Entry into Local Retail Food Markets in Sweden: A Real-Options Approach*

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Abstract

A real-options approach was used, incorporating uncertainty and irreversibility of investments, to study the number of stores entering the Swedish retail food market during the period 1994-2002. It was found that uncertainty affected the entry-decision. Entry was less frequent in highly concentrated local retail food-markets characterized by a high degree of uncertainty, whereas higher profit opportunities seem to have increased the probability of entry.

Key words: Real options, uncertainty, retail food, entry, negative binomial regression.

JEL classification: L13, L81.

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1 Introduction

Over the last decade the retail-food industry has seen great changes (Clarke et al., 2002). Large firms such as Wal-Mart, Aldi, Carrefour, and Tesco, have expanded into new markets and become even larger, store concepts have become more defined, and chain-store operators have invested more in store-brands. The retail-food market in Sweden is no exception. In most other countries the four largest chain store operators account for 30-80% of total retail-food sales (Clarke et al., 2002, Table 6.5). In Sweden, however, only three chain-store operators (ICA, COOP, and Axfood) had a total market-share in 2002 of almost 90%. It is an open question whether the market in Sweden will only support so few chain-store operators or if ICA, COOP, and Axfood's dominant market-position is a result of low competitiveness and entry barriers.[1]

The question of firm entry and firm-size distribution have received considerable attention in the literature (e.g., Dunne et al., 1988; Audretsch and Fritsch, 1994; Keeble and Walker, 1994; Love, 1996; Sutton, 1997; de Juan, 2003) and it is well known that entry-rates vary strongly across industries (Dunne et al., 1988; Berglund and Brännäs, 2001). However, entry within the retail-food industry in particular has been analyzed in very few studies. Coterill and Haller (1992), who analyzed the entry-behavior of leading supermarket chains in the United States is a rare exception. They found that

[1] The Swedish Competition Authority (2002:5) recently reported that retail-food prices in Sweden were about 11% higher than the European Union average. The difference was primarily explained by lack of competition. On the other hand, Asplund and Friberg (2002) found that that the degree of market-concentration had only a modest effect on retail-food prices in Sweden, and Bergman (2004) argued that higher prices in Sweden can be explained primarily by higher direct and indirect taxes.

the entry-decision had been influenced by both the existing market-structure and the capabilities of potential competitors.

The purpose of the present paper was to analyze entry within the Swedish retail food industry. A shortcoming with most previous entry-studies, irrespective of the market analyzed, is that they have ignored both uncertainty regarding future market-conditions and the effects of potential investment-irreversibility, i.e., sunk investment-costs. Uncertainty regarding future profits and the possible irreversibility of investment are included in both the theoretical and the empirical parts of this paper. Specifically, the economic value of being able to defer the decision to enter a market was studied using the theory of real options.[2]

The predictions of the model were tested using a unique data-set that covered all retail food-stores in Sweden during the period 1994-2002. As distinct from previous entry-studies, we were thus able to control for several possible confounding factors, such as industry, region - and store-type determinants of entry.

We found that uncertainty seems to have affected the decision to establish new retail food-stores in the Swedish market. Unsurprisingly, high uncertainty regarding future profits reduced entry; while higher potential profits increased it. However, according to the calculated marginal effects, both impacts were small.

Entry was less likely in highly concentrated markets and in regions with less purchasing power, and these marginal effects were larger than those from

[2] Dixit and Pindyck (1994) provide an excellent introduction to the theory of real options.

size and uncertainty of potential profits. Finally, regions with a non-socialist local government had more entry.

The theoretical framework of the study is presented in the next section. Section 3, then describes the data and the econometric specifications, while the results are presented in section 4. Finally, section 5 summarizes and draws conclusions.

2 Investment under Uncertainty

The theoretical model underlying the empirical study is based on the theory of real options, to which Dixit and Pindyck (1994) provide a good introduction. There are three important characteristics of the investment-problem that must be fulfilled, as they are in this case, for this approach to be appropriate. First, there must be some degree of uncertainty about the future "state of the world", i.e., some uncertainty about future market-conditions. Second, the decision to enter a market must entail some irreversible commitment of resources, i.e., some of the investment-cost must be sunk. Finally, the potential entrant must have some discretion as to the timing of market-entry.

