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"A Structural Analysis of Entry Order, Performance, and Geography: The Case of the Convenience-Store Industry in Japan"

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A Structural Analysis of Entry Order, Performance, and Geography: The Case of the Convenience-Store Industry in Japan*

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Abstract

Despite a large literature that documents a market-share advantage for pioneering firms, entry-order effects on economic profits and their implications for marketing strategy are largely unknown due to limitations in accounting profits and costs. This paper empirically examines the entry-order effects on profit components: revenues, entry costs, expansion costs, and variable costs. Unlike conventional analyses, this paper leverages a structural approach that does not require information on accounting profits and costs. By assuming that forward-looking firms maximize economic profits under strategic interactions, the approach infers cost and revenue parameters such that these parameters justify the observed entry and expansion behaviors as equilibrium outcomes of a dynamic game. I apply the revealed-preference argument to the panel data set from the convenience-store industry in Japan on store counts and revenues for 47 geographic markets for years 1984 through 2010. Variation in entry order, store counts, and revenues across markets, firms, and years, together with the dynamic equilibrium model, allows researchers to uncover the entry-order effects on revenue and cost functions. I find whereas a firm earns 5.0% more revenues at the outlet level relative to the next entrant, the next entrant earns a reduction in variable costs per outlet and expansion costs per outlet by 5.7% and 15.9%, respectively. The difference in entry-order effects on profits accounts for 10.1% of the differences in total economic profits across two leading firms, 7-Eleven and LAWSON. Based on the interplay between competition, market growth, and geography, simulation analyses reveal that a firm may initially benefit from postponing its market-entry consideration, but the advantage could disappear in around 25 years. The benefits for a late entrant are larger if the market is growing and distant from the firm's and competitor firms' parent companies' headquarters.

Keywords: Dynamic Games; Structural Estimation; First-Mover Advantage; Pioneer Advantage; Firm Performance; Order-of-Entry; Convenience Store; Chain; Retailing.

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1 Introduction

Does a pioneering firm entering a new market or developing a new product achieve higher performance than late entrants? Under what conditions and mechanisms does entry order affect economic profits? The entry-order effects on a firm's performance have been a topic of particular interest to marketing, economics, and strategic management scholars for over the past 40 years. Because economic profits are the ultimate objective for firms, a vast body of theoretical literature on entry-order effects provides models that assume firms maximize economic profits.[1] A large empirical literature has also followed and documented a market-share advantage for pioneering firms (see, e.g., Urban, Carter, Gaskin, and Mucha, 1986; Lieberman and Montgomery, 1988, 1998, 2012; Kalyanaram, Robinson, and Urban, 1995), because market shares are an accessible performance measure and limitations exist in utilizing accounting profits and accessing cost information. Nonetheless, market shares are shown to be incomplete proxies for economic profits (e.g., Jacobson, 1988; Lieberman and Montgomery, 1988). Consequently, entry-order effects on economic profits and their implications for marketing strategy, which are the essential objects of interest for scholars and practitioners, are largely unknown, and several empirical questions remain unanswered. For instance, how do forward-looking firms balance potential trade-offs between cost-side and demand-side (dis) advantages for early entrants in the presence of competitors and growing markets? If entry-order effects on profit components do exist, would expediting (postponing) entering a market relative to competitor firms make sense in the long run? If markets are heterogeneous, what would be a role of geography in shaping the strategic decision regarding entry timing?

This paper empirically examines the entry-order effects on major components in economic profits, revenues, entry costs, expansion costs, and variable costs. Unlike the conventional descriptive analyses that rely on access to accounting profits and costs, this paper leverages a structural approach that does not require information on accounting profits and costs. By assuming that forward-looking firms maximize economic profits under strategic interactions, this approach infers cost and revenue parameters such that these parameters justify the observed entry and expansion behaviors as equilibrium outcomes of a dynamic game. Relying on this revealed-preference argument, I apply the dynamic equilibrium model to the panel data set on store counts and revenues at the market level from the convenience-store industry in Japan from 1984-2010. Variation in entry order, store counts, and revenues across markets, firms, and years, together with the model, allows researchers to examine the entry-order effects on revenue and cost functions, while controlling for the strategic interactions among firms and the endogeneity of dynamic entry and expansion behavior.

The estimated parameters reveal a mixture of positive and negative entry-order effects on

[1] The seminal survey by Lieberman and Montgomery (1988) defines first-mover advantages as "the ability of pioneering firms to earn positive economic profit."

revenues and costs. I find the entry-order effects on the demand side materialize as a 5.0% increase in the average revenues per outlet relative to the next entrant. At the same time, a firm benefits from a 5.7% reduction in variable costs per outlet and a 15.9% reduction in expansion costs per outlet relative to the previous entrant. Because the revenue increase per outlet for early entrants and the reduction in variable cost per outlet for late entrants are recurring each year with similar magnitudes, late entrants are, on average, rewarded by a reduction in sunk costs of expansion per outlet. The difference in entry-order effects on economic profits accounts for 10.1% of the differences in total economic profits across two leading firms, 7-Eleven and LAWSON. Overall, the estimates seemingly suggest a late-mover advantage in all times. Nonetheless, the implications for marketing strategy may be more nuanced than these entry-order effects on revenue and cost functions, because an interplay among moderating factors in competition, market growth, and geography exists: markets are heterogeneous in demographics and the distance to each firm's largest shareholder's headquarters, which influences the likelihood of entry and thus competitors' responses.

To examine the model's implications for marketing strategy beyond the entry-order effects on model primitives, I conduct simulation exercises. Because three moderating factors exist– market growth, competition, and geography– I proceed in two steps. First, I conduct simulation exercises by focusing on the dynamics of the market growth and competition over time. The results reveal that on average, a firm may initially benefit from postponing its market-entry consideration for four years, but the advantage could disappear in around 25 years. Postponing a firm's entry consideration has two countervailing effects on a trajectory of store counts: On one hand, postponing its entry consideration accelerates the expansion speed in that market later on, because expansion is smoother and more rapid when the market demand is greater in level and growth rate ("demographic effect"). On the other hand, postponing its entry consideration is harmful from the perspective of competition, because during those four years of inactivity, competitors can increase their presence through market entry and expansion, which then discourages the firm's entry and expansion later on ("competition effect"). Overall, the latter effect starts to dominate the former in around 25 years since the beginning of the time horizon.

Second, I conduct simulation exercises by focusing on the role of geography on top of the role of market growth and competition in influencing the performance differences across markets. The results confirm that the implications of postponing an entry consideration differ across markets for two reasons. First, the demographic effect is greater in markets that are distant from the headquarters of the firm's largest shareholder company, because in such markets, the distance plays a less dominant role in shaping entry decisions. Meanwhile, the competition effect, namely, the loss in store counts due to competition, is greater if the market is close to the competitors' largest shareholder's headquarters, because these competitors have higher store counts. Overall, the managerial implications are that the benefits from postponing its market-entry consideration are larger when the market is growing and distant from the firm's and competitor firms' largest shareholder's (i.e., parent company's) headquarters.

This paper contributes to the sizable literature regarding entry-order effects on firm performance in three ways. First, this paper is among the few to shed light on the entry-order effects on economic profits and their components: revenues, entry costs, expansion costs, and variable costs. A large empirical literature on entry-order effects on performance has examined an advantage in market shares for pioneering firms (e.g., Golder and Tellis, 1993; Kalyanaram and Urban, 1992; Lieberman and Montgomery, 1988; Robinson and Fornell, 1985; Shankar, Carpenter, and Krishnamurthi, 1998).[2] Due to limitations in using accounting profits (e.g., Schmalensee, 1989) and in accessing firms' cost-side information, which are often kept private, however, existing evidence has mostly relied on survival measures (e.g., Bohlmann, Golder, and Mitra, 2002) and demand-side performance measures, such as market shares. Nonetheless, as a profit-maximizing entity, firms may also consider (dis) advantages for early entrants in various cost components, such as entry, expansion, and variable costs. For instance, late entrants may either benefit from reduced costs due to inter-firm technological spillovers (e.g., Ghemawat and Spence, 1985) or hurt from increased costs due to early entrants' preemption of scarce input resources (e.g., Main, 1955). The notable exceptions to a dearth of empirical studies on entry-order effects on costs and profits are Cui and Lui (2005) and Boulding and Christen (2003, 2008, 2009), where the latter authors use disguised cost variables and net income from the Profit Impact of Market Strategy (PIMS) database. Regrettably, those studies rely on accounting profits and costs and thus suffer from several limitations stemming from the conceptual divergence between accounting and economic profits (e.g., Schmalensee, 1989). Unlike these studies, this approach does not rely on accounting profits and costs, which would be useful for a marketer who may not fully observe competitors' information on profit components.

Second, unlike the existing empirical literature that does not endogenize entry and expansion behaviors of competitors, the current paper incorporates several institutional aspects of industries, such as forward-looking decision making in entry, expansion, and investment and strategic interactions across firms, which the recent literature in economics and marketing has documented as being salient (e.g., Ryan, 2012; Collard-Wexler, 2013). This approach has two benefits. First, by having a model that endogenizes entry and expansion, this approach avoids issues related to survivor bias (see, e.g., Golder and Tellis, 1993; VanderWerf and Mahon, 1997) and has a benefit of not requiring instruments for entry and expansion. Some existing work, such as Moore, Boulding, and Goodstein (1991), Boulding and Staelin (1993), and Boulding and Christen (2003), addresses the endogeneity of entry by instruments, but none has addressed the endogeneity of expansion behavior due to a lack of convincing instruments. Second, this paper points to the importance of simulating the market outcomes based on a dynamic model with strategic interactions, because the implications of entry order on

[2] This paper uses revenues and sales interchangeably.

economics profits differ across firms and markets due to the interplay of competition, market growth, and heterogeneous geographic markets.

Finally, this paper contributes to the literature on entry-order effects on performance in geographic markets. Because differences in resources and capabilities across firms may influence the market-entry strategies (e.g., Barney, 1986), utilizing multiple observations from a firm in a given year allows us to control for the differences in underlying resources at the firm level. Using cross-category data and regional roll-out data, Brown and Lattin (1994) document a market-share advantage for early entrants that is likely to decline over time. Bronnenberg, Dhar, and Dubé (2009) document a persistency of market shares in the 50 largest U.S. cities over many decades, using market-level data from 34 consumer-packaged goods (CPG) industries, and Bronnenberg, Dubé, and Gentzkow (2012) show past experiences influence such variations in market shares in the long run.[3] This paper examines the entry-order effects on economic profits through a structural approach and highlights the role of market growth, competition, and geography in shaping the entry-timing strategy.

2 The Institutional Background and Data

This section provides the empirical context of the study. I first introduce the Japanese convenience-store industry's competitive landscape and institutional background. I then describe the data and conduct descriptive analyses on the relationship between entry order and revenues by highlighting how the distance to the largest shareholder's headquarters relates to the entry order and market shares.

2.1 The Japanese Convenience-Store Industry

The convenience-store industry has been a thriving retail sector in many countries in the last couple of decades. For instance, the world's largest convenience-store chain, 7-Eleven, has more than 64,000 outlets worldwide in 2017.[4][5] The number of 7-Eleven stores exceeds the number of Wal-Mart stores and McDonald's restaurants worldwide by approximately 53,000 and 27,000, respectively. The convenience-store industry's total sales in Japan and the United States in 2011 explained 6% and 5% of total retail sales, respectively.

As in the United States, the convenience-store industry in Japan has been successfully expanding in store counts over the years as Figure 1 displays.[6] Although some contraction

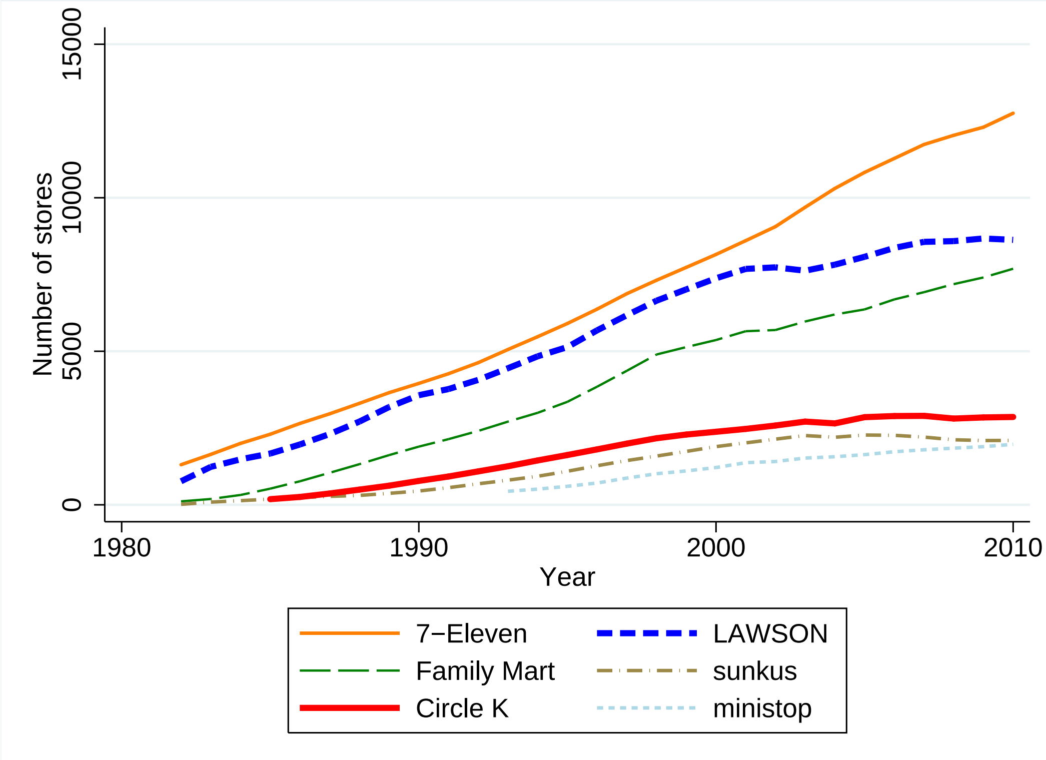
[3] Dubé, Hitsch, and Rossi (2000) study the short-run effects of past purchases on consumer choices.

