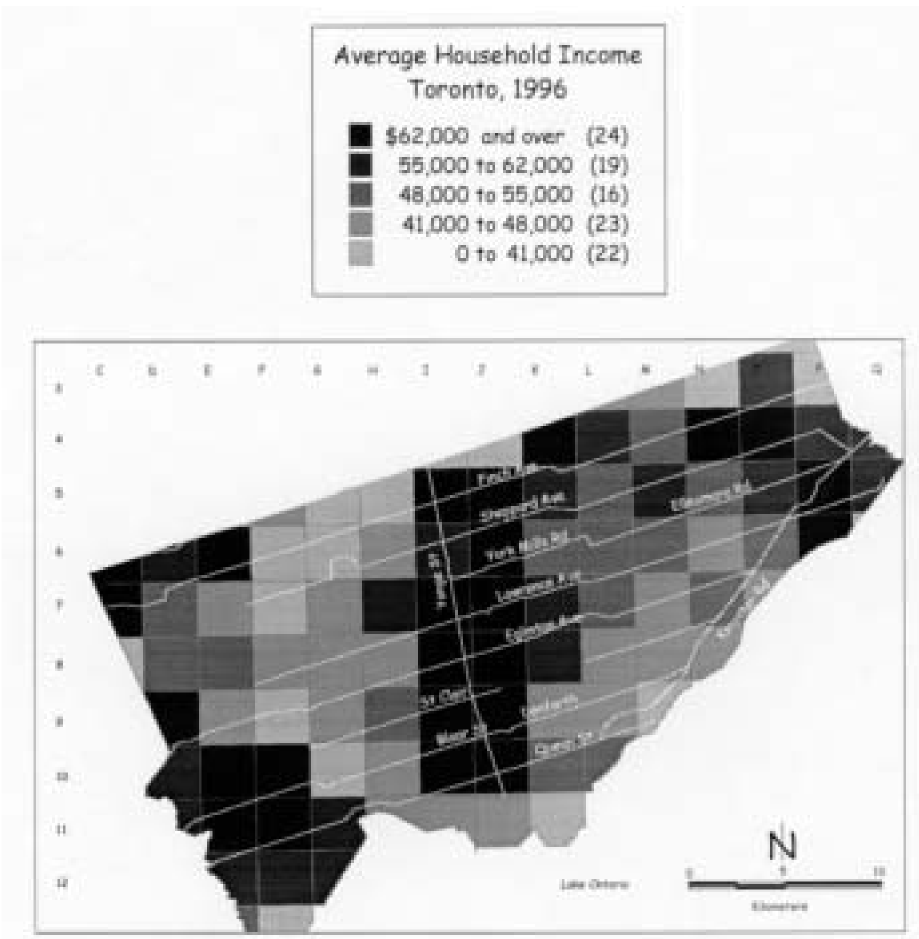

FIG. 4. Average Household Income (1985 dollars) within Square in 1996, Toronto Video Store Sample

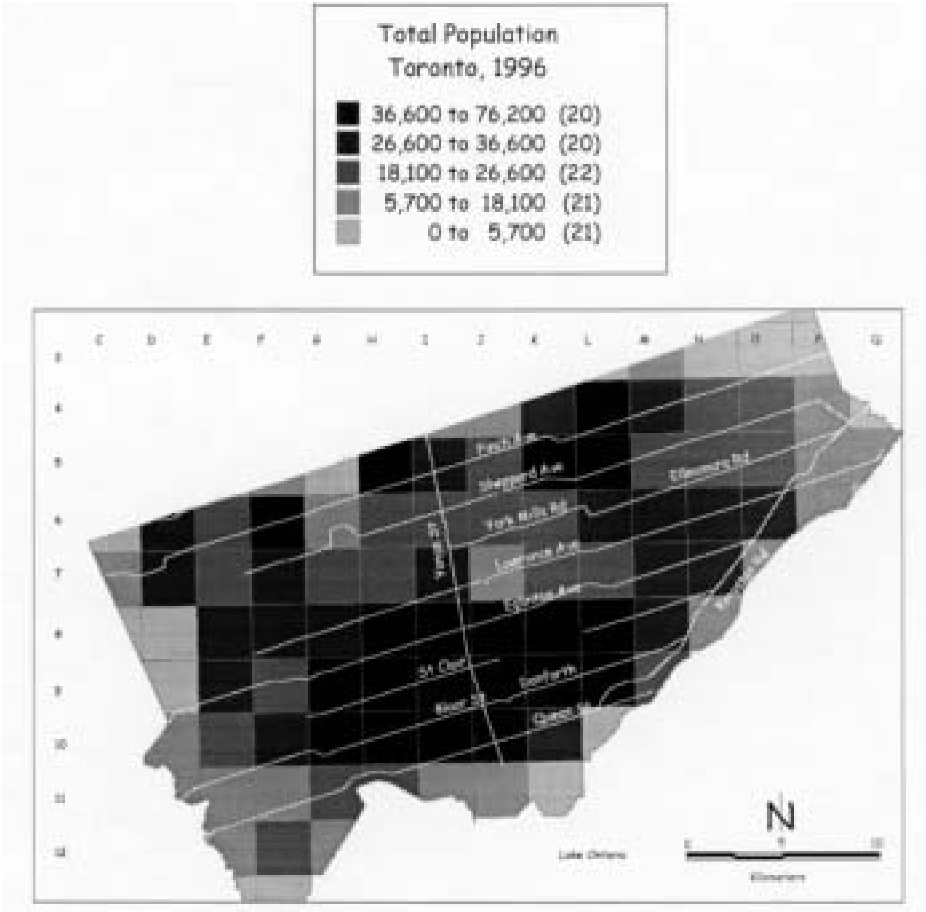

FIG. 5. Total Population within Square in 1996, Toronto Video Store Sample

1996. Population density is highest in the area south of Eglinton Avenue and running about 1 kilometer east to about 5 kilometers west of Yonge Street, and in the eastern part of the former City of Toronto stretching above and below Danforth Avenue. Outside these two areas, population density falls off abruptly except in the clusters of suburban high-rise apartment towers along major arterials, expressways, and rapid transit routes.