There is certainly uncertainty regarding future profits; a chain store operator wanting to open a new store does not know with certainty how demand-conditions and prices will develop in the future, partly because there are also other agents facing similar decisions. Opening a new store also involves large sunk-costs that cannot be retrieved if the investment fails.[3]

[3] Building-costs are approximately equal across regions in Sweden, while real-estate values are much lower in less densely-populated areas, so the percentage of sunk-costs is

And of course potential entrants need not enter the market at all or at any particular place and time.

The decision-process of a chain-store operator planing to open a new store can be described as follows:[4] First, the profitability of the project is evaluated. The purchasing-power of the area is an important decision-variable when potential future revenues are calculated, often approximated using measures of private retail-food consumption and population size. The supply-side of the market is also analyzed to determine if there is room for a new store given the existing degree of local competition. Finally, possible entry barriers are investigated.[5]

Consider firm j which is planning to open a new store. We will define the store's appropriately-discounted expected-revenues, D_{jt}, as

$$D_{jt} = E_t \int_t^\infty u_{j\tau} e^{-\rho\tau} d\tau \tag{1}$$

where $u_{j\tau}$ is revenue and ρ is the firm-specific discount rate. The potential entrant is assumed to know the current level of revenue u_{jt}, while future revenues are uncertain due to possible changes in market conditions, assumed evolving according to the geometric Brownian-motion

$$dD_{jt} = \alpha D_{jt} dt + \sigma D_{jt} dz_t \tag{2}$$

much greater in less densely-populated areas.

[4]The description of the entry decision process is based on interviews with Fredrik Bergström, president of the Swedish Research Institute of Trade (HUI) and Peder Larsson, chief operating officer of ICA Sweden AB.

[5]Some municipalities have used the Planning and Building Act (PBA) to prevent or at least delay entry.

where dz_t is the increment of a Wiener-process, σ the volatility-coefficient, and α the drift-rate.

Investment costs, I_j, are assumed known through estimates from contractors, and the costs of operating a certain type of store concept, $c_{j\tau}$, are assumed known from prior experience. The discounted expected-costs of entry, U_{jt}, can then be written

$$U_{jt} = E_t \int_t^{\infty} f(c_{j\tau}, I_j) e^{-\rho\tau} d\tau \tag{3}$$

The initial investment, I_j, is assumed lost if the investment fails.[6] Such sunk-costs, in combination with uncertainty about future revenues, create an option-value of waiting, as long as there is a possibility that management might soon revise their estimate of future revenues downward and then prefer not to enter the market (McDonald and Siegel, 1986; Dixit and Pindyck, 1994).

The solution to an investment-problem of this type is given by a second-order differential equation which can be written

$$\frac{1}{2}\sigma^2 D_{jt}^2 F''(D_{jt}) + \alpha D_{jt} F'(D_{jt}) - \rho F(D_{jt}) = 0 \tag{4}$$

where $F(D_{jt})$ denotes the value of the firm's option at time t,[7] with bound-

[6] One could include some form of "salvage value" if the investment fails. This would not alter any of the testable predictions, however, while making the theoretical model more complex. Empirically, salvage value was included in our measurement of the irreversibility of investment.

[7] A thorough derivation of Equation (4) is given in Dixit and Pindyck (1994), chapter 5.

ary conditions

$$\begin{aligned} F(0) &= 0 \\ F(D_j^*) &= D_j^* - U_j \\ F'(D_j^*) &= 1 \end{aligned}$$

The first boundary condition means that if the value of D goes to zero, it will stay at zero (i.e., zero is an absorbing state for the geometric Brownian-motion). The second is the "value-matching condition", that at the optimal trigger-level (D_j^*) the pay-off is simply net profit, revenues minus costs. The third is the "smooth pasting condition" (Dixit, 1993).