[4] http://www.sej.co.jp/company/tenpo.html

[5] For expositional ease, the current paper uses chain and (multi-store) firm interchangeably.

[6] In the United States, where the sales of brick-and-mortar retail outlets are severely challenged by e-commerce, the number of outlets increased by 8,650 outlets in the Convenience & Gas category between 2007 and 2017 despite the rise of e-commerce, and the magnitude in store counts is the second largest among 20 retail categories. See https://www.statista.com/chart/13550/change-in-retail-store-count-by-category.

Figure 1: Total Store Counts in Japan by Year



at the market level exists, as Figure 1 suggests, exits at the market and firm levels are rare in Japan, and no major convenience-store chains failed in the data period.

One of the reasons for the business category's successful growth in Japan relates to a lack of entry regulations for small-size outlets. The convenience stores in Japan started their business when the government enforced the Large-Scale Retail Stores Law in 1973 to protect small- and medium-sized traditional retail stores from large-scale retail stores by preventing the opening of those large retailers. To address this challenge, several general-merchandise-store firms sought to introduce the convenience-store business category. The intent was two-fold: The first was to increase retail sales by freely opening small-sized convenience-store outlets with the latest technologies and distributions. The second was to reduce the capital costs of such expansion by recruiting existing small-sized retail outlets' owners, who were mostly independent, as these convenience-store chains' franchisees. The general-merchandise-store firms, Ito-Yokado Co., Ltd., The Daiei, Inc., Seiyu GK., Nagasakiya Co., Ltd., UNY Co., Ltd., and JUSCO Co., Ltd., started 7-Eleven Japan Co., Ltd, LAWSON, Family Mart, sunkus, Circle K, and ministop in 1974, 1975, 1973, 1980, 1980, and 1980, as those convenience-store chains' largest shareholders, respectively. I later exploit this convenience-store chains' vertical relationship with the nationwide retailers as an exclusion restriction in the empirical model.

Reflecting the convenience-store industry's economies of scale and scope in distribution, advertising, product developments, and purchasing power, the industry has become increasingly concentrated over time in Japan. The six largest firms in the industry are 7-Eleven, LAWSON, Family Mart, sunkus, Circle K, and ministop. They have been the major nationwide multi-store firms since they started their businesses in the late 1970s and early 1980s.[7] The industry structure has gradually shifted toward being concentrated due to the aforementioned economies of scale and scope. The six-firm concentration ratios (CR-6), which are the sum of the market-share percentage held by the six largest firms in sales in the industry, have steadily increased over time: 65.9, 77.4, and 86.2 in 1991, 2001, and 2010, respectively.

All six major firms exhibit store sizes similar to the national average. The average number of SKU items in a typical store ranges from 2,800 to 3,000 and is comparable across firms. The outlet format, including floor size, variety of goods, and pricing, is highly homogeneous across outlets within a firm, regardless of whether the outlet is a franchise or is company owned.[8] All six firms adopt uniform pricing across outlets in a firm. This feature of uniform product assortments and pricing allows researchers to avoid the issue of confounding effects of price and location (e.g., Duan and Mela, 2009) and price and volume.

2.2 Data

This subsection first introduces a market definition for the convenience-store industry in Japan. Based on the market definition, the subsection then describes the data sources and provides summary statistics.

Market Definition

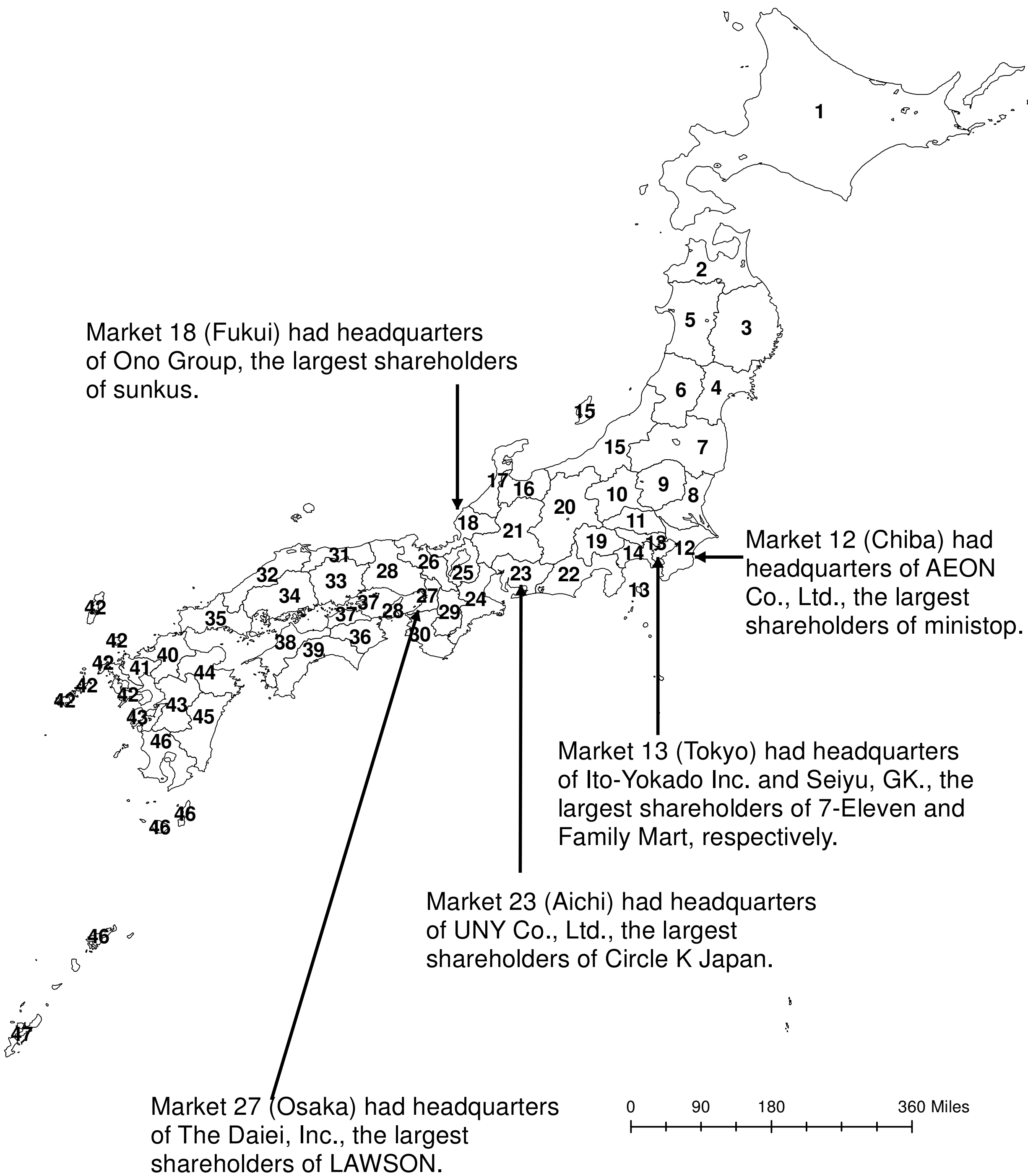
Figure 2 presents 47 prefectures in Japan, where each prefecture is a governmental body with a governor. These six major convenience-store firms in Japan have regional branches at the prefecture level aside from their corporate headquarters in Japan, and these regional branches are responsible for monitoring and advising existing outlets and developing new outlets in a prefecture. When they enter and expand in a market, these firms publicly announce the dates and locations of the new outlets through press releases, such that consumers and competitor firms are informed about the firm's plan in the prefecture that year. After entry, the competitor firms and investors learn about a firm's performance at the prefecture level in sales and store counts through the annual financial statements submitted to the Financial Services Agency of Japanese Government.

Aside from data accessibility, I treat each prefecture as an independent geographic market for three reasons. First, convenience-store markets are geographically isolated in demand

[7]The seventh-largest firm, Daily Yamazaki, had a market share of 0.8% in 2010, which was significantly smaller than the sixth-largest firm's market share of 4.0%.

[8]For the evidence of such homogeneity across firms, see Appendix C in Nishida (2017).

Figure 2: Locations of Six Firms' Headquarters in 1995 and 47 Prefectures in Japan



across prefectures. This market definition almost rules out the potential demand spillovers across markets (i.e., consumers crossing the prefecture boundary to shop at a convenience-store outlet) and resulting correlated demands, which bring a typical issue for analyzing retailing markets (see, e.g., Shen and Xiao, 2014; Toivanen and Waterson, 2005). The demand spillover is limited given that the average size of a prefecture is $3,104$ square miles and that a typical trade area for convenience-store markets has a radius of a half mile.[9] Because the convenience-store demand is approximately linear in population, this definition allows the accurate prediction of store counts at the market level. Second, for the supply side, each firm makes an entry decision at the prefecture level because the entry involves a large amount of sunk-cost investments in setting up prefecture-level local branches and facilities for distribution and logistics network at the prefecture level and establishing contracts with local lunchbox factories. Finally, collapsing firms' entry and expansion decisions at the market level allows researchers to construct and estimate a model with forward-looking firms under strategic interactions via two-step estimators. By contrast, a model that incorporates the dependence across markets either in demand or costs at a smaller market definition (e.g., blocks or streets) would suffer from tractability, which is problematic for estimating the primitives of a dynamic equilibrium model and simulating outcomes based on the estimated model.

Data Sources and Summary Statistics

Based on the market definition, I utilize manually collected panel data from the convenience-store industry in Japan. I obtain store counts and revenue information in annual financial statements from the six largest convenience-store firms: 7-Eleven, LAWSON, Family Mart, Circle K, sunkus, and ministop. A unique feature of the data is that these firms used to publish market-level store counts and revenues, unlike other public retail firms, which typically publish firm-level data in store counts and revenues that are multi-market aggregates. Exploiting this feature, several recent studies utilize this data set, including Nishida (2017) and Nishida and Yang (2017, 2018). The coverage of market-level store counts and revenues ranges across firms, and the longest period covers 1984 through 2010.[10] For the entry timing and entry order at the year-market level, I collected the historical data on each firm's roll-out year in a given market from the financial statements, direct communication with each firm's headquarters' investor relations department, or past local Yellow Pages obtained from the National Diet Library.

I supplement the data on store counts, revenues, and entry order with demographic

[9]A potential issue in defining a market too broadly against a trade area is that the empirical model may not well capture the business-stealing effects among firms, especially when the market is in an early stage such that it does not contain many outlets that directly compete against each other. Section 5 revisits this issue, where I present the empirical results on the competitive effects.

[10]Nishida and Yang (2017) provide the exact data-coverage years for each chain.

information from multiple sources. Annual population data at the prefecture level are sourced from the Census Bureau at the Ministry of Internal Affairs and Communications. The Cabinet Office provides annual income information at the prefecture level, and to compute the income per capita, I divide the aggregate income at the prefecture level by the population of that prefecture. Annual Handbook of Minimum Wage Decisions publishes information about minimum wage, which I include in the data as well. The total annual sales from the convenience-store industry come from the Current Survey of Commerce at the Ministry of Economy, Trade and Industry. Finally, the annual land-price data for multiple points for each of the prefectures are available from the Ministry of Land, Infrastructure, Transport and Tourism, where I take the average across data points for each of the prefectures to construct the land price index for that prefecture that year. For all variables subject to inflation, such as sales and income, I deflate nominal values by using the annual GDP deflator from the Cabinet Office. For the analysis of entry order and input prices Section 7.2 develops, I use cross-sectional information on the exact location of each outlet for all convenience stores in Japan in 2001 from TBC (2002), which provides the physical address of all outlets in Japan, which I geocoded into a latitude and longitude.

The summary statistics in Table 1 show that variation in store counts, sales per outlet, and the distance to the largest shareholder's headquarters exists across markets, years, and firms. The average sales per outlet provide a rough measure of the sales performance across firms before controlling for year, demographics, and endogeneity of entry and expansion. I compute the average sales per outlet by dividing a firm's total sales from a given market and a given year by the store counts of the firm in the market and year. Aside from 7-Eleven, which earns the highest sales per outlet, the average annual sales per outlet among all firms range from 140 million to 160 million Japanese yen. The data also exhibit variation in demographics, such as population and income, across markets and years.