MODEL OF STORE DEATH

Let us now estimate a model of store death.[16] From each of the 1591 store histories in the Toronto video store sample, I can build records of transition from year t to the following. Overall, the typical store history is four years long, permitting three year-to-year transitions: in all, a dataset of $n = 5{,}502$ transitions can be built. Of these,

16. Whether a store switches between single-site and chain status is an interesting question: see the discussion of retail power in Hallsworth (1997).

3,718 were single-store sites ($s = 1$) and 1,784 were chain-store sites ($s = 2$) in the initial year t. For store i of type s present in year t (that is, $y_{sit} = 1$), the dependent variable is d_{sit} is defined to be (for t from 1982 to 1998):

- one if the store is not present in the following year (that is, $y_{sit+1} = 0$) and has not moved (that is, $l_{si} = 0$)
- zero otherwise.

Note that the model focuses simply on survivorship. Specifically, I do not consider here the distinction between movers and nonmovers. In addition, I do not examine whether or not a store switches between from being a chain store to a single-site store over the year, or vice versa.

Using logistic regression,[17] the model relates the probability of death, p_{sit}, to three sets of explanatory variables. A separate model is estimated for each type of store (single-site and chain).

The first set of explanatory variables measures the income and tastes of consumers living nearby. I experimented with the concept of "nearbyness." Three approaches are possible here: Thiessen, Potential, and Window.

•*Thiessen.* Construct a polygon around each store site enclosing all places closer to that site than to any other store site, and then count consumers within the polygon. Such an approach assumes that consumers are indifferent among stores and thus patronize the closest. However, because of idiosyncrasies or a taste for variety, consumers may not always choose the nearest. More importantly, this approach does not distinguish between (1) the store in an area with many people living nearby but many competitors as well and (2) the store in an area with few people nearby and few competitors. In each case, the store may have the same population in its polygon, but in the former case, the store is at greater risk of the kind of price competition mentioned at the outset of this paper. The Thiessen approach also becomes problematic when we consider two types of stores (single-site and chain) because it is hard to know if or how to adjust polygons for this distinction.

•*Potential.* Assume that all consumers, wherever located, have some probability of being customers at this store, but that the probability declines with increasing distance from the store site. In its simplest versions, the Potential approach does not see a distance threshold beyond which the probability of shopping at this store suddenly drops off. Instead, the probability is seen to decline smoothly with distance to the store, presumably because either the store is too far away (that is, beyond the consumer's range) or because there are comparable or better stores within the consumer's range (that is, intervening opportunities).

•*Window.* Assume that all consumers within a defined radius (range) are potentially customers at this store, but that the presence of competitors nearby reduces the number of customers who patronize this particular store site. Put differently, stores are assumed to have the potential to draw customers from within their range and that the possibility of heterogeneity among stores (for example, in hours of service, convenience of parking, friendliness of staff) makes everyone within the range a potential customer.

In this research, I opted for the Windows approach. The Potential approach confounds the notions of range and intervening opportunities, and in comparison with the Thiessen approach, the Window approach gave a better model fit.

I also experimented with the representation of consumer tastes. First, I divided the population into elderly (aged 65 or older) and nonelderly because Schaninger and Danko (1993) present evidence that elderly are less likely to rent movies than are the

17. In their study of retail store closure in Boston, Lerner, and Liu (1984) also use logistic regression.

rest of the adult population. Second, I had also expected to find that families with children would be more likely to rent movies than would other kinds of consumers: for them, videos are a particularly cost-effective alternative to going out to the movies. However, I found no evidence that the number of children nearby has any effect on store survivorship, and so abandoned this variable. I was thus left with the following three income and taste variables

X_{1sit}: Population aged under 65 (hundreds of thousands of persons) resident in EAs whose centroid is nearby store i in year t. Data come from censuses in 1981, 1986, 1991, and 1996. Intercensal data are interpolated; 1997 through 1999 data are extrapolated from 1991–96 trends. Since younger consumers are more likely to rent videos, I expect this to have a negative effect on store death.

X_{2sit}: Population aged 65 or older (hundreds of thousands of persons) resident in EAs whose centroid is nearby store i in year t. Data come from censuses in 1981, 1986, 1991, and 1996. Intercensal data are interpolated; 1997 through 1999 data are extrapolated from 1991–96 trends. Since older consumers are less likely to rent videos, I expect an insignificant or positive effect on store death.

X_{3sit}: Average household income site (hundreds of thousands of 1985 dollars) of households resident in EAs whose centroid is nearby store i in year t. Data come from Censuses in 1981, 1986, 1991, and 1996. Intercensal data are interpolated; 1997 through 1999 data are extrapolated from 1991–96 trends. Since a higher income makes video rentals more affordable, I expect a negative relationship with store death.

An obvious variable missing here is any measure of the ownership of an important complementary good: a home VCR machine. Ideally, I would include as an explanatory variable, the incidence of ownership of home VCRs among households resident near each store site. However, such data are not available. To the extent that ownership of VCRs is correlated with household income, it can be argued that X_{3si} proxies its effect. The proliferation of VCRs in the 1980s happened in conjunction with a sharp drop in the price of a VCR relative to other consumer goods, so it might be argued that VCR ownership increased at all levels of income. I return to this argument below.