The general solution to equation (4) is

$$F(D_j) = A_1 D_j^{\beta_1} + A_2 D_j^{\beta_2} \tag{5}$$

where A_1 and A_2 are constants to be determined, while β_1 and β_2 are the positive and the negative root of the fundamental equation

$$Q = \frac{1}{2}\sigma^2\beta(\beta - 1) + \alpha\beta - \rho = 0 \tag{6}$$

The first boundary condition implies that $A_2 = 0$. The solution to this problem (see Dixit and Pindyck, 1994), is given by the equations

$$A_1 = \frac{(\beta_1 - 1)^{(\beta_1 - 1)}}{\beta_1^{\beta_1} U_j^{(\beta_1 - 1)}} \tag{7}$$

and

$$D_j^* = \frac{\beta_1}{(\beta_1 - 1)} U_j \tag{8}$$

Since $\beta_1/(\beta_1 - 1) > 1$, this means that, for investment to go ahead, expected revenues should be greater than expected costs, reflecting uncertainty concerning future profits and the value of waiting for more information. By comparison, the optimal behavior without uncertainty would be to enter the market whenever $D_{jt} \geq U_{jt}$.

In order to apply the model empirically using our data, two additional problems had to be solved. First, Equation (8) gives the optimal level of potential revenues D_j^* at which to enter, while our data-set gives the time of entry. Second, we have the total number of entrants, while the model considers the decision problem for each potential entrant. Thus we need an expression for the expected number of firms entering the market during the discrete time-period t to $t+1$.

Oksendal (1995) has shown that the optimal wait-before-entry time under the conditions set out above is given by

$$T_j^* = \inf \left\{ t > 0 : D_{jt} \notin (0, D_j^*) \right\} \tag{9}$$

since T_j^* is the first time the firm's revenues equal or exceed D_j^*. If $D_{j0} \geq D_j^*$, then $E(T_j^*) = 0$, and immediate entry is optimal.

Now let us assume that expected wait-before-entry times, T, among firms which had not entered the market at time t have a distribution $\int_t^\infty g(T)\, dT$, assumed constant over time. The expected number of firms entering the market, N_t, during the discrete time-period t to $t+1$, is then given by

$$N_t = \int_t^{t+1} g(T)dT = h(u, \sigma, \alpha, c, I) \tag{10}$$

All variables affecting potential revenues (Equation 1 and 2) and costs (Equation 3) enter the analysis by affecting the distribution of T through Equation (8). Increased uncertainty affects Equation (10) by shifting the mean of the wait-before-entry time-distribution to the right, so that fewer firms reach their critical value during $(t, t+1)$ and enter the market. Entry is thus less frequent in markets where uncertainty concerning revenue is large. Variables increasing revenue increase entry, while of course variables increasing costs reduce it. Finally, if irreversibility (i.e. the level of sunk-costs) increases, entry will be less frequent.

3 Data and Econometric Specification

3.1 Data

Empirical analysis was based on data obtained from Delfi Marknadsparter AB (DELFI), Statistics Sweden (SCB), and the Swedish Research Institute of Trade (HUI). The data from DELFI covered all retail-food stores in Sweden during 1993-2002, including store specific information such as location, store-type, chain-store affiliation, sales-area and revenues. The dependent variable in our empirical analysis was the number of stores of a specific type j ($j = 1, ..., 12$) entering the market in municipality m ($m = 1, ..., 290$) in period t ($t = 1994, ..., 2002$).

We used three types of independent variables: industry-specific factors, municipality-characteristics, and store-type indicators. Industry-specific factors were average revenues per square meter of sales-area, a proxy for uncertainty, a proxy for irreversibility of investment, and local chain-store concentration.

We used municipality-specific data provided by Statistics Sweden (SCB) to control for average income, the presence of a university, and the political persuasion of the local government. Local purchasing-power was approximated using a sales-index developed by the Swedish Research Institute of Trade (HUI), where 100 is average for the population size. Definitions of these variables, as well as means and standard deviations, can be found in Table 1, and are also discussed further in section 3.2.