The variation in the distance to the largest shareholder's headquarters is partially shown in Figure 2, which displays a snapshot of where these six firms' largest shareholders' headquarters were located in 1995. With the exception of markets 13 (Tokyo) and 12 (Chiba), where headquarters of the largest shareholders of 7-Eleven, Family Mart, and ministop were located, the locations of the headquarters of the largest shareholders were geographically dispersed across firms in 1995. The variable has variation across years for each firm due to several ownership turnovers for each firm during the data period.

To illustrate variation in entry order exists across markets, firms, and years, Table 2 presents three snapshots of entry order by firm and market in 1980, 1995, and 2010. The entry orders vary across firms and even within a firm for all firms.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N.
Number of outlets per market					
7-Eleven	275.095	265.773	1	1,676	695
LAWSON	169.668	185.017	8	1,255	654
Family Mart	141.311	181.773	1	1,158	777
sunkus	77.973	80.199	1	506	444
Circle K	115.819	163.311	1	858	365
ministop	76.581	73.592	1	308	303
Average sales per outlet (million Japanese yen, per year)					
7-Eleven	203.097	42.921	29.049	271.517	532
LAWSON	161.839	15.516	113.981	218.247	564
Family Mart	146.004	33.147	2	205.468	657
sunkus	156.519	31.413	4.125	212.8	297
Circle K	153.429	26.178	20.829	209.631	265
ministop	147.01	32.726	3	295	303
Distance to largest shareholder's headquarters (kilometers)					
7-Eleven	481.472	329.826	5.907	1,493.68	695
LAWSON	386.964	255.108	37.493	1,140.714	654
Family Mart	480.385	331.118	4.615	1,498.554	777
sunkus	447.739	306.596	4.023	1,488.17	444
Circle K	380.353	255.267	35.518	1,244.453	365
ministop	483.441	330.42	8.972	1,496.469	303
Market characteristics (47 markets * 27 years)					
Population (thousand people)	2,670.994	2,475.924	589	13,159	1,269
Population growth rate (percentage)	0.065	0.462	-1.153	2.022	1,201
Income per capita (thousand yen)	2,629.892	458.881	1,580.772	5,263.833	1,269
Income pc growth rate (percentage)	1.253	3.367	-15.712	16.594	1,201
Minimum wage (yen, per hour)	570.769	86.116	409.164	865.121	1,269
Land price (yen, per square meter)	179,063.505	218,499.839	35,727.082	2,480,561.25	1,269

Note: A unit of observation is a market-year combination for market characteristics. For revenues and number of outlets, a unit of observation is a market-year-firm combination. I calculate average sales per outlet by dividing a firm's total sales in a given year and market by the store counts in that market and year. Income per capita, wages, land prices, and sales are deflated by GDP deflator (base year 1990).

Table 2: Number of Markets by Historical Entry Order and Firms in 1980, 1995, and 2010

	Entry order in 1980							
Firm	1st	2nd	3rd	4th	5th	6th	No entry	Sum
7-Eleven	9	1	0	0	0	0	37	47
LAWSON	8	5	0	0	0	0	34	47
Family Mart	0	0	4	0	0	0	43	47
sunkus	0	0	0	0	0	0	47	47
Circle K	0	1	0	0	0	0	46	47
ministop	0	0	0	0	0	0	47	47
Total	17	7	4	0	0	0		

	Entry order in 1995							
Firm	1st	2nd	3rd	4th	5th	6th	No entry	Sum
7-Eleven	14	4	2	2	1	0	24	47
LAWSON	24	15	2	0	0	0	6	47
Family Mart	2	9	15	3	0	0	18	47
sunkus	1	3	4	4	5	0	30	47
Circle K	6	5	4	2	0	2	28	47
ministop	0	0	1	2	2	0	42	47
Total	47	36	28	13	8	2		

	Entry order in 2010							
Firm	1st	2nd	3rd	4th	5th	6th	No entry	Sum
7-Eleven	14	4	6	4	5	5	9	47
LAWSON	27	16	4	0	0	0	0	47
Family Mart	2	13	20	12	0	0	0	47
sunkus	2	6	6	9	11	1	12	47
Circle K	6	5	10	2	1	2	21	47
ministop	0	0	1	9	10	5	22	47
Total	51	44	47	36	27	13		

Note: In the third panel, the total number of the first and second entrants in 2010 does not sum up to the number of markets (i.e., 47), because of the presence of ties in the entry order in the years between 1996 and 2010.

2.3 Descriptive Analyses of Entry Order and Revenues

Before moving to the structural model in Section 3, this subsection offers some descriptive analyses about the entry order and revenues, which suggest a presence of an advantage in revenues for early entrants, and how this advantage relates to the distance to the largest shareholder's headquarters.

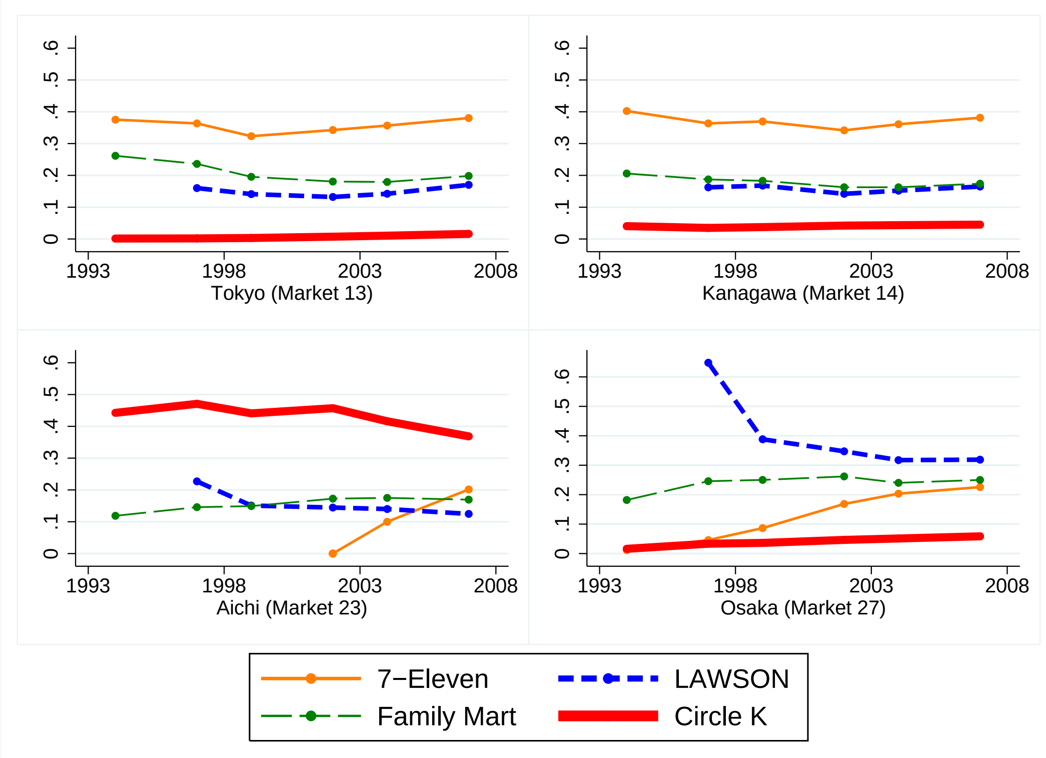
Due to the aforementioned vertical relationships between those convenience-store chains and their largest shareholders, which were mostly general-merchandise-store firms, the distance to the largest shareholder's headquarters tends to drive the entry decisions of a multi-store firm (i.e., chain) in two ways. First, the distance influences market shares. Each firm tends to earn the highest market shares in markets where their headquarters and their largest shareholder's headquarters are located among the markets it entered. Note that except for LAWSON after 2001 and sunkus, the markets where firms corporate headquarters are located are largely the same markets where those firms' largest shareholder's headquarters are located. The discussion on identification in Section 4.4 details why the distance to a firm's largest shareholder's headquarters serves as a refined exclusion restriction over the distance to each convenience-store chain's corporate headquarters, which the existing literature often utilizes (e.g., Zhu and Singh, 2009). Second, a firm tends to be an early entrant in markets where the largest shareholder's headquarters are located.

To take a closer look at market shares and entry order at the market level, I pick four major markets in Japan: Tokyo, Kanagawa, Aichi, and Osaka. I pick these markets for two reasons. First, they are the four largest markets in Japan in population. Second, three out of those four markets, Tokyo, Aichi, Osaka, have four of the convenience-store chains' largest shareholders' headquarters, as shown in Figure 2.

Figure 3 illustrates the variation in market shares across these four geographical markets. Note that for this industry, the variation is related to the distance to the largest shareholder's headquarters. In particular, in the markets with the largest shareholder's headquarters, a firm tends to earn higher store counts and thus market shares, and the tendency is not completely washed away over time. For instance, 7-Eleven and Family Mart, both of which have headquarters of their shareholding companies in Tokyo (market 13), earn the highest market shares in Tokyo and Kanagawa (market 14), which neighbors Tokyo. Similarly, LAWSON and Circle K earn the highest market shares in Osaka (market 27) and Aichi (market 23), where their largest shareholding companies' headquarters are located, respectively. The persistency of market shares over time echoes the findings from Bronnenberg, Dhar, and Dubé (2009).

Second, the distance influences the entry timing. Each firm tends to enter the market with the headquarters of the largest shareholding companies and geographically neighboring markets earlier than competitor firms. For instance, 7-Eleven and Family Mart are the first and second entrants in Tokyo, respectively, and the first and third entrants in Kanagawa, respectively, whereas LAWSON and Circle K are the first and second entrants in Osaka

Figure 3: Market Shares in Tokyo, Aichi, Osaka, and Japan



and Aichi, respectively. Together with the relationship between headquarters and market shares, these two patterns suggest the presence of market-share advantages for early entrants. Indeed, utilizing the same panel data set and regressions using the distance to the largest shareholder's headquarters as an instrument, Nishida (2017) provides descriptive evidence of the positive entry-order effects on revenues for early entrants through distribution.

Taken together, these two patterns suggest heterogeneous implications of entry and expansion decisions on performance across markets on the demand side. Nonetheless, to examine the role of geography in driving performance, as well as the implications beyond revenues, while accounting for strategic interactions among forward-looking firms, I will now proceed to the structural approach in the next section.

3 Empirical Model

This section develops a dynamic retail expansion model that explicitly takes into account entry-order effects on the revenue and cost functions.

The model has I forward-looking firms in the industry. At the beginning of each time period t, firm i observes the current state and first decides whether to enter a geographic market m, which I denote as $a_{imt} \in \{0, 1\}$, if the firm is not already active in that market.

Incumbent firms decide how many new outlets to open or close in geographic market m, which I denote as $n_{imt} \in \mathcal{A}$, where $\mathcal{A} = \{-A, ..., 0, 1, ..., A\}$ is the set of all feasible actions the firm can take.

Given these decisions, firm i's total number of active outlets in market m evolves according to $N_{imt} = N_{imt-1} + n_{imt}$, where N_{imt} is the total number of outlets in market m, and the current period's market structure is $N_{mt} = \{N_{imt}\}_i$. Because firms are forward-looking, firm i maximizes its discounted profit stream $\sum_s \beta^s \Pi_{imt+s}$, where $\beta \in (0,1)$ is the discount factor. Π_{imt+s} is the one-shot payoff at the market level as defined by

$$\Pi_{imt} = R(n_{imt}, N_{imt}, X^R_{imt}, F_{imt}, \zeta^R_{imt}, \xi^R_{imt}; \theta^R) - C(n_{imt}, N_{imt-1}, N_{-imt-1}, X^C_{imt}, F_{imt}, \zeta^C_{imt}, \xi^C_{imt}; \theta^C), \tag{1}$$

where θ denotes a set of parameters. In the one-shot payoff, $R(\cdot)$ is the total revenues from market m that the firm receives from operating N_{imt} active outlets, whereas $C(\cdot)$ is the total costs, which are a combination of operating costs and sunk costs associated with entering a market and adding or subtracting n_{imt} outlets in market m. F_{imt} denotes the entry order of firm i in market m at time t, which takes a value of 1 if firm i is the first entrant and 2 if firm i is the second entrant and so on. I assume here that firms play a game of incomplete information, as in Seim (2006). Accordingly, $\zeta_{imt} = (\zeta^R_{imt}, \zeta^C_{imt})$ can be interpreted as private information that is i.i.d. across markets and time with Type I Extreme Value distribution. I also include optimization error $\xi_{imt} = (\xi^R_{imt}, \xi^C_{imt})$. Unlike ζ_{imt}, the optimization errors will not have an impact on firm behavior, such that firms ignore these errors when constructing their best-response functions. From a technical standpoint, this optimization error brings this model closer to the Ellickson and Misra's (2012) modeling framework, which is a selection-correction approach to address potential biases in revenue regressions.