The second set of explanatory variables counts the number of competitors nearby. I track the number of chain and single-site stores separately to take into account the fact that a store might see these two kinds of competitors differently. As noted above, the number of competitors is important in two ways. First, it indicates the number of competitors with whom the store must share some or all of the customers in its market area. Second, it proxies the level of risk introduced by having competitors close by.

X_{4sit}: Number of chain store competitors nearby store i in year t. Since competitors make it more difficult to survive, I expect a positive relationship with store death.

X_{5sit}: Number of single-site store competitors nearby store i in year t. Again, since competitors make it more difficult to survive, I expect a positive relationship with store death.

The third set of explanatory variables is labeled "experience." Here are included measures of both the experience of the industry (presumably different for chains than for single-site stores) and the experience of the store at its own site.

At the level of the industry, I expect the probability of store death (especially among single-site firms) to be high in the early years of the sample, when the industry is new, and to decline with maturation of the video rental market. In part, this is because pioneering retailers must learn largely from experience. In the early 1980s, the video rental business was new and not well understood. As the years have gone by, retailers have learned more about the nature of the business and are now better able to ensure their own survival. In part, store death rates may have declined also because of the diffusion of home VCR units discussed above. In the early 1980s, the number of VCR players in Toronto homes was still small. With VCRs present in a large proportion of homes, retailers in 1999 should find it easier to survive given fixed levels of population and incomes nearby.

I also expect to see the rate of death vary thereafter with the business cycle. In the case of chain stores, I hypothesize that the death rate will not be as marked in the early years of the sample as the owners struggle to establish network economies. Thereafter, I expect the death rates for chain stores and single-site stores to be similarly responsive to the business cycle.

In principle, there are three main ways to capture industry experience. One is to proxy the business cycle effect by adding a dummy variable that takes on a value of one at the troughs of the business cycle (for example, 1982–83 and 1991–93) and zero otherwise. However, this presumes that the effect of the recession is immediate whereas firms may well survive a trough but be too weakened to fully wait out the next boom. The second is to capture high death rates in the early years of the industry by including a time trend as an explanatory variable (which presumably would yield a negative slope coefficient). However, this presumes a smooth trend over time, which might be unwarranted in the sample. Instead of these two, I adopt a third approach in which I attach to each transition a time dummy.

D_{msit}: A dummy variable for transition m ($m = 1$ for 1982–83 through $m = 17$ for 1998–99). $D_{msit} = 1$ if $t = m$, zero otherwise.

The advantage of this third approach is that I do not specify the particular way in which store survivorship has changed from one year to the next, but instead allow the data to dictate the temporal pattern.

As an additional explanatory "experience" variable, I include the number of years that this particular store history has been underway. The store history is seen to start a new experience. Note that, because the sample starts in 1982, each store in that year is "newborn." This potentially creates a left-censoring problem in model estimation. I ignore this problem because the high store death rate in 1982–83 means that such cases were overall only a small part of the Toronto video store sample. In the case of single-site stores, I expect experience to have a positive effect on store survivorship, as new store operators gradually learn how to run the business. In the case of chain stores, I expect that experience at that site would be less important because the chain would have accumulated experience from other sites and thereby have better management training.

A_{sit}: The number of completed years in the store history to date.

Finally, I must define a radius for the construction of X_1 through X_5. Above, I argue that 2 kilometers is a plausible distance for defining what is "nearby." In what follows, I try four different values (1, 2, 3, and 4 kilometers) to see which distance performs best in the modeling of store death.

Table 4 shows mean values for variables in the single-store and chain-store transition samples. Over the 5,502 transitions in the Toronto video store sample, the mean probability of death is 0.19 for a single-site store and 0.13 for a chain store. For both single-site and chain stores, the average number of years established is 2.4. The mean values for the remaining variables, $X1$ through $X5$, vary depending on the measure of nearbyness used.

TABLE 4
Mean Values for the Dependent and Selected Independent Variables, Toronto Video Store Sample

		Single-site stores, using radius of				Chain stores, using radius of			
		1 km	2 km	3 km	4 km	1 km	2 km	3 km	4 km
Y	Death of store	.19	.19	.19	.19	.13	.13	.13	.13
X_1	Population under 65 nearby	.16	.54	1.12	1.83	.14	.48	1.00	1.66
X_2	Population 65 or older nearby	.02	.08	.16	.26	.02	.07	.14	.24
X_3	Average household income nearby	.38	.39	.40	.40	.41	.41	.41	.41
X_4	Chain-store sites nearby	.84	2.78	6.06	9.82	.73	2.44	5.52	9.28
X_5	Single-store sites nearby	2.17	7.32	15.64	24.55	1.76	5.80	12.64	20.46
A	Years established	2.44	2.44	2.44	2.44	2.42	2.42	2.42	2.42

NOTES: X_1 and X_2 measured in hundreds of thousands of persons, X_3 measured in hundreds of thousands of 1985$
SOURCE: Toronto video store sample: calculations by the author.

I can now estimate a conventional binomial logit model. As is well known, the logarithmic odds of death in year t (that is, of not surviving from t to $t+1$) are assumed to be given by the following:

$$z_{sit} = b_{s0} + \sum_{k=1}^{5} b_{sk} X_{skit} + \sum_{m=1982}^{1997} c_{sl} D_{smit} + d_s A_{sit} \ .$$

Further, the probability of death (p_{it}) between dates t and $t+1$ is then given by the familiar model,

$$p_{sit} = \frac{e^{z_{sit}}}{1+e^{z_{sit}}} \ .$$

The coefficient estimates (b_{s0}, b_{s1}, …, b_{s5}, c_{s1982}, c_{s1983}, …, c_{s1997}, d_s) for each type of store and the four choices of nearness are presented in Table 5.