- Table 1 about here -

The retail food-industry consists of a number of different type of stores, e.g., gas-station and convenience stores, grocery stores, supermarkets, and hypermarkets,[8] and location, product assortment, and the level of service can differ dramatically. For instance, hypermarkets are classified as self-service stores with at least 2,500 square meters of sales-area, external location supported by no less than 300 parking-spaces, and a broad range of food and non-food products, whereas gas-station stores are small and have a very limited product-mix, so that they are not necessarily competitors even though prices can differ considerably. Thus entry may be influenced by store-specific factors. Table 2 shows the numbers of each of the twelve types of stores with their average sales-areas and revenue.

[8] Classification according to DELFI.

- Table 2 about here -

At the beginning of the study-period the Swedish retail food-market was dominated by four chains (ICA, COOP, Axel Johnson, and the D-Group). In 1998, Axel Johnson and the D-Group merged under the name Axfood[9]. These three companies controlled 89% of the market in 2002 (Table 3). Thus the Swedish retail food-market is highly concentrated, which may reduce competition and entry. On the other hand, in a European context, the Swedish market is relatively small, with high entry-costs, so it can be argued that it is a "natural" oligopoly, supporting only a few chain-store operators.

- Table 3 about here -

The total number of stores decreased during the study-period. ICA was clearly dominant throughout, with approximately 44% market-share (in some municipalities it exceeds 70%). Traditionally ICA was a cooperation of independent stores collaborating on purchasing, transport, and marketing. But in recent years it has adopted more centralized decision-making, for instance, regarding product-assortment. COOP, long the second-largest chain, consists of regional cooperatives that are centrally coordinated. Its market share decreased during the study-period. Axfood initially consisted of a very heterogenous group of stores, but recently it has increased centralized decision-making, limited the number of store-concepts, and changed its overall strategy in favor of low-price segment-shops. By 2002 its market share slightly exceeded COOP's. Bergendahl is the fourth largest single actor in the Swedish retail food-industry, but it is mainly established in

[9] Note that the name Axfood was not introduced until 2000.

the southwest of Sweden and its share of the total market is only about 3% (though increasing rapidly). The remainder (8.1% in 2002) consisted of a varity of stores and concepts, e.g., gas-station stores, convenience stores (such as 7-Eleven), and foreign establishments. The Danish Netto group entered the Swedish retail food-market in 2002 (and the German Lidl group in 2003); their share of the market is increasing but still below 2% (Swedish Competition Authority, 2004).

3.2 Econometric specification

As the number of firms entering a market is a positive integer, a count-data model is used. The common starting-point for most count-data analysis is the Poisson-regression model, but such a model has the moment-restriction $E(N_{mt}|\mathbf{X}_{mt}) = var(N_{mt}|\mathbf{X}_{mt}) = \mu_{mt}$, where N_{mt} would denote the number of entrants in municipality m at time t, $\mathbf{X}_{mt}$ a vector of independent variables, and μ_{mt} the mean. Since the conditional variance in most cases exceeds the conditional mean (over-dispersion), the negative binomial (NB) regression-model was used instead, with density

$$\begin{aligned} \Pr(N_{mt}|\mathbf{X}_{mt}) &= \frac{\Gamma(N_{mt}+\phi^{-1})}{\Gamma(N_{mt}+1)\Gamma(\phi^{-1})}\left(\frac{\phi^{-1}}{\phi^{-1}+\mu_{mt}}\right)^{\phi^{-1}}\left(\frac{\mu_{mt}}{\phi^{-1}+\mu_{mt}}\right)^{N_{mt}} \quad (11) \\ \phi &\geq 0,\ N_{mt}=0,1,2,3... \end{aligned}$$

where $\Gamma(.)$ is the gamma function and ϕ is a dispersion parameter. The variance-function for the NB model used here is given by $\mu_{mt}+\phi\mu_{mt}^2$. Hence, this model allows for a flexible relationship between conditional mean and conditional variance.