The total revenues are a function of the number of active outlets the firm has in the market (N_{imt}), the competitive landscape (N_{-imt}), demand-side market characteristics (X^R_{mt}), and the entry order (F_{imt}). I further decompose the revenues at the market level into the term that represents the number of outlets multiplied by the average per-outlet revenue and the terms of those various shocks I described. Namely,

$$R_i(\cdot) = N_{imt} \cdot r_{imt}(X_{imt}, N_{imt}, N_{-imt}, F_{imt}) + \omega_m + \theta^R_{FE,i} + \zeta^R_{imt} + \xi^R_{imt},$$

where $r_{imt}(\cdot)$ is the average per-outlet revenue at the market level represented by the following:

$$r_{imt}(\cdot) = \theta^R_1 + \theta^R_2 X^R_{imt} + \theta^R_3 D_{imt} + \theta^R_4 D_{-imt} + \theta^R_5 F_{imt}. \tag{2}$$

I utilize a specification with a revenue-per-outlet equation for three reasons. First, the literature on retailing and service has regarded the sales per outlet as one of the critical performance measures for a firm (see, e.g., Caves and Murphy, 1976; Martin 1988; Lafontaine, 1992). Second, practitioners have used this measure to gauge and compare sales performance across firms (e.g., Kosová, Lafontaine, and Zhao, 2012). Finally, because the market size in population differs significantly across markets, this decomposition yields a revenue equation that can be applied to markets with heterogeneous market size. The market-level demand characteristics affect revenues at the outlet level through θ_2^R. The presence of own-brand outlets may have an impact on sales, as reflected by θ_3^R. Furthermore, the presence of competitor firms may also impact sales, as reflected by θ_4^R. To measure the presence of own (competitor) outlets, I use the outlet density D_{imt} (D_{-imt}), which is the number of own (competitor) stores per population in that market. Namely, $D_{imt} = N_{imt}/X_{pop,mt}$. This density measure, which is normalized by population, allows these parameters, θ_3^R and θ_4^R, to provide consistent implications across markets with different market sizes. I capture the entry-order effect on the average per-outlet revenue by θ_5^R. The firm fixed effects in revenues at the market level are captured by $\theta_{FE,i}^R$. I let ω_m be a prefecture-level fixed effect to capture time-invariant heterogeneity in revenues across markets.

The market-level cost function $C_i(\cdot)$ is denoted by

$$\begin{aligned} C_i(\cdot) = {} & \theta_1^C X_{imt}^C + \theta_2^C \cdot 1\{a_{imt} = 1\} + \theta_3^C \cdot F_{imt} \cdot 1\{a_{imt} = 1\} \\ & + \theta_4^C \cdot |n_{imt}| + \theta_5^C \cdot F_{imt} \cdot |n_{imt}| + \theta_6^C \cdot N_{imt} + \theta_7^C F_{imt} \cdot N_{imt} + \theta_{FE,i}^C + \zeta_{imt}^C + \xi_{imt}^C, \end{aligned} \quad (3)$$

where θ_1^C is a parameter that describes how market characteristics affect the aggregate costs at the market level. The sunk costs of entering a market are captured by θ_2^C. A firm incurs this one-time sunk investment at the market level when it enters a market. For a retail firm, the entry costs include several items of expenditures at the market level, such as costs of setting up a facility for distribution, installing a system of logistics, and opening a regional office at the market level for monitoring and assisting operation of their franchised and company-owned outlets in that market.

The sunk costs of expansion and contraction are normalized at the outlet level and captured by θ_4^C. The expansion costs are a one-shot sunk investment a firm additionally incurs when it increases the number of outlets by one. In the context of convenience-store markets, the expenditures per outlet include costs of building a new outlet or remodeling an existing outlet, installing the outlet's point-of-sales system, recruiting and educating a franchisee for the outlet, and convincing consumers of the new business format (i.e., buyer education) in that outlet's trade area.

The variable costs at the outlet level are represented by θ_6^C. Unlike expansion and entry costs, the variable costs at the outlet level are the recurring expenses an outlet incurs every year. For the convenience-store outlets, variable costs include several items of expenditures at the outlet level, such as crew labor, rent, utilities, and wholesale costs of good sold. The firm fixed effects in costs at the market level are captured by $\theta_{FE,i}^C$. Finally, as in the revenue equation, both private information (ζ_{imt}^C) and optimization error (ξ_{imt}^C) are present.

Entry order influences revenue and cost components such that early entrants' revenues, entry costs, expansion costs, and variable costs may be different from subsequent entrants'. Parameters θ_5^R, θ_3^C,θ_5^C, and θ_7^C describe the entry-order effects on revenues at the outlet level, entry costs at the market level, expansion costs at the outlet level, and the variable costs at the outlet level, respectively.

Equilibrium

I define the Markov strategies as the mappings from payoff-relevant states to entry strategies and outlet expansion strategies. I use $S_{imt} = (N_{imt-1}, N_{-imt-1}, X_{imt}, F_{imt})$ to denote the payoff-relevant states, and σ_i^{entry} and $\sigma_i^{expand} : S \rightarrow \mathcal{A}$ to denote firm i's entry and expansion strategies, respectively. Let $\sigma = \{\sigma_i^{entry}, \sigma_i^{expand}\}_i$ be a Markov-strategy profile. Assuming firms employ a stationary Markov Perfect Equilibrium (MPE), the optimal strategy profile σ_i^* satisfies the following condition:

$$V_i(S_{imt}; \sigma_i, \sigma_{-i} | \sigma_i^*, \sigma_{-i}^*) \geq V_i(S_{imt}; \sigma_i, \sigma_{-i} | \sigma_i, \sigma_{-i}^*),$$

for all σ_i, with the Bellman equation defined as

$$V_i(S_{imt}; \sigma_i, \sigma_{-i}) = E[\Pi_{imt}(S_{imt}; \sigma_i, \sigma_{-i}) + \beta E(V_{imt}(S_{imt}; \sigma_i, \sigma_{-i}) | a_{mt} = \sigma^{entry}, n_{mt} = \sigma^{expand})].$$

For the empirical application, I restrict to symmetric equilibria across firms.

4 Estimation through Three Steps

This paper estimates the model in three steps. The first is to estimate flexible policy functions that approximate entry and expansion decisions. The second is to recover revenue parameters by employing Ellickson and Misra (2012), who allow for the potential selection bias. The final step is to recover the cost parameters by applying the forward-simulation approach based on the estimated first-stage policy functions ϕ and the revenue function. Given the potentially large state space associated with the retail expansion model, the three-step approach would be ideal, because solving the model itself would be computationally intractable given the curse of dimensionality.

4.1 Step 1: Policy Functions

The first step of this estimation approach is to approximate the policy functions σ_i for all i. To obtain this approximation, I follow a flexible parametric approach similar to Ryan (2012), who uses separate policy functions for investment in capacity and entry. The main objects of interest are $P(\sigma_i^{entry}|S)$ and $P(\sigma_i^{expand}|S)$. I use a binary probit estimator to obtain

$\hat{P}(\sigma_i^{entry}|S)$. The probability of entry can be characterized by the following binary probit regression:

$$\Pr(a_{imt} = 1|N_{imt-1} = 0) = \Phi(\psi_1 S_{imt} + \psi_2 \breve{S}_{imt}),$$

where S_{imt} are all payoff-relevant states, and $\breve{S}_{imt}$ are b-splines of the payoff-relevant states (i.e., finite-dimensional piecewise polynomials). Next, I use non-linear least squares to obtain expansion policy functions:

$$n_{imt} \quad = \quad \phi_1 + \phi_2 S_{imt} + \phi_3 \breve{S}_{imt} + \nu_{imt}^{expand},$$

where ν_{imt} are i.i.d. shocks.

4.2 Step 2: Revenue Function

I estimate the revenue function via regressions. The analysis makes use of the fact that I observe firm-specific revenues at the market level. Because of the potential selection bias in observed revenues that is induced by the underlying dynamic game of expansion, I employ a propensity-score method by Ellickson and Misra (2012). I run revenue regressions, with the inclusion of a control function $\Lambda(\hat{n}_{imt})$. Here, $\hat{n}_{imt}$ is the predicted number of opened/closed outlets as determined using the first-stage policy approximation. I make the control function a flexible function of $\hat{n}_{imt}$, which is approximated using high-order polynomials. The set of revenue regressions for company-owned and franchised outlets is defined as

$$R(\cdot) = N_{imt} r_{imt}(X_{imt}^{rev}, N_{imt}, N_{-imt}) + \Lambda(\hat{n}_{imt}) + \tilde{\vartheta}_{imt},$$

where $\tilde{\vartheta}_{imt} = \widetilde{\zeta^R}_{1imt} + \tilde{\xi^R}_{1imt}$ is a homoskedastic, mean zero error term. To obtain $\hat{n}_{imt}$, I take the average number of outlets across simulations for a given market and time.

To set up this selectivity-correction term, I choose a simple polynomial, which is a flexible non-linear function of the predicted number of added or subtracted outlets $\hat{n}_{imt}$:

$$\Lambda(\hat{n}_{imt}) = \varphi_1 \hat{n}_{imt} + \varphi_2 \hat{n}_{imt}^2.$$

The selectivity-correction term, $\Lambda(\hat{n}_{imt})$, is meant to control for the expectation of ϑ_{imt}, conditional on $n_{imt} > 0$.

4.3 Step 3: Forward Simulations

With the approximated policy functions and the revenue function in the first and second step, respectively, I proceed with forward simulations as proposed in Bajari, Benkard, and Levin (2007).

For the exogenous states, X_{imt}, I employ a seemingly unrelated regression (SUR) to simulate forward. I do so to capture the dynamics of the demand-side (e.g., population, income) and cost-side (e.g., minimum wage, land price) variables. Such an approach permits potential correlation between the exogenous variables. For example, income and property value often move along similar trends. The SUR specification is

$$\begin{bmatrix} X_{1mt} \\ X_{2mt} \\ \dots \\ X_{kmt} \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ \dots \\ c_k \end{bmatrix} + \begin{bmatrix} A_{11} & A_{12} & \dots & A_{1k} \\ A_{21} & A_{22} & \dots & A_{2k} \\ \dots & & & \\ A_{k1} & A_{k2} & \dots & A_{kk} \end{bmatrix} \cdot \begin{bmatrix} X_{1mt-1} \\ X_{2mt-1} \\ \dots \\ X_{kmt-1} \end{bmatrix} + \begin{bmatrix} e_{1mt-1} \\ e_{2mt-1} \\ \dots \\ e_{kmt-1} \end{bmatrix},$$

where $c = (c_1, \dots, c_k)$, $A = (a_{ij})$, and $\Omega = E[e_{mt}e'_{mt}]$ are parameters to be estimated.

To proceed with the inference, I assume the data are generated by a single MPE strategy, which is a typical assumption in applications that employ such forward-simulation estimation methods (e.g., Jeziorski, 2014; Ryan, 2012). Unlike nested fixed-point estimation methods, this assumption does not require any particular equilibrium selection; I am only assuming the equilibrium selection is the same across markets. By first using the initialized payoff-relevant states S_{im0}, and then using the approximated policy functions, I simulate the actions of the firms over time. For any given initial state $S_1 = (N_0, X_1)$, I can then forward simulate the following value function:

$$\begin{aligned} \bar{V}_{i,m}(S_1; \sigma^{entry}, \sigma^{expand}, \theta) &= \mathbb{E}\left[\sum_{\tau=1}^{\infty} \rho^{\tau-1} \Pi_{i,m}(\sigma^{entry}(S_\tau, \varsigma_\tau), \sigma^{expand}(S_\tau, \varsigma_\tau), S_\tau, \varsigma_{i\tau}; \alpha) \mid S_1, \sigma\right] \\ &\simeq \frac{1}{\bar{S}} \sum_{s=1}^{\bar{S}} \sum_{\tau=1}^{T} \rho^{\tau-1} \Pi_{i,m}(\sigma^{entry}(S^s_\tau, \varsigma^s_\tau), \sigma^{expand}(S^s_\tau, \varsigma^s_\tau), S^s_\tau, \varsigma^s_{i\tau}; \theta). \end{aligned}$$

Subscript s represents each simulation, where $\bar{S}$ paths of length T are simulated in the second stage. The term $\sigma(S^s_\tau, \varsigma^s_\tau)$ denotes a vector of simulated actions based on the policy profile σ.

With this construction of forward-simulated actions and payoffs, I then consider perturbations of the policy function to generate B alternative policies. With each alternative policy, I can obtain the forward-simulated profit stream using the previous two steps. I let b be an index for each off-equilibrium strategy. The forward simulations yield approximated value functions, in equilibrium and off equilibrium, and the difference in valuations for firm i in market m using inequality b is denoted by

$$g_{i,b,m}(\hat{\sigma}, \theta) = \bar{V}_{i,m}(S^b_1; \hat{\sigma}, \theta) - \bar{V}_{i,m}(S^b_1; \tilde{\sigma}_i, \hat{\sigma}_{-i}, \theta),$$

where $\hat{\sigma} = (\hat{\sigma}^{entry}, \hat{\sigma}^{expand})$. This difference should be positive in equilibrium, because off-equilibrium values have to be lower than discounted profits under equilibrium play. I estimate parameters θ by minimizing the number of cases in which off-equilibrium values exceed equilibrium values. Namely, I search for parameters that penalize cases in which $\bar{V}(S_1^b; \hat{\sigma}, \theta) < \bar{V}_{i,m}(S_1^b; \tilde{\sigma}_i, \hat{\sigma}_{-i}, \theta)$. The criterion function to minimize the violations of the equilibrium requirement is as follows:

$$Q(\theta) = \frac{1}{B} \sum_m \sum_i \sum_b (\min\{g_{i,b,m}(\hat{\sigma}, \theta), 0\})^2.$$

To estimate the parameters, I use 250 simulated inequalities. I generate the perturbations by randomly adjusting the parameters in the approximated policy function. To obtain the standard errors of these parameters, I employ bootstrapping in which I use 100 replications with replacement from a sample of 47 markets.