Which distance works best here? One criterion here is model fit. Scanning the model chi-squares near the bottom of Table 5, a radius of 2 kilometers performs best among the four distances evaluated for single-site stores and for chain stores. A second criterion would be statistical significance. For single-site stores, we get six significant coefficients when the radius is 2 kilometers (compared to only five at any of the other three distances) and all six have the correct sign. For chain stores, the number of significant coefficients is similarly at a maximum in the 2-kilometer-radius model.

Let us now turn to the chain store (right-hand columns) estimates in Table 5, focusing on the 2-kilometer-radius model. Here we see that more nonelderly (aged under 65) nearby significantly reduces the likelihood of store death. So too does a higher average income nearby. Comparing the two, an increase in average household income nearby of $7,442 (in 1985 dollars) reduces the likelihood of store death as much as does 10,000 more nonelderly. The elderly (aged 65 or older) have no statistically significant effect on store survivorship. The more competitors nearby, the greater the probability of store death. In comparative terms, 4.6 more single-store competitors within 2 kilometers increases the probability of (chain) store death by the same amount as a reduction of 10,000 nonelderly. The model estimates also show that chain stores are especially sensitive to the number of chain competitors nearby. One more chain competitor within 2 kilometers has the same impact on (chain) store survivorship as 2.7 single-store competitors. The time dummies for chain stores show significant spikes in store mortality in 1984–85, 1985–86, 1988–89, 1995–96, and

TABLE 5

Logistic Regressions to Explain Deaths of Video Stores, Toronto Video Store Sample

		Single-site stores, using radius of 1 km	2 km	3 km	4 km	Chain stores, using radius of 1 km	2 km	3 km	4 km
X_1	Population under 65	−1.302	−1.024*	−.375	−.231	−3.400*	−2.216*	−1.132*	−.877*
X_2	Population 65 or older	−.699	2.720	1.256	.995	2.532	6.072	4.124	3.432
X_3	Household income	.098	.005	−.120	−.484	−1.731*	−2.978*	−3.871*	−4.160*
X_4	Chain-store sites	.045	.032	.037*	.035*	.159*	.083*	.086*	.057*
X_5	Single-store sites	.050*	.026*	.001	−.003	.088*	.048*	.012	.010
D_{1982}	Death in 1983	.784*	.883*	.886*	.909*	−.783	−.699	−.562	−.488
D_{1983}	Death in 1984	.243	.294	.260	.270	−.027	.076	.093	.125
D_{1984}	Death in 1985	−.012	.024	−.015	−.024	.678*	.809*	.774*	.820*
D_{1985}	Death in 1986	−.138	−.103	−.121	−.125	.884*	.969*	.996*	1.007*
D_{1986}	Death in 1987	.100	.124	.133	.152	−.056	−.018	.040	.066
D_{1987}	Death in 1988	−.132	−.120	−.110	−.095	−.235	−.219	−.143	−.124
D_{1988}	Death in 1989	−.050	−.048	−.040	−.026	.508*	.511*	.583*	.595
D_{1989}	Death in 1990	.271	.264	.274	.293	−.053	−.018	.023	.020
D_{1990}	Death in 1991	−.437*	−.453*	−.442*	−.434*	.468	.475	.452	.463
D_{1991}	Death in 1992	.190	.168	.188	.204	.096	.091	.094	.077
D_{1992}	Death in 1993	−.015	−.049	−.025	−.026	.334	.321	.324	.285
D_{1993}	Death in 1994	.216	.182	.212	.217	−.145	−.198	−.180	−.202
D_{1994}	Death in 1995	.115	.082	.080	.063	.217	.155	.137	.098
D_{1995}	Death in 1996	.242	.211	.179	.147	.554*	.473*	.390	.372
D_{1996}	Death in 1997	.413*	.390*	.384*	.368*	.071	−.005	−.064	−.105
D_{1997}	Death in 1998	−.146	−.166	−.163	−.189	−.698*	−.780*	−.905*	−.934*
A	Years established	−.044*	−.044*	−.046*	−.046*	.071*	.073*	.075*	.070*
Intercept		−1.369	−1.327	−1.361	−1.306	−1.367	−.847	−.724	−.566
$-2\ln[L^*]$		3493	3491	3495	3494	1320	1314	1317	1324
Model chi-square		92.5*	94.4*	90.5*	91.1*	73.6*	80.1*	76.8*	70.4*
Sample size		3718	3718	3718	3718	1784	1784	1784	1784

NOTES: * indicates coefficient is significant at 95 percent level. Wald test employed for slope coefficients. L^* is likelihood value when slope coefficients chosen to maximize. Default is death in 1999.
SOURCE: Toronto video store sample. Calculations by author

again in 1997–98. See Figure 6. However, these do not correspond well to either of the two effects (industry start-up, and the recession of 1991–93) that I postulated above. The coefficient for store age (years established) is positive and significant. It is also numerically large: the passage of just 3.1 years has about the same effect in increasing the likelihood of store death as does a 10,000 person reduction in the nonelderly population. A positive coefficient on store age is not surprising if we imagine that the potential for network economies make the chain owner inclined to keep open a less-profitable store in the early days of the chain.

Finally, let us consider the coefficients for the time dummies for chain stores. Exponentiation of these coefficients yields an annual index of the likelihood of store death wherein the transition from 1998 to 1999 (the default case) is indexed to 100. See Figure 6. The chain store death index is low in the first transition (1982–83), rises to a sharp peak in 1985–86, and then settles down to a moderate variability for the remainder of the period. The sharp rise in the first half of the 1980s is consistent with the idea that the first chains (those listed at the bottom of Table 2) tried to reach the number of sites needed to exploit network economies, but as that profitability eluded them, these chains went out of business. Interestingly, the index provides no evidence that the recession of 1991–93 had an effect on store death. Neither is there any evidence over the sample period of a downward trend in the index of store death, as we might have expected from the increasing incidence of VCR ownership.