Since the number of entrants was observed over time (longitudinal/panel-data) it was possible to control for all three types of independent variables described earlier: store, industry and municipality specific heterogeneity. With only 12 store-types and 290 municipalities, a fixed-effects NB model was easily estimated with maximum likelihood, by specifying the exponential mean-function as $\exp(\alpha+\sum_{j=1}^{J}\gamma_j S_{jt}+\sum_{m=1}^{M}\eta_m R_{mt}+\boldsymbol{\beta}_s^{'}\mathbf{Z}_{mt}+\boldsymbol{\delta}_z^{'}\mathbf{Y}_{mt}+\boldsymbol{\theta}_t^{'}\mathbf{T}_t)$.[10] The store-type indicators, S_{jt},were set equal to one if the observation was for store type j, and zero otherwise, while the municipality indicators, R_{mt}, were set equal to one if the observation was for municipality m. Characteristics of the incumbents and the market structure were captured by the vector $\mathbf{Z}_{mt}$; $\mathbf{Y}_{mt}$ is a vector of municipal characteristics; $\mathbf{T}_t$ is a vector of time-specific dummy variables; α is a constant; and γ_j, η_m, $\boldsymbol{\beta}_s^{'}$ $(s = 1, ..., 5)$, $\boldsymbol{\delta}_z^{'}$ $(z = 1, ..., 4)$, and $\boldsymbol{\theta}_t^{'}$ are parameters to be estimated: All to be explained more fully below.

$\mathbf{Z}_{mt}$ consisted of proxies for profit-opportunities, investment-uncertainty, and investment-irreversibility, as well as an interaction term of the last two, plus the chain-store concentration-rate. The potential profit from investing in a new store was assumed to be captured by the average revenues per unit of existing sales-area in municipality m at time $t-1$.[11] Lagging this variable

[10] Random effects NB models have also been estimated. The random effects are assumed beta-distributed, giving a closed-form analytic expression for the unconditional density as the basis for maximum-likelihood estimation (Hausman et al., 1984). However, if the individual effects are correlated with the regressors, the random-effects specification of the model will suffer from inconsistency due to omitted variables. The null hypothesis of orthogonality of the random effects and the regressors has been tested using a Hausman test (Greene, 1993, p.479). The test statistic $\chi^2 = 37.51$ $(p = 0.038)$ suggests that the null hypothesis can be rejected. Thus all results presented in the paper here are from the fixed-effects specifications of the model.

[11] Ideally, one would like to have data regarding profit per krona-invested. However, only revenue per unit of sales-area was available. Thus, sales area was used as a proxy for

corresponds directly to the potential entrant's decision-problem, since they only have access to other firms' annual reports with a one year time-lag. This also alleviates a possible endogeneity problem, since previous years' values concerning sales-revenues are, by definition, predetermined.

Uncertainty concerning the future state of the market was proxied by the conditional variance in firms' average revenue per unit of sales-area in municipality m at time $t-1$, measured by the first five lags of the squared-error terms from an autoregressive conditional heteroskedasticity (ARCH) model[12]. Planned sales-area multiplied by the negative of the population density in the municipality was used as a measure of the irreversibility of investment because while building costs are approximately equal throughout Sweden, land values are much lower in less densely-populated areas. For a given initial investment in sales-area, sunk costs are thus much greater in less densely populated areas, and (possible) salvage value much less. The effect of uncertainty on entry should have been more pronounced when the irreversibility of the investment was large, so an interaction term between uncertainty and irreversibility was also included in the model.

Market-concentration in a specific market is often measured by a Herfindahl index consisting of the sum of squares of all firms' market-shares. In the present case, "firms" were defined as chain-store operators rather than individual stores, to reflect the lack of competition if, for example, ICA totally dominates a local market. Concentration was therefore computed as the sum of squares of chain store market-shares (Table 3 above), i.e.,

the size of investment, while revenue was used as a proxy for profits.

[12] Several specifications for this variable were tried. The final specification was choosen using the consistent-Akaike-information-criterion.

$s_{1m}^2 + s_{2m}^2 + ... + s_{km}^2$, where k is the number of chain store operators in municipality m. If all chain store operators had equal revenues, the concentration rate would then be $1/k$, whereas it would be one if the entire local market were supplied by one operator.