4.4 Identification

This subsection discusses how sources of variation in the data help identify the model primitives.

For the revenue parameters, identification follows from the fact that I observe the exact revenues for each firm at the market level. Furthermore, I control for market-specific heterogeneity via observed controls and market-level fixed effects. Of course, issues related to selection arise, in that I only observe revenues for cases in which a firm has at least one outlet. For this reason, I use the selectivity corrections based on control functions.

For identification of the strategic interaction parameters among firms, I rely on two exclusion restrictions (Bajari, Chernozhukov, Hong, and Nekipelov, 2007). First, I make use of the lagged size of the firm that ultimately enters through entry and expansion costs. This exclusion restriction is valid when the sunk costs are a function of a firm's past presence in the market, but are not a function of its rivals' past presence, such that a component of the profits is not universally relevant for all of the players. The second exclusion restriction I exploit is the physical distance to a firm's largest shareholder's headquarters, which provides an additional source of unique firm-market-specific variation in costs. This distance variable serves as an exclusion restriction for three reasons. First, because general-merchandise-store (GMS) firms started convenience-store chains as the largest shareholders, using their own resources, the distance to the headquarters of those GMS firms is likely to affect the entry of subsidiary companies (i.e., convenience-store chains) via various mechanisms, including the cost of monitoring (e.g., Brickley and Dark, 1987; Minkler, 1990). Second, the distance to the largest shareholder's headquarters was unlikely to affect preference shocks in the revenue equation, because GMS firms and convenience stores were operated separately, and thus customers did not have the chance to realize the association of these vertical relationships. This vertical aspect of the instrument serves as a refinement over the distance to the convenience-store chains' headquarters as an instrument, because for the latter instrument, convenience-store chains' brand equity could be correlated with the distance to their headquarters for several reasons, such as spillovers across prefectures via TV advertising. Finally, because the location decision of the headquarters of GMS firms were made decades before the introduction of the convenience-store chains as a new business category, the entry and expansion plans of convenience-store chains arguably did not influence the locations of GMS firms' headquarters.

For the costs of entry and expansion, identification follows from the variation in entry and expansion that the fitted revenues cannot already explain. As an additional identification argument, I note the specification includes market characteristics that are included in costs (i.e., land rent, minimum wage) but not revenue.

5 Empirical Results

5.1 Policy-Function Estimates for Entry and Expansion

This subsection describes the results from policy-function estimation. Overall, the estimates suggest two findings. First, the presence of competitor firms discourages entry and expansion, and simulation results confirm the magnitude of the competitive effect is economically significant. Second, the distance to a firm's largest shareholder's headquarters negatively influences the likelihood of entry. This relationship plays a role in generating market heterogeneity in outcomes that Section 6 investigates.

Table 3 provides the estimated policy-function approximations for entry. As expected, higher population and income, both in level and growth rate, increase the likelihood of entry.

Three key findings emerge from Table 3. First, the density of competitor firms' outlets discourages the likelihood of entry. Second, the coefficient on entry order implies that as the number of incumbent firms in a market increases, a firm is less likely to enter the market (albeit insignificantly). Taken together with the first finding, entrants are more discouraged to enter a market when the presence of competitor firms, either in the number of outlets or entry order, is more significant. Finally, the likelihood of entry is lower if the distance to the firm's largest shareholder's headquarters is greater. This negative relationship echoes the descriptive analysis in Section 2.3.

Table 4 describes the estimated policy-function approximations for expansion. As expected, again, population and income, both in level and growth rate, positively influence the degree of outlet expansion.

As in the policy function on entry, the presence of competitor firms measured by the density of outlets discourages the degree of expansion. Similar to Kalyanaram and Urban (1992), later entrants into the market expand more extensively than early entrants do conditional on entry. Furthermore, a firm is willing to expand more rapidly if the market is farther from their largest shareholder's headquarters, which partially offsets the negative effect of a

Table 3: Estimated Policy Function on Entry

	Coeff.	SE
Density of competitor chains' outlets	-2.9218	1.0904
Entry order	-0.0606	0.0497
Distance to headquarters	-0.2994	0.0687
Population density	0.0107	0.0742
Population density (growth rate)	16.1710	11.5669
Income per capita	0.0001	0.0002
Income per capita (growth rate)	2.8181	1.2529
Minimum wage	0.0070	0.0014
Land price	0.0000	0.0000
Constant	-3.6810	0.7181

Note: The number of observations is 3,503.

delay in entry in such markets on the trajectory of the store counts.[11]

Effect of Presence of Competitor Firms on Store Counts

An empirical question that often comes up in a study of concentrated industries is whether strategic interactions among firms would be negligible. For this purpose, this subsection quantifies how the presence of competitive firms would influence the total counts.

To implement this exercise, I simulate the entry and expansion behavior of the two largest firms in Japan, 7-Eleven and LAWSON, to study the evolution of market structure when each of four entry-order effects are muted. I run two forward simulations. The first baseline scenario mimics the reality by allowing all six firms to enter and expand over time. The counterfactual simulation ("duopoly scenario") allows only 7-Eleven and LAWSON to enter and expand, and does not allow remaining firms to enter. The comparison between these scenarios highlights the economic significance of those four entry-order effects on store counts.

Simulation results in Table 5 present the simulated store counts and profits for 7-Eleven after 25 years. The results imply the competition among firms significantly dampens the store counts and profits. 7-Eleven's overall store counts and profits increase by 34.9% and 14.4%, respectively, when the market structure allows oligopoly. Together with the negative business-stealing effect the next subsection presents, the magnitude suggests the need

[11] I quantify the countervailing effects of the distance to the largest shareholder's headquarters on entry and expansion through simulations using the settings Section 6 develops. The results reveal that the negative effect of the distance on the entry likelihood largely dominates the positive effect of the distance on the expansion speed.

Table 4: Estimated Policy Function on Expansion

	Coeff.	SE
Density of own outlets (lag)	171.8137	19.0506
Density of own outlets, squared (lag)	-894.9979	123.1961
Density of rival outlets (lag)	-41.5038	10.4031
Density of rival outlets, squared (lag)	21.6427	31.1974
Entry order	0.8842	0.2211
Distance to headquarters	0.6128	0.2335
Population density	3.0800	0.2484
Population density (growth rate)	211.3123	52.7701
Income per capita	0.0034	0.0008
Income per capita (growth rate)	-0.0342	6.1316
Minimum wage	-0.0197	0.0056
Land price	0.0000	0.0000
Constant	2.6765	3.4143

Note: The number of observations is 3,593.

Table 5: Simulated Store Counts and Profits of 7-Eleven after 25 Years

	Number of outlets	Profits
Baseline scenario: Six firms	5,094.40	6,174,124
Duopoly scenario	6,870.44	7,060,185

Note: I aggregate the number of outlets and profits of 7-Eleven across all markets. Profits are in million Japanese yen.

to account for the strategic interactions among firms for the convenience-store industry in Japan.

5.2 Revenue-Function Estimates and Entry-Order Effects

Table 6 presents the estimates of the revenue function described by Equation (2).

The parameter of interest is θ_5^R, which measures the entry-order effects on the revenues at the outlet level. With the full specification with firm-level fixed effects, I estimate $\theta_5^R = -7.52$, which suggests an entrant's outlet earns 5.0% (= 7.52/151.51) on average more than the next entrant in the same market. The key insight is that, on average, earlier entrants will enjoy higher revenues at the outlet level, which leads to a potential market-share advantage of early entry. Section 7.1 further discusses the implications of this positive entry-order effect on revenues for early entrants from theoretical arguments in the literature.

Most other coefficients have the expected signs. For instance, the estimate of the effect of the density of rival outlets on revenues at the outlet level is negative. The magnitude of the estimate suggests the business-stealing effects across firms are both statistically and economically significant. The negative sign of the business-stealing effect in revenues echoes the findings from the policy functions on entry and expansion decisions. The firm-brand fixed effects at the market level vary significantly across firms. 7-Eleven is the most successful in generating revenues per outlet, ceteris paribus. This finding is in line with the analysis of unconditional average sales per outlet in Section 2.3.

Meanwhile, the density of own-brand outlets has a positive effect on revenues. This effect of a firm's own outlets on the average revenues at the outlet level may be either the positive influence of past purchase experiences (e.g., Bronnenberg, Dubé, and Gentzkow, 2012) or some form of repetition effects (e.g., Batra and Ray, 1986; Nishida, 2017) on purchases.

5.3 Cost-Function Estimates and Entry-Order Effects

Table 7 provides the estimates of the cost-function parameters described by Equation (3). Note that due to the way I decompose profits into revenues and costs in Equation (1), a positive sign in Table 7 implies a positive contribution to the total costs (and thus reduces profits).

The estimates show these retail firms incur positive entry costs at the market level and positive expansion costs and variable costs at the outlet level. All other parameters except minimum wage exhibit expected signs. For instance, the higher the land prices, the higher the costs at the market level. Similarly, operating outlets farther away from their largest shareholder's headquarters is more costly. This pattern is consistent with Brickley and Dark (1987), who find the costs of monitoring franchisees' outlets increase in the distance from the headquarters. Similar to the demand-side estimates, the firm-brand fixed effects at the

Table 6: Estimated Revenue Function at the Outlet Level

		(1)	(2)
Constant (θ_1^R)		145.3764	151.5119
		(4.6838)	(4.1740)
Population density ($\theta_{2,population}^R$)		0.9176	-0.4232
		(0.6296)	(0.5432)
Income per capita ($\theta_{2,income}^R$)		0.0231	0.0235
		(0.0016)	(0.0014)
Density of own outlets (θ_3^R)		292.1216	119.2357
		(29.3763)	(25.9353)
Density of competitor firms' outlets (θ_4^R)		-209.8206	-119.5504
		(17.8070)	(15.5618)
Entry order (θ_5^R)		-6.2507	-7.5261
		(0.6099)	(0.5541)
Selection correction terms			
	φ_1	182.8093	-111.4771
		(65.9696)	(59.2888)
	φ_2	-31.1930	-34.1946
		(4.1710)	(3.5475)
Firm-brand fixed effects at the market level ($\theta_{FE,i}^R$)			
	7-Eleven		9469.4182
			(527.7611)
	LAWSON		-2924.7608
			(467.3258)
	Family Mart		-298.7625
			(415.8498)
	sunkus		1710.1738
			(603.7636)
	Circle K		-1449.2924
			(634.9965)

Note: ministop is the reference group for the firm-brand fixed effect.
Estimates are in million Japanese yen. The number of observations is 2,590.
Standard errors in parentheses.

market level vary across firms, and 7-Eleven is by far the most efficient convenience-store chain in Japan, followed by Family Mart.

For the variable costs per outlet, which represents the recurring costs for an outlet, the magnitude of the late entrants' advantage is around 7 million to 9 million Japanese yen per outlet per year. The magnitude of the entry-order effect amounts to a 5.7%(= 9.58/169.48) reduction in the total variable costs. Given that the sales-performance increase for early entrants is around 6 million to 8 million yen per outlet per year, these two opposing effects almost offset each other at the outlet level, yielding virtually no early entrants' (dis) advantage in variable profits (i.e., sales per outlet minus variable costs) at the outlet level.

For the effect of entry order on expansion costs at the outlet level, I find late entrants appear to expand with greater ease on the cost side. Parameter θ_5^C is negative and statistically significant at the 5% level. This result implies being an early entrant is associated with approximately15.9%(= 91.23/574.13) higher expansion costs per outlet. This finding is quantitatively consistent across specifications with and without firm-brand fixed effects. The results offer support for several explanations in Section 7.2 that are in favor of the disadvantages in expansion costs for early entrants.

Meanwhile, I do not find as much presence of the entry-order effects on entry costs. The parameter for the entry-order effect on entry costs, θ_3^C, is negative but is not precisely estimated at the 5% level, similar to the parameter for the sunk entry costs (θ_2^C).

Overall, I find negative entry-order effects on expansion and variable costs, but I do not find an entry-order effect on entry costs. Section 7.2 revisits and discusses the implications of these empirical findings from theoretical arguments in the literature.

Discussions: Evaluating Overall Entry-Order Effects on Economic Profits

The estimated revenue and cost functions, after controlling for the endogeneity of entry and expansion behaviors and strategic interactions, illustrate that entry order does play a role in both revenue and cost functions. In particular, whereas the entry-order effect leads to slightly higher revenues for early entrants at the outlet level, this effect is offset by the lower variable costs at the outlet level for late entrants. In addition, late entrants enjoy a reduction in the expansion costs at the outlet level. As a consequence, just from the perspective of parameters related to entry order in the revenue and cost functions, the net entry-order effects on early entrants are seemingly negative on average across markets due to reduced expansion costs for late entrants.