Let us now turn to the single-store estimates in Table 5, again focusing on the 2-kilometer-radius model. As was the case in the chain model, we see that the likeli-

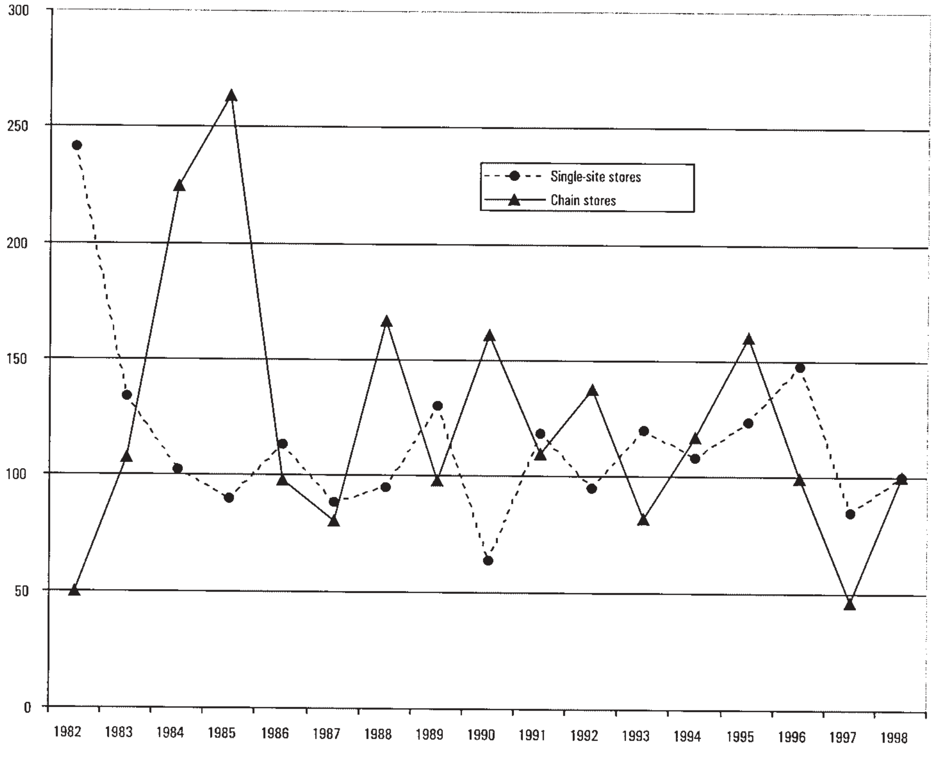

FIG. 6. Index of the Likelihood of Store Death, 1998 = 100. Source: Toronto Video Store Sample; calculations by author

hood of store death is (1) significantly reduced with more nonelderly nearby, (2) significantly increased with more single-site competitors nearby, and (3) not significantly affected by the number of elderly nearby. However, unlike the chain model, the likelihood of store death is not significantly affected by average income nearby. As well, unlike the chain model, the number of chain competitors nearby has no significant effect in the single-site model. The coefficient for store age is negative and significant. It is also numerically large: the passage of just 2.3 years reduces the probability of store death about as much as an increase in the nonelderly population nearby of 10,000. A negative coefficient on store age is consistent with the argument that, while single-site store owners may be inexperienced and inefficient initially, survivors (be they adapters or the adopted) better manage the business.

Now, consider the coefficients for the time dummies for single-site stores. The index of store death for single-site stores is shown in Figure 6 as well. Note the difference in trend between chain stores and single-site stores in the first four transitions in the sample. The index of store death starts high for single-site stores, then troughs by the 1985–86 transition: the opposite of what we had found for chain stores. This trend for single-site stores is consistent with the argument that the owners of pioneer stores in this industry were learning the trade as they went along, with considerable fall-out along the way. However, after 1986, the single-site store death index, like that for chain stores, shows no overall downward trend.

The models estimated above assume that the marginal effects of income, demographic composition, and the number of competitors on store death remain the same across the sample. Above, I argue that there was a great proliferation of inexpensive home VCRs during the 1980s. Does this therefore mean that the income of nearby residents became less important in determining store survivorship over the sample period compared to these other variables? To test that argument, I fitted a second (interaction effect) model to allow these coefficients to vary over time.

$$z_{sit} = b_{s0} + \sum_{k=1}^{5} b_{sk}(1+b'_{sk}t)X_{skit} + \sum_{m=1982}^{1997} c_{sl}D_{smit} + d_sA_{sit} \ .$$

However, in neither the chain-store nor the single-site-store transition samples were any of the five interaction effect parameters (b'_{sk}) statistically significant. In other words, I cannot reject the argument that the model of store death is invariant over the period covered by this sample. Why not? I suspect that it is because consumers want to rent what is for them a "good movie," and recognize that many videos to them are simply "bad." Of course, from one consumer to the next, tastes vary widely and hence the definition of "good" or "bad." To find a good movie requires that the consumer assemble information and clues. The time spent acquiring this information (for example, from film reviews, the comments of friends, and casual remarks overheard in the video store) is high, as is the "penalty cost" of sitting through a bad movie. The kind of consumer who is prepared to acquire the necessary information is someone who has the wherewithal and for whom (popular) culture is important. I suspect that this is likely to be someone who is better educated and has a good income. I suspect also that such costs have not changed substantially over the period of the Toronto video store sample. Hence, the temporal stability of my estimated model of store death is not surprising.

In comparing these two logistic regressions (again using the 2-kilometer radius), I draw three main implications. First, survivorship of a chain store is more sensitive to the presence nearby of other chain stores than to single-site stores. This implies that chains interested in survivorship would distance their stores and stay away from competing chains. Second, survivorship of a single-site store is less affected by the arrival of a new chain competitor than is the survivorship of a chain store. This suggests that single-site stores can compete by swarming. Third, single-site stores are less affected by the incomes of residents nearby. From the data in this study, it is hard to tell why.

DO VIDEO RETAILERS BEHAVE LIKE LÖSCHIAN COMPETITORS?

Löschian competitors locate to maximize profit. Since I proxy profit by survivorship, I therefore rephrase the question to ask whether video retailers locate to maximize the near-future probability of survivorship. To illustrate the method I employ here, consider the sample of 117 video retailers (consisting of 48 chain-store and 69 single-store sites) listed in the 1982 Yellow Pages. The actual sites of these stores are represented in Figure 7 as large gray circles. The 117 "best" sites (that is, the set that maximizes the probability of initial-year survivorship over the next year (that is, from 1982 to 1983) are represented in Figure 7 as small black circles.

To find the first of the best sites in 1982, I evaluate all of the 1,246 sites ever occupied in the Toronto video store sample. I take these to form the set of potential sites. For each potential site, I calculate the probability of first-year death (once for a chain store and once again for a single-site store) and then I assign the first store (chain or single) to the site with the lowest probability of death. The best that we can do here is to put a chain store at the site (just south of York Mills Road, east of Yonge Street) labeled "1" on Figure 7. The first-year probability of chain-store death at this site—with 26 thousand nonelderly, 3 thousand elderly, and an average income of $88,693 in the vicinity—is 0.0103.

I then find the second-best site in 1982 by reevaluating the remaining 1,245 potential sites, and now including that first store as a competitor where within 2 kilometers. The second-best choice is to put a chain store at the site labeled "2" on Figure 7. The probability of death for a chain store at this site—with 118 thousand nonelderly, 12 thousand elderly, and an average income of $32,474—is 0.0125. Interestingly, the third-best site turns out to be beside site 2, and then site 4 is selected, near site 1. My algorithm then selects site 5 on St. Clair west of Yonge Street, but subsequently picks, as site 6, a location very close to sites 2 and 4. Note that my method does not ask whether the stores at sites 2, 3, and 6 are in the same chain. The question of how one chain chooses sets of store sites is not addressed here.[18]

I continue this process of selecting best sites in 1982 until the best 48 chain-store sites and 69 single-store sites have been found. I argue that this simulation approximates the concept of Löschian competition. In practice, because chain-store sites tend to have lower rates of first-year death than do single-site stores, this simulation typically allocates all the chain stores first and then allocates single-site stores from among the remaining sites. Also, because the method is sequential (not simultaneous), I do not take into account how subsequent allocations affect the probability of death for stores allocated sites earlier in the simulation.[19] However, the sequential approach makes sense if we think of store site choice as competitive (not collusive) wherein stores are Löschian competitors who "cherry pick" from among the available sites. Further, there is probably not much difference between a simultaneous solution and a sequential solution. In the 1982 allocation, for example, the probability of first-year death was 0.0103 for the first chain store allocated (as noted above) and 0.0253 for the last one (the 48th). Similarly, among single-site stores, the one-year probability of survivorship was 0.2615 for the first site, and 0.3118 for the last (the

18. Claycombe (1998) discusses the complications that arise in competitive location of chain stores.

19. Drezner, Wesolowsky, and Drezner (1998) discuss the simultaneous location problem, and a method of simplifying that problem.

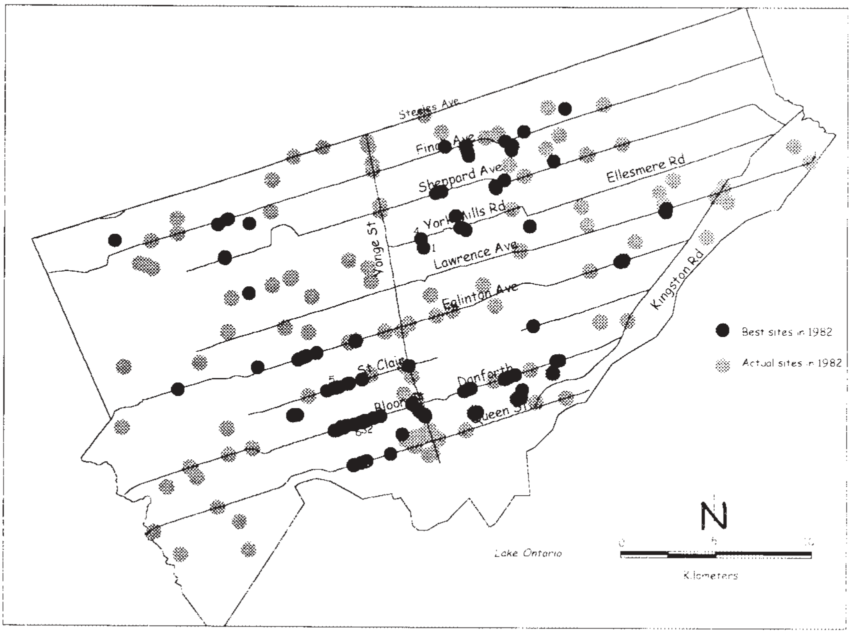

FIG. 7. Chosen and Best Store Sites, Toronto, 1982

69th). Presumably, if subsequent entrants did increase the likelihood of death for the earlier entrants in the simulation, the early entrants would be no worse off than the last entrants.

Just where and how does the Löschian (best sites) solution for 1982 differ from the sites actually occupied in that year? Figure 7 provides evidence of some interesting differences.