Nonetheless, these estimated entry-order effects on model primitives by themselves do not provide the overall entry-order effects on the trajectories of store counts and economic profits for two reasons. First, because several costs differ in their time horizon (i.e., recurring vs. one-shot expenditures) and in the level of aggregation (i.e., outlet vs. market-level expenditures), we cannot simply sum up these entry-order effects to obtain the overall implications for economic profits. Second, the interplay between competition, market evolution,

Table 7: Estimated Cost Function

		(1)	(2)
Entry costs per market (θ_2^C)		21842.9503	16637.1718
		(15508.0713)	(9521.1653)
Entry costs per market * Entry order (θ_3^C)		-2383.8437	-2563.7
		(2723.5921)	(1701.2915)
Expansion costs per outlet (θ_4^C)		618.5383	574.1296
		(144.1270)	(289.2186)
Expansion costs per outlet * Entry order (θ_5^C)		-71.8836	-91.2313
		(27.9790)	(27.7053)
Minimum wage ($\theta_{1,wage}^C$)		-7.7409	-5.2293
		(2.0997)	(1.7039)
Land price ($\theta_{1,land}^C$)		0.0042	0.0042
		(0.0031)	(0.0033)
Variable costs per outlet (θ_6^C)		140.0518	169.4816
		(22.1587)	(22.4875)
Variable costs per outlet * Entry order (θ_7^C)		-6.7918	-9.5784
		(0.9538)	(2.2008)
Distance to headquarters ($\theta_{1,distance}^C$)		10.4191	6.9268
		(3.7923)	(4.1934)
Firm-brand fixed effects at the market level ($\theta_{FE,i}^C$)			
	7-Eleven		-150413.7950
			(19424.7607)
	LAWSON		-19784.7384
			(16232.8627)
	Family Mart		-38346.8413
			(6804.7254)
	sunkus		-19548.9793
			(6391.2250)
	Circle K		-24869.0675
			(10502.9630)

Note: ministop is the reference group for the firm-brand fixed effect.
Estimates are in million Japanese yen. The total number of inequalities evaluated is 9,870.
Standard errors in parentheses.

and market heterogeneity in the distance to the largest shareholder's headquarters influences the outcome in store counts and economic profits. For these reasons, the next section in various settings delivers implications of how entry order affects firm performance in different markets through simulations.

6 Examining Implications of Entry-Order Effects in a Dynamic Model through Simulations

This section examines the implications of entry-order effects in a dynamic model via simulation exercises.

The section has two goals. First, I evaluate the magnitude of entry-order effects against overall economic profits and their components at the firm level. Second, I investigate the implications of entry-order effects in a dynamic model for marketing strategy. In particular, I examine how deliberately postponing an entry consideration into a market yields heterogeneous consequences over time and across different geographical markets.

To evaluate several hypothetical scenarios, I forward simulate the outcomes based on the estimated parameters, following Benkard, Bodoh-Creed, and Lazarev (2010) and Jeziorski (2014). Throughout this section, I run 250 simulations for each of 47 different geographical markets with two leading firms, 7-Eleven and LAWSON, and take the average of the outcomes across 250 simulations. For simplicity, I deactivate the other four firms, but the implications do not change if I allow them. I endogenize the entry and expansion decisions of both firms by forward simulating the path of store counts using the entry and expansion policy functions estimated in the previous section. To compare revenues, costs, and economic profits between these two firms easier, I deactivate the firm fixed effects for the revenue and cost components and market fixed effects in revenues.

To highlight the role of each firm's distance to its largest shareholder's headquarters in influencing the implications of the simulation outcomes, I control for other differences in demographic variables, such as market size, by setting all markets to follow the initial condition in market 6 (Yamagata) in all demographic variables. With each year's idiosyncratic shocks in these demographic variables at the market level and the SUR estimates I obtain in the third step, I forward simulate the evolution of the demographic variables for each market.

6.1 Measuring Entry-Order Effects on Economic Profits

This subsection compares the magnitude of entry-order effects against economic profits and their components at the firm level. For this purpose, I forward-simulate the outcomes for 30 years and aggregate the entry-order effects in revenues across all 47 markets for each firm (i.e., $\sum_{m=1}^{47}(N_{im,t=30} \cdot \theta_5^R)$). Note this term– absolute entry-order effects in revenues– is a simple sum of the entry-order component in the revenue function across markets and thus is not de-meaned using either the first or the last entrant's component as the benchmark. Therefore, the sign of this effects is not itself informative about whether the overall entry-order effects on revenues are positive. Rather, by taking the difference of this term across firms, this measure is meaningful for comparing two firms' entry-order effects on revenues. Similarly, I construct the aggregate entry-order effects in costs by summing up the three entry-order components in cost function, variable costs, entry costs, and expansion costs, and aggregating them across 47 markets for each firm (i.e., $\sum_{m=1}^{47}(\theta_3^C + |n_{im,t=30}| \cdot \theta_5^C + N_{im,t=30} \cdot \theta_7^C)$).

Table 8 presents the simulation outcomes for 7-Eleven and LAWSON. Reflecting that Japan has more markets in which the distance to the largest shareholder's headquarters of LAWSON is shorter than the distance to the largest shareholder of 7-Eleven would be, LAWSON tends to be the earlier entrant in more markets than 7-Eleven: the average entry order of 1.403 implies LAWSON is the first entrant for 59.7% in all markets on average. As a result of the early entry and subsequent expansion with less competitive pressure, LAWSON yields more store counts and economic profits than 7-Eleven.

Turning to the differences in entry-order effects across these two firms, LAWSON earns a larger advantage in revenues per outlet by 0.31 million Japanese yen ($= -9.57 - (-9.89)$), because it tends to be the earlier entrant on average across markets. Meanwhile, 7-Eleven earns advantages in reduced costs per outlet by 1.38 million ($= 15.36 - 16.75$). Taken together, the positive entry-order effects for late entrants on costs, 1.38 million Japanese yen per outlet, dominate the negative entry-order effects for late entrants on revenues, 0.31 million Japanese yen per outlet.

Overall, the outcomes from the snapshot in 30 years since the beginning of the time horizon suggest a late-mover advantage in profits, and the magnitude of the entry-order effects on economic profits is non-negligible in two ways: the difference in entry-order effects accounts for 10.1%($= 4,570/45,453$) of the differences in total economic profits across 7-Eleven and LAWSON, and the entry-order effects in level account for 26% and 19% of the total economics profits of 7-Eleven and LAWSON, respectively.

6.2 Effect of Deliberately Postponing Entry into Markets on Performance

This subsection examines the effects of deliberately postponing the entry consideration on firm performance.

With the magnitude of the entry-order effects on profit components in the previous subsection, of interest to managers might be whether deliberately postponing its considerations to enter a particular market yields a higher performance in store counts and profits. A trade-off exists in this strategic decision. On one hand, with some market-demand prospects, a firm may defer its entry consideration and expand until the potential demand for convenience-

Table 8: Entry-Order Effects on Economic Profits in 30 years

		7-Eleven	LAWSON	Difference
Store counts: (0)		7,421	8,001	-580
Entry order		1.465	1.403	0.062
Total revenues: (1)		1,611,593	1,745,809	-134,216
Total costs: (2)		1,413,745	1,502,508	-88,763
Total economic profits: (3) =(1) - (2)		197,847	243,300	-45,453
Entry-order effects				
	On total revenues: (4)	-73,372	-76,599	3,227
	(per outlet) = (4)/(0)	-9.89	-9.57	-0.31
	On total costs: (5)	124,270	122,928	1,343
	(per outlet) = (5)/(0)	16.75	15.36	1.38
Total entry-order effects: (6) =(4) + (5)		50,898	46,328	4,570
Fraction to economic profits: =(6)/(3)		0.26%	0.19%	0.07%

Note: I aggregate each market's simulation outcomes across 47 markets.
Estimates are in million Japanese yen.

store markets becomes strong enough in a given market. This action allows the firm to grow more rapidly in that market, as the estimated expansion policy function in Table 4 suggests.

On the other hand, however, a firm may wish to be one of the early entrants in markets either to have less influence from its competitor or to discourage the likelihood of competitor firms' entry and expansion, as suggested in the entry and expansion policy functions. The analysis is further complicated by the fact that markets differ not only in demographics, which the simulations turn off for simplicity, but also the distance to each firm's largest shareholder's headquarters, which affects their entry and expansion decisions. Accordingly, quantitatively evaluating these two opposing factors requires simulation exercises based on the estimated model and heterogeneous markets.

This subsection compares the outcomes from two distinct scenarios. In the counterfactual scenario, 7-Eleven postpones its decision to enter that market for the four years from the beginning of the time horizon, and resumes to be actively making decisions of entry and expansion after these four years. This scenario provides the opportunity for the competitor firm, LAWSON, to enter and expand while the competitive pressure from 7-Eleven is absent for those four years. The baseline scenario ("Baseline"), on the other hand, does not have any restriction regarding when both firms enter and expand.

Because three moderating factors exist in influencing the entry-order effects on performance, that is, market growth, competition, and geography, I first examine the dynamics of the first two factors by focusing on the trajectory of store counts over time. I then examine how the third factor, geography, could influence the dynamics of these two factors, by focusing on the snapshot of the industry across markets.

6.2.1 Role of Demographics and Competition in Influencing Long-run Store Counts

This subsection examines the long-run consequences of a firm's decision to postpone its market-entry consideration on store counts. Because the purpose of this exercise is to examine the implications over time, I simulate the entry and expansion decisions for 7-Eleven and LAWSON, and generate the average trajectory in store counts for 7-Eleven across all 47 simulated markets. The focus is 7-Eleven's decision to postpone its entry for four years, but the implications do not change if I switch the roles that 7-Eleven and LAWSON play.

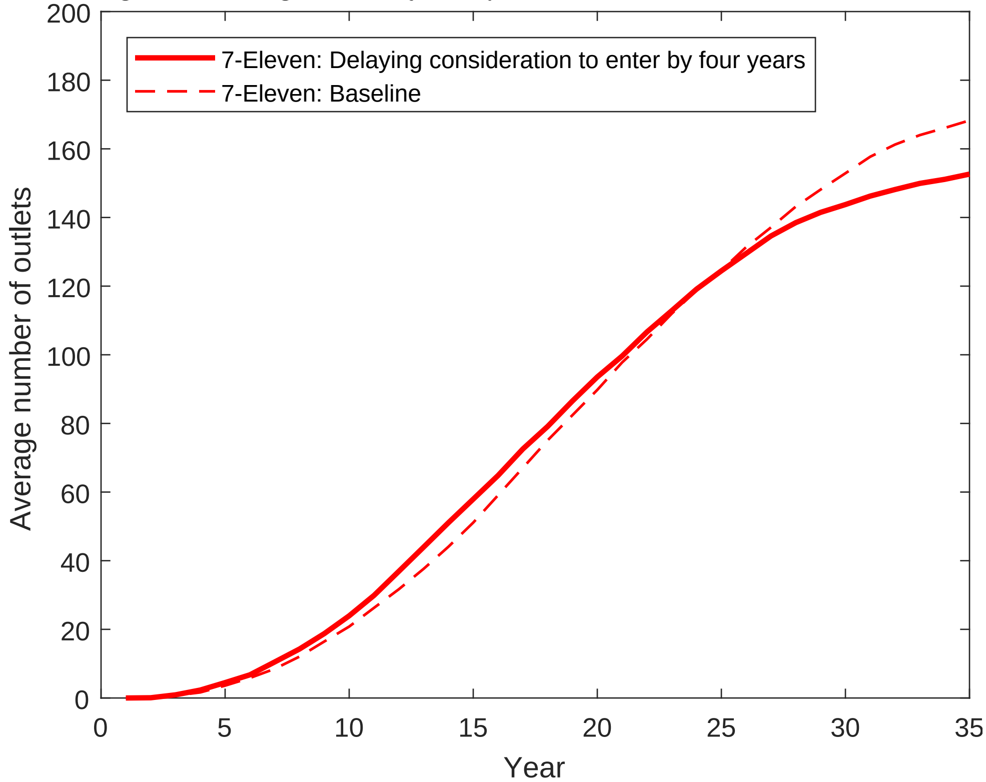
Figure 4 highlights the roles that competition and demographics play in influencing the long-run trajectory of 7-Eleven's store counts over time. The year on the x-axis measures the years since 7-Eleven initiated its entry consideration in both the hypothetical case and the baseline case.[12]

Two noteworthy patterns emerge from Figure 4 by comparing the counterfactual and the baseline scenarios. First, for 7-Eleven, postponing its market-entry consideration leads to a higher store count up to somewhere around 24 years. This gain in store counts is due to the evolution of demographics. Namely, when markets are growing in population density, as shown in the actual markets and the markets I simulate via SUR, postponing its market-entry consideration increases 7-Eleven's expansion speed upon entry later on, because expanding is smoother than in a case in which population density and its growth rate is low ("demographic effect"), as the expansion policy function suggests. Second, nonetheless, the growing presence of 7-Eleven's competitor, LAWSON, is more harmful for 7-Eleven's entry and expansion when 7-Eleven postpones its entry consideration ("competitive effect"). On average across markets, the competitive effect matches the demographic effect in 25 years, and eventually, this competitive effect influences the differences in the long-run steady-state store counts across these two scenarios in 35 years.

Taken together, the simulations reveal that a trade-off between the demographic effects and competitive effects delivers heterogeneous consequences in store counts over time. In particular, a late-mover advantage does initially exist but may be short lived in a time horizon of more than 30 years. Because the trajectory is an average across markets, however, the simulations do not exhibit how the heterogeneity across markets would influence the trade-off. The next subsection sheds light on this geographic aspect, holding the time-horizon aspect constant.