- The cluster of stores downtown (near the Yonge-Queen intersection) is not reproduced in the Löschian solution. I suspect that these stores were linked to vendors who sold VCRs and who used a tape rental shop nearby (or in-house) as a selling feature for their equipment.
- The Löschian solution shows clusters of stores (along the east-west arterial streets) in the densely populated inner city areas south of Eglinton Avenue and running about 5 kilometers west from Yonge Street. However, very few stores actually chose sites in this area in 1982.
- The Löschian solution shows several clusters of chain stores. One of these clusters consists of 16 chain sites within a span of 2.5 kilometers along Bloor Street and including sites labeled "2" and "3" in Figure 7. If, in fact, a chain spaces its stores about 4 kilometers apart, this implies that there must be at least 16 chains in the Löschian solution.
- Many stores actually chose to locate in the low-density suburbs in the former Etobicoke, North York, and Scarborough, but the Löschian solution has few sites in these areas. Of course, this might reflect the limited diffusion of VCRs which, at this early point in time, might well have been concentrated in the more-affluent suburbs.

Just how bad were the actual choices in 1982 relative to the best sites? According to this simulation, only eight stores actually chose a best site in 1982. Figure 7 contrasts the 117 best sites and the actual sites chosen. How much worse off were stores for choosing the sites that they did? To mimic the choice of actual sites, I repeated the simulation as above but now limited potential sites to the 117 actually chosen in 1982 (as opposed to the 1,246 used above). In so doing, I am interested not in the sites chosen (we already know these), but in the probability of survivorship at the last (marginal) store site actually chosen. For the marginal chain store in 1982, the probability of first-year death is twice as large at the 48th-best of the 117 sites actually chosen in that year compared to at the 48th-best site from among the 1,246 potential sites: see Table 6. For the marginal single-store site, the probability of first-year death at the least attractive site chosen (the 117th) is 0.38, compared to just 0.31 at the 117th best among the 1246 potential sites. I draw two conclusions from this. First, the calculations suggest either (1) that the chain and single-site stores were Löschian competitors but not were choosing their sites well, or (2) that the stores were not Löschian competitors. Second, in terms of the probabilities of death attached to marginal sites, single-site stores came relatively closer to finding the best sites than did their chain store competitors.

To this point, I have mentioned only the initial year, 1982. However, this method can be applied to look at the locations of movers and new stores in each year of the sample. Results are shown in Table 6. Here, in each year, the stores that have not moved (including those that changed name) are treated as given, and the model is used to find the best locations of new births and stores that change location. Throughout the period covered by this sample, the last (marginal) chain store had a probability of death that was typically twice as high as for the marginal best chain site predicted by the model. The probability of death of the last (marginal) single-site store, while higher absolutely, was only about 25 percent higher than of the marginal best single-store site. I conclude therefore again that single-site stores came relatively closer to finding the best sites than did their chain store competitors. I argue that this is because single site stores are swarming good sites whereas chain stores attempt to preserve regular spacing of their sites.

To further illustrate this argument, consider another thought experiment. Suppose that we observe each chain store at its chosen site in 1999, and treat these locations as given. Suppose that we then allocate a first single-site store to whichever of the remaining ever-occupied sites is best, then allocate a second single-site store and so on as above until every single-site store in 1999 (240 in total) is allocated to the site that maximizes recursively its probability of survivorship. Then lay the grid squares in Figure 3 on top of these sites, and count the population in each square as well as the number of (1) single-site stores, (2) Blockbuster, (3) Rogers, and (4) Video 99 chain stores. Now array the grid squares in order of increasing population, and calculate the cumulative frequency distribution for each of the four groups of stores. The result is Figure 8. The difference between the cumulative distribution for single-site stores and cumulative distributions for the three main chains is marked. For the single-site store, under 50 percent of sites are to be found in grid cells with a population of 40,000 persons or less versus 62 percent for Rogers, 66 percent for Blockbuster, and 68 percent for Video 99. In fact, only Blockbuster shows any attempt to swarm higher density locales, and this appears only in that couple of central-city grid squares mentioned above where population exceeds about 65 thousand persons. In conclusion, with the exception of Blockbuster's attempt itself to swarm a couple of high-density areas, the video rental retailing landscape in Toronto is characterized by regular spacing among chains contrasted with swarming among single-site stores.

CONCLUSIONS

Löschian analysis emphasizes the importance of locational choice in competition among firms within an industry. According to Lösch, new firms choose locations to

TABLE 6
Probability of First-Year Death among New Store Sites

	Chain stores					Single-site stores				
		Best sites		Chosen sites			Best sites		Chosen sites	
	Sites	First	Last	First	Last	Sites	First	Last	First	Last
1982	48	0.01	0.03	0.02	0.06	69	0.26	0.31	0.27	0.38
1983	36	0.02	0.06	0.05	0.13	91	0.17	0.21	0.16	0.28
1984	25	0.04	0.11	0.11	0.28	56	0.14	0.17	0.11	0.22
1985	20	0.04	0.13	0.13	0.27	41	0.12	0.15	0.10	0.20
1986	14	0.02	0.05	0.05	0.15	72	0.15	0.19	0.15	0.24
1987	14	0.01	0.04	0.05	0.10	50	0.13	0.16	0.14	0.20
1988	19	0.02	0.08	0.06	0.19	52	0.14	0.17	0.13	0.21
1989	23	0.01	0.05	0.04	0.13	54	0.18	0.22	0.18	0.28
1990	21	0.02	0.08	0.07	0.21	60	0.10	0.12	0.10	0.16
1991	30	0.01	0.06	0.06	0.16	55	0.18	0.21	0.18	0.26
1992	25	0.02	0.08	0.02	0.16	55	0.14	0.18	0.15	0.24
1993	20	0.02	0.05	0.04	0.14	46	0.18	0.21	0.19	0.28
1994	17	0.04	0.06	0.07	0.18	48	0.16	0.20	0.17	0.26
1995	30	0.05	0.10	0.06	0.23	41	0.18	0.21	0.19	0.28
1996	15	0.02	0.06	0.04	0.15	41	0.20	0.24	0.20	0.32
1997	18	0.01	0.03	0.02	0.08	55	0.13	0.16	0.13	0.21
1998	13	0.03	0.06	0.06	0.22	31	0.15	0.18	0.17	0.24

NOTES: New store sites includes both store births and stores that move to new site. It does not include stores that remain at same address but change name.
SOURCE: Toronto video store sample. Calculations by author

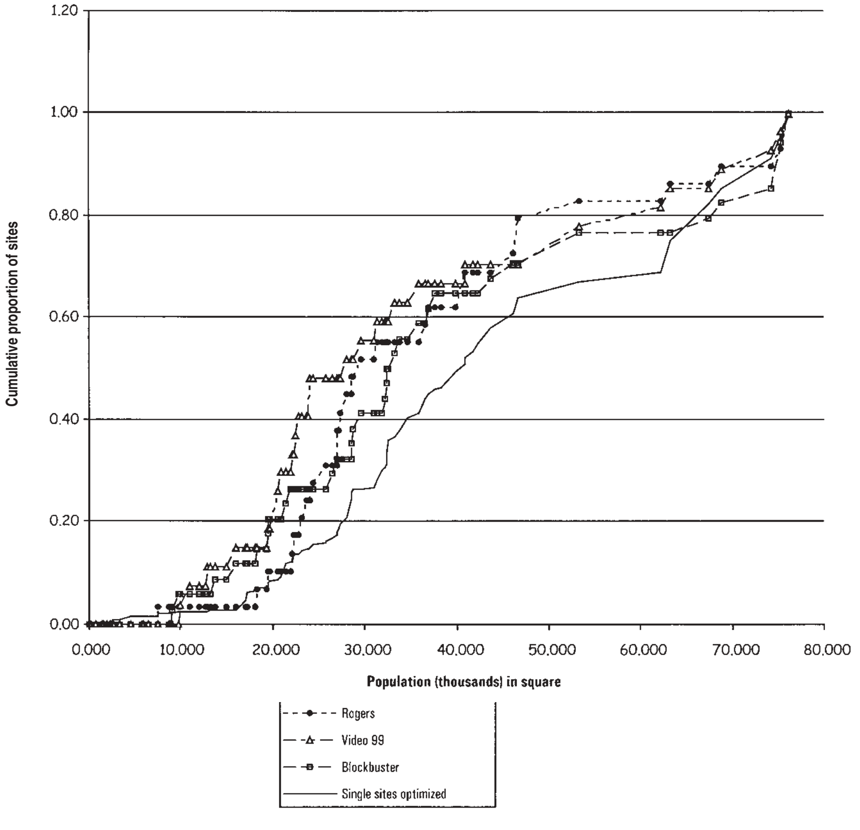

FIG. 8. Cumulative Distribution of Stores across Squares, Toronto, 1999

maximize profits, and end up cutting into the spatial markets of existent firms nearby. Consequently, some firms eventually die because their market area becomes too small to support the enterprise. It is important to note here that Lösch is not talking about the kind of locational issues that modern retailers think of, for example, parking facilities, ease of access, or complementary shopping facilities nearby), but simply spatial proximity to consumers' homes. Löschian analysis is constructed on the assumption of single-site firms, and this paper is careful to treat single-site and chain stores separately.

This paper has examined whether evidence from a case study of the video rental business conforms to Löschian analysis. The estimated model of store death suggests that chain and single-site stores are more likely to die if there are fewer nonelderly persons, and more competitors in the surrounding neighborhood. Survivorship of chain stores is also sensitive to the income of residents nearby, and is especially sensitive to the presence of chain stores nearby. The latter is consistent with the idea that chain stores in the video rental business tend to space themselves out regularly across the landscape while single-site stores are (relatively) prone to swarming.

Regular spacing is a feature of many kinds of retail chains. However, there are notable exceptions. Coffee shop chains (like Starbucks), for example, are prone to putting clusters of their stores in high-demand areas. What is it about video retailing that makes a chain less inclined to such a locational strategy? Is it an economies-of-scale argument (that is, one large store is more profitable for the chain than several small stores in the area), an identity argument (that is, consumers get confused or alienated when there is more than one outlet of the chain in their area), or something else? Answers to such questions are important if we want to better understand the important role that geography plays in locational competition.

Further, the differences between chain and single-site stores reveal much about evolution in the industry. What is it about single-site stores that make them still able to compete with chains? In this essay, I have hinted that single-site stores may have made niches for themselves, partly by swarming and partly by appealing to a different market segment (for example, adult or foreign language videos). To date, the major chains in the Toronto video store sample (with the possible exception of Blockbuster in a couple of districts of the City) have not followed suit. In other kinds of retailing, entrepreneurs have created sibling chains (as in clothing, for example, where The Gap has coverage upmarket with its Banana Republic chain and downmarket with its Old Navy chain). Presumably, we might expect to see video chains proliferate similarly in the future. In this paragraph, I link the notions of swarming and market segmentation because the creation of sibling chains also allows firms to swarm districts within the city even though it may have only one store of each chain locally. In that sense, we are still in the early days of video retailing; hence the emphasis on an "emerging" retail industry in the title to this paper. At the same time, the growing competition with video-on-demand and other ways of delivering video to consumers may mean that this industry will die out before it matures to this next level.

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