[12] For instance, if the baseline scenario with no delay in entry consideration starts in 2000, the year for the baseline scenario measures the years since 2000, whereas the x-axis for the hypothetical scenario measures the number of years since 2004 (= 2000 + 4).

Figure 4: Long-run Trajectory of Store Counts for 7-Eleven



6.2.2 Role of Geography in Influencing Performance

I now examine the role of geography in influencing the performance differences across markets and implications for marketing strategy. Geographical markets are heterogeneous in many aspects, including population, income, and the distance to the headquarters. Because the distance is one of the key variables that determine the likelihood of entry and expansion, this subsection focuses on the implications of geography by looking at 47 simulated markets that are identical at the beginning of the time horizon, except for each firm's distance to its largest shareholder's headquarters and idiosyncratic shocks in the demographic variables.

Figure 5 compares 7-Eleven's store counts by market in the 26 years ($= 30 - 4$) since 7-Eleven initiated its entry consideration in both the postponing and baseline scenarios. I choose 26 as the benchmark years since being allowed for entry consideration, because, as Figure 4 shows, the trade-off in store counts is likely to be the most sensitive in years 24 through 26. Reflecting the negative effect of the distance on the likelihood of entry in the policy function, the scatter plots show a negative relationship between the store counts and the distance to 7-Eleven's largest shareholder's headquarters for 47 simulated markets.

Figure 5 yields heterogeneous implications across markets in store counts for 7-Eleven. In some markets distant from the headquarters, postponing its entry consideration by four years may actually allow 7-Eleven to achieve higher store counts than it does in the baseline

Figure 5: 7-Eleven's Number of Outlets in 47 Markets

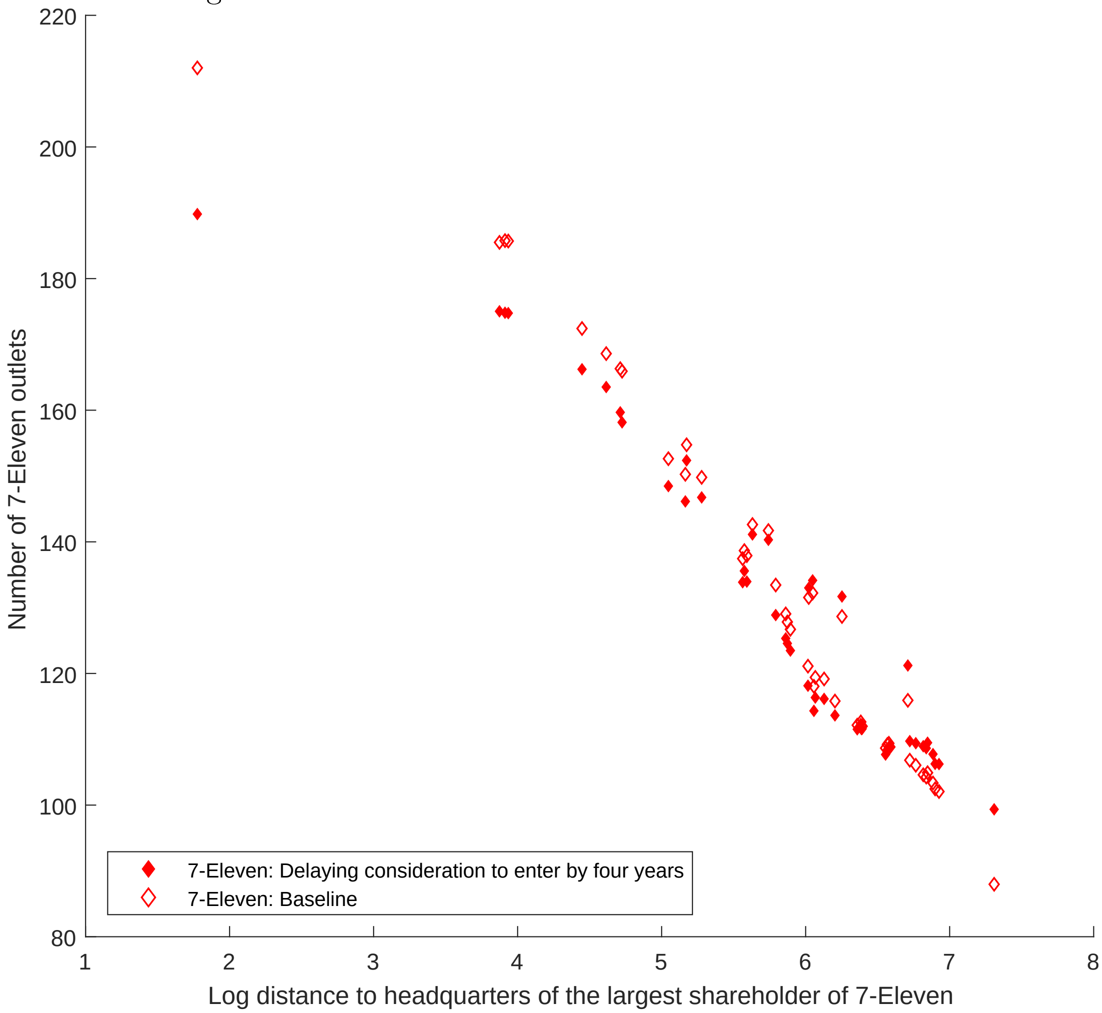


Table 9: Gains in Store Counts by Postponing Entry Consideration

	(1)	(2)
Distance to 7-Eleven's largest shareholder's headquarters	4.9543	4.8103
	(0.157)	(0.282)
Distance to LAWSON's largest shareholder's headquarters	2.0666	
	(0.205)	
Constant	-42.4429	-29.8334
	(1.556)	(1.665)
R-squared	0.960	0.866

Note: The dependent variable is the gain in 7-Eleven's store counts by postponing its market-entry consideration. The number of observations is 47. Standard errors in parentheses.

without a delay. Meanwhile, 7-Eleven earns lower store counts than in the baseline case when 7-Eleven enters in markets close to its largest shareholder's headquarters.

As the previous subsection illustrates, the trade-off between the evolution of market demographics and the presence of a competitor generates these heterogeneous implications across markets for 7-Eleven. On one hand, a gain in store counts exists when postponing its entry consideration, because expansion is smoother and more rapid when the markets are growing. Because the distance to 7-Eleven's largest shareholder reduces the likelihood of entry, as Table 3 displays, the gain from postponing its entry consideration is more pronounced as the distance becomes greater. On the other hand, the competition effect tends to be larger in markets that are located close to market 26 (Osaka), where LAWSON's largest shareholder's headquarters are located: As the distance to LAWSON's parent company's headquarters decreases, LAWSON's entry tends to be more active, thus making postponing 7-Eleven's entry consideration more costly. In other words, the gains from postponing its entry consideration increase in the distance to LAWSON's parent company's headquarter. Simple regressions in Table 9 indeed confirm the gain in store counts from postponing its market-entry consideration is higher if the distance to 7-Eleven's and LAWSON's parent companies' headquarters is higher.

Taken together, these two countervailing effects yield contrasting managerial implications for 7-Eleven in different geographic markets: a firm should (not) postpone entry consideration when the market is growing (not growing) in population and the market is distant from (close to) the firm's and the competitors' parent companies' headquarters, ceteris paribus.

Meanwhile, Figure 6 shows the competitor, LAWSON, earns gains in store counts from not having the new entrant for the first four years in all markets. Unlike 7-Eleven, the benefits of the late entry by its rival measured in store counts are almost constant across

Figure 6: LAWSON's Number of Outlets in 47 Markets

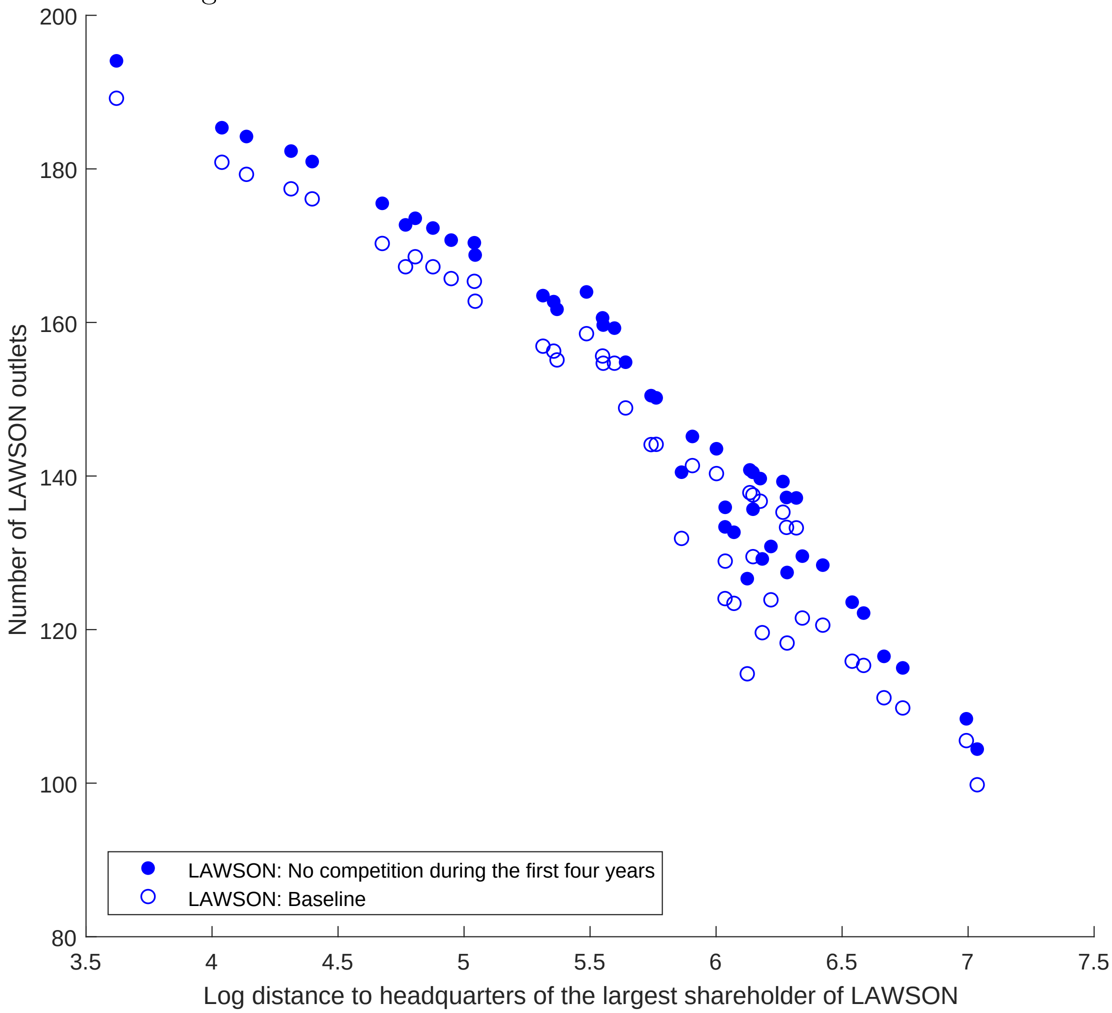
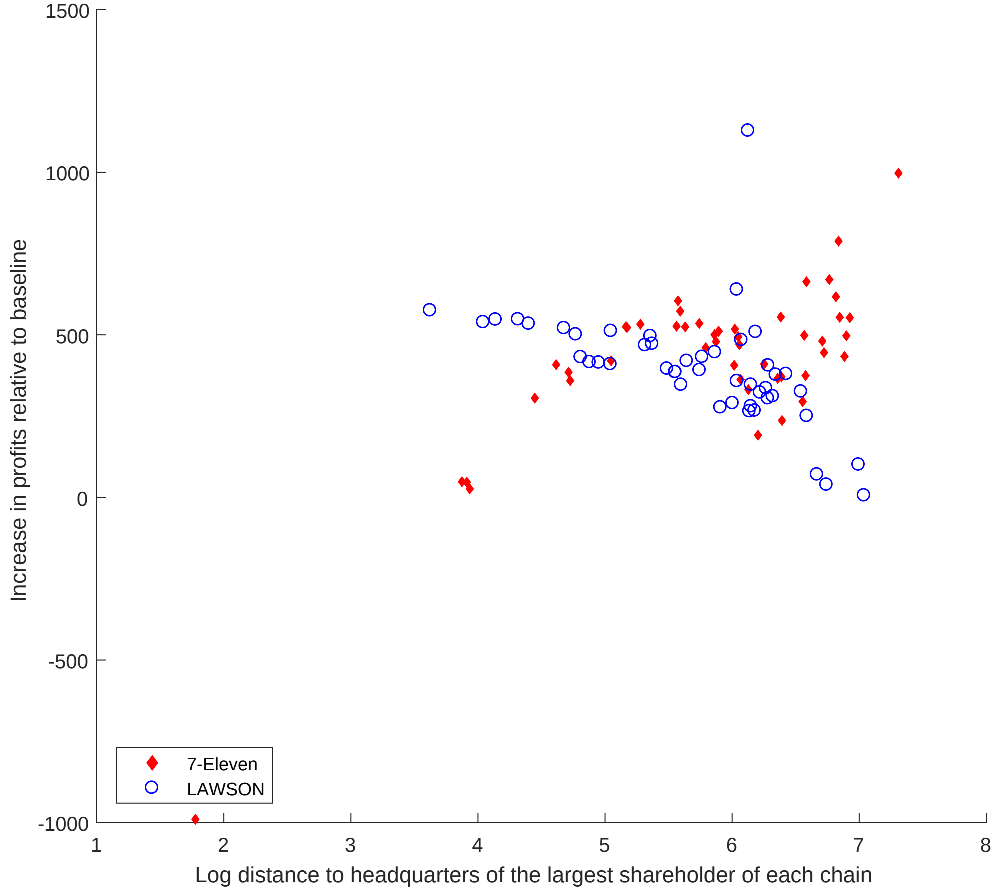


Figure 7: Profit Gains by Postponing Entry Consideration in 47 Markets



markets and do not vary in the distance to LAWSON's largest shareholder's headquarters. This result suggests that unlike 7-Eleven, the differences in 7-Eleven's actions across markets do not significantly affect LAWSON's entry and expansion decision.

Figure 7 delivers this simulation exercise's implications in economic profits for both firms. Because the firm fixed effects in revenues and costs are absent, the difference in profits among these two firms solely comes from the store counts and the distance to their largest shareholder's headquarters. For 7-Eleven, postponing its entry consideration increases profits in all markets except market 13 (Tokyo), because late entrants are rewarded by reduced expansion costs. In particular, 7-Eleven benefits from this late entry consideration where the headquarters are far away from the markets, reflecting the gain in store counts in those markets as Figure 5 shows. Note that these managerial implications are valid for around 26 years on average and may be subject to change as the previous subsection suggests.

7 Discussion of Pioneering (Dis) Advantages in Costs and Revenues: Theory and Empirics

This section discusses the general implications of the observed entry-order effects on several profit components in Section 5 from the perspective of several theoretical arguments on entry-order effects in the literature. Because extensive theoretical arguments exist, the list of potential sources for pioneering (dis) advantage is by no means exhaustive. Rather, I point to those that may be relevant in the context of the empirical setting.

7.1 Sources of Revenue (Dis) Advantage for Early Entrants

The extant literature on entry-order effects provides three distinct predictions about how entry order affects the sales performance measured by the revenue per outlet. First, firms may benefit from being early entrants in the market due to prime location (e.g., Lieberman and Montgomery, 1988), increased brand awareness via prototypicality (e.g., Carpenter and Nakamoto, 1989) and repetition effects (e.g., Batra and Ray, 1986), switching costs (e.g., Klemperer, 1987; Wernerfelt, 1986), and uncertainty about the quality differential between an entrant and incumbents (e.g., Coscelli and Shum, 2004). Second, meanwhile, being an early entrant could offer no demand-side advantages. For instance, Judd (1985) argues that entry deterrence through preemption of product and geographical space is not credible for incumbents when the investment costs are not sunk. Finally, later entrants may grow faster than the pioneer, because late entrants are able to free-ride the informative marketing activities (e.g., Ching and Lim, 2017), and greater diffusion of innovative later entrants may reduce the effectiveness of early entrants' marketing (e.g., Shankar, Carpenter, and Krishnamurthi, 1998; Shankar and Carpenter, 2012).

These different theoretical predictions about sales performance yield an empirical question about whether either early entrants or late entrants achieve higher sales per outlet. Although the majority of existing research has documented a negative relationship between entry order and market shares (e.g., Kalyanaram, Robinson, and Urban, 1995), some studies report a positive or no relationship (see, e.g., Golder and Tellis, 1993).

The empirical findings in Section 5.2 support the first prediction. In particular, the observed pioneering advantage in revenues for the convenience-store industry is consistent with Porter (1976) and Schmalensee (1982), who argue consumers may stick with the first brand when uncertainty in product quality exists in low-cost convenience goods. That I do not find support for the second prediction may be driven by the presence of sunk costs for entry and expansion that the estimates suggest.

7.2 Sources of Costs (Dis) Advantage for Early Entrants

Several potential sources of cost (dis) advantage exist for early entrants. Because various costs differ in their time horizon (i.e., recurring vs. one-shot expenditures) and in the level of aggregation (i.e., outlet vs. market-level expenditures), I separately argue the entry-order effects on costs in three dimensions: expansion costs, entry costs, and variable costs.

Sources of (Dis) Advantage in Expansion Costs at the Outlet Level

The marketing research offers two opposite predictions about the entry-order effects on expansion costs per outlet. On one hand, a strand of literature predicts a lower cost for expansion for late entrants for two reasons. The first reason is free-rider effects on investments in buyer education, R&D, and infrastructure (e.g., Lieberman and Montgomery, 1988). Because convenience stores were perceived to be different from existing small-size independent retailers and were seen as a new business format in Japan in the late 1970s and early 1980s, late entrants in a market may face lower costs of educating consumers, convincing and persuading potential franchisees, and launching new technology regarding retail logistics. For instance, additional marketing expenses for consumers and potential franchisees may decrease as the awareness of the business format increases. Similarly, by entering late, a firm may be able to imitate the same technology at a lower cost, provided that the costs of imitation are lower than costs of innovation (e.g., Mansfield, Schwartz, and Wagner, 1981). For convenience-store markets, technology imitations amount to the investments in technology associated with logistics and distribution, including adopting the latest version of the point-of-sales (POS) system that assists store managers' inventory and ordering decisions at the outlet level. If the latest technology reduces costs in managing inventory and ordering at the outlet level, late entrants may face lower costs of expansion per outlet.

The second reason is that late entrants may benefit from imitating incumbents' marketing strategies when uncertainty in market demand exists. For instance, several studies confirm that in fast-food retailing, a chain opening a new outlet may involve in learning about attractiveness of locations from the performance of incumbent firms (e.g., Toivanen and Waterson, 2005; Shen and Xiao, 2014; Yang, 2018) and incumbents' mistakes (e.g., Shankar, 1999). Thus, by observing the early entrants' actual trials in these dimensions, late entrants may save marketing expenses per outlet that they incur for researching good locations, store types, and market segments when they add a new outlet.

On the other hand, late entrants may face higher costs of expansion per outlet due to leadership in technology in learning curves. When cost curves shift down by learning-by-doing (LBD), early entrants may successfully deter market entry by late entrants by gaining significant market shares and lowering the prices (e.g., Spence, 1984). This aspect is relevant to retailing if incumbents benefit from intangibles, such as stock of know-how regarding developing a new outlet in searching for the prime location and efficiently recruiting good franchisees.

Given these two opposing predictions, what the entry-order effects are on the expansion costs at the outlet level is an empirical question. The empirical results in Section 5.3 yield support for the hypothesis that early entrants face disadvantages in expansion costs per outlet. Considering that brand equity exists for some firms, such as 7-Eleven, and the fraction of franchised outlets is on average equal to or more than 90% across all firms, the reduction in expansion costs for late entrants may represent less advertising costs for educating consumers and potential franchisees.

Sources of (Dis) Advantage in Entry Costs at the Market Level

For sunk entry costs at the market level, opposing explanations exist for whether and how early entrants gain (dis) advantage compared to late entrants in entry costs at the market level. On one hand, late entrants may benefit from adopting the latest technologies and innovation in distribution and logistics that influence costs at the market level. In the context of convenience-store industry, the benefits amount to access to the latest system regarding the logistics of goods and service, which often requires a sizable amount of upfront investments at the market level. On the other hand, late entrants may face disadvantages in entry costs if early entrants hold scarce assets as inputs for the business (e.g., Main 1955).

The empirical results in Section 5.3 show the entry-order-effect parameter for the entry costs is statistically imprecisely estimated, offering no support for either hypothesis. The impreciseness may not be surprising, given the entry-cost parameter is not precisely estimated.

Sources of (Dis) Advantage in Variable Costs at the Outlet Level

Two mixed predictions exist for the variable costs per outlet. First, late entrants may attract more productive labor than pioneers (e.g., Guasch and Weiss, 1980), which reduces costs of labor for late entrants. Second, however, late entrants may face higher variable costs due to the preemption of prime inputs by early entrants, such as capital or labor (e.g., Main, 1955). In the retailing context, early entrants may be able to choose the best locations (franchisees) among a set of potential locations (franchisees) for their outlets. If, by nature, such "good" resources are limited for a given price, late entrants may face a higher input price per outlet, which will increase costs per outlet. Also, late entrants may experience a disadvantage in the costs of purchasing (e.g., Boulding and Christen, 2008).

The empirical results in Section 5.3 offer support for the hypothesis that late entrants benefit from the reduced variable costs and offer no support for the hypothesis of the preemption of input resources. The empirical result squares with a tendency in franchising sectors to typically not require technical skills or educational backgrounds from its franchisees.

Overall, the empirical result offers support for a late-mover advantage in all these three

Table 10: Entry Order and Average Land Price

	(1)	(2)
Entry order	-0.0269	-0.0213
	(0.0267)	(0.0267)
Population	0.0000259	
	(0.0000648)	
Number of households		0.000205
		(0.000176)
Constant	11.73	11.60
	(0.230)	(0.235)
Firm-brand fixed effects	Yes	Yes
Market fixed effects	Yes	Yes
R-squared	0.926	0.927

Note: A unit of observation is a firm-market combination.
The dependent variable is the log of average land prices across outlets of a firm in a market in 2001.
Standard errors in parentheses.

cost components, in contrast to the mixed results in Boulding and Christen (2008), who find a late-mover advantage in average production costs and average SG&A costs and a pioneering advantage in average purchasing costs.

Entry Order and Land Price Based on Store-Level Location Data

To further confirm the absence of entry-order effects in input factors in the industry, I conduct descriptive analyses by utilizing the rent and exact location data at the outlet level for all convenience-store outlets in 2001. To construct the dependent variable, the average land price each firm faces for its outlets at the market level, I first pick the surveyed land price that is closest for each firm's outlet. I then take an average of all these surveyed land prices across all of the firm's outlets in the market. The independent variable is the entry order at the firm-market level I use throughout the current paper. To control for the level of attractiveness of location, I include the average population or the average number of households, which I construct by taking the average of all outlets for each firm in a similar manner as for the land price.

Table 10 shows that the cross-section data are inconclusive about the entry-order effects on the land prices, which are taken as a proxy variable for the input prices for land use (i.e., rent). The coefficient on the entry-order variable does not support the hypothesis of preemption of input resources, which should predict a positive sign for the parameter. The negative sign itself is rather in line with the technological free-riding, but parameters are imprecisely estimated. Note this descriptive analysis neglects several critical features of the industry, such as strategic interactions among firms and forward-looking entry and expansion decisions.

8 Conclusions

Utilizing the data from the convenience-store industry in Japan, this paper empirically examines the entry-order effects on profit components and their implications for marketing strategy. Unlike conventional descriptive analyses that rely on accounting profits and costs, this paper leverages a structural approach that does not require information on accounting profits and costs. By assuming that forward-looking firms maximize economic profits under strategic interactions, the approach infers cost and revenue parameters such that these parameters justify the observed entry and expansion behaviors as equilibrium outcomes of a dynamic game. Relying on this revealed-preference argument, I apply the dynamic equilibrium model to the panel data set on store counts and revenues at the market level for years 1984 through 2010. Variation in entry order, store counts, and revenues across markets, firms, and years, together with the model, allows researchers to not only evaluate the presence of such entry-order effects, but also to quantify the effects on model primitives. I find that whereas early entrants see 5.0% more revenues at the outlet level than the next entrant, late entrants enjoy 5.7% reduction in the variable costs per outlet and 15.9% reduction in expansion costs per outlet. The difference in entry-order effects on profits accounts for 10.1% of the differences in total economic profits across two leading firms, 7-Eleven and LAWSON. Simulation analyses imply the interplay among moderating factors in competition, market growth, and geography determines the overall entry-order effects on profits: a firm may initially benefit from postponing its market-entry consideration, but the advantage could disappear in around 25 years. The benefits for late entrants are larger if the market is growing and distant from the firm's and competitor firms' parent companies' headquarters.

The current study has three limitations, each of which motivates a possible expansion point for future work. First, the empirical model deals with the entry and expansion at the market level and abstracts away from these retailers' location and pricing decision at the outlet level (e.g., Chan, Padmanabhan, and Seetharaman, 2007). In reality, these convenience-store chains employ uniform pricing across outlets within a firm. Nonetheless, these firms' store locations are not randomly chosen. Although solving the optimization problem of where to locate its outlets in the presence of competitor firms, combined with the aspects of dynamic entry and expansion, is challenging, an examination of the entry-order effects on outlet locations and performance would be fruitful if outlet-level location information over time were available.

Second, even though this approach has a practical advantage of having light data requirements, such as relying on information on store counts and revenues, this paper does not control for several important factors that could influence the revenues and costs, such as the advertising expenditures and location of distribution centers. Access to such data will enable scholars to conduct more accurate evaluation of entry-order effects.

Finally, the empirical findings are confined to the case of the convenience-store industry in Japan. Because the empirical approach is independent of the industry setting, extending the analysis beyond the current industry may prove useful. This study shows the dynamic model employing data on store counts and revenues can shed light on how entry order affects revenues and costs and what these effects would imply for marketing strategy. This approach will encourage researchers and practitioners to explore other industries and study the interplay of entry order, performance, and geography.

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