Virtually all of the models that have been used in the literature to explain empirical patterns of entry predict that it should occur until expected profits in each period are driven to zero. We therefore expect entry to be positively related to potential profitability (in this case, revenues per sales-area). On the other hand, in accordance with our theoretical model discussed in Section 2, we expect uncertainty and irreversibility to be negatively related to entry. Highly concentrated markets indicate lack of competition, which should also be negatively related to entry.

Entry was also assumed to be determined by municipality-specific factors, $\mathbf{Y}_{mt}$ (see Daunfeldt et al., 2002; Fritsh and Falck, 2003): average income, relative purchasing power, presence of higher education, and the political persuasion of the local government. A number of previous entry studies (e.g., Audretsh and Fritsch, 1994; Davidsson et al., 1994; and Guesnier, 1994) found that more entry occured in regions where demand was high, so that high average income and high purchasing power should be associated with more entry. Audretsh and Fritsch (1994) among others also found that entry was positively influenced by the level of education in the region, possibly indicating that firms demand highly skilled labor. More entry is, therefore, expected in municipalities with a university. Finally, socialist or non-socialist political leadership might have an effect on entry. It can be argued, for instance, that firms prefer a non-socialist local government, seeing it as more business-friendly, imposing less restrictions and requirements.

4 Empirical Results

Two different versions of the empirical model were estimated, one with municipality fixed-effects and one without. A likelihood ratio test of the hypothesis of equal intercepts for all municipalities yielded a test-statistic λ (289) = 983.23, equivalent to a probabilty of less than 1%. Thus only results from the model with municipality specific effects are presented.[13] The municipality-specific fixed-effects (289 parameter estimates) are omitted to save space.

Table 4 about here -

As expected, profit-potential (previous revenues per existing sales-area) had a positive and statistically significant effect on entry. This result has not been widely reported in previous entry studies, however (Geroski, 1995). Similarly, uncertainty had a negative and significant effect. Irreversibility (measured as population-density times sales-area) and its interaction term with uncertainty were both negative, but not significant even at the 10% level. Market-concentration had a negative and significant effect, indicating that entry was less likely where, for example, one chain store operator dominated a local market.

[13] The first five autocorrelation coefficients of the residual was 0.019 (0.0043), -0.0013 (0.0024), -0.0038 (0.0019), 0.00028 (0.0023), and -0.00083 (0.0014), with standard errors in parentheses. Since the autocorrelation coefficients are fairly small, autocorrelation seems not to be an important problem.

Average income in the municipality had no significant effect on entry, but purchasing power (retail food-sales relative to populations) had a positive and significant effect. Contrary to expectations, the presence of a university had a negative significant effect, while the precense of a non-socialist local government had a positive effect.

In order to get a sense of the magnitudes involved, marginal effects were calculated at the mean values of the explanatory variables included in the analysis (Table 4), and the expected number of entrants at those values. Then the expected number of entrants was recalculated after increasing each statistically-significant continuous variable in turn by one standard deviation. Finally, the difference in the expected number of entrants, measured in percentage points, was calculated for such a change in each variable.

If potential profits (previous revenues per existing sales-area) increased by one standard deviation, mean entry increased by 2.37%, while such an increase in uncertainty (the variance of previous revenues per existing sales-area) decreased entry by 2.44%. These effects were thus quite small. Such a change in purchasing power, on the other hand, increased entry by 8.79%, while such an increase in market-concentration decreased entry by 22.80%. Chain-store concentration thus had a large negative impact on entry.

Judged by the estimates for store-type indicator (Table 5), department stores and small and large supermarkets entered less frequently than hypermarkets (included in the intercept), while entry was relatively more common for small firms such as gas-station stores, mini-markets, conveniene stores and "normal" grocery stores. This suggests that the Swedish retail food market has two growing groups; hypermarkets and various small stores, while the intermediate size is declining.

-Table 5 about here -

5 Summary and Conclusions

We studied entry into the Swedish retail-food during 1994-2002 using the theory of real options (Dixit and Pindyck, 1994). There are three important characteristics of the investment-problem that must be fulfilled for this approach to be appropriate. First, there must be some degree of uncertainty about the future "state of the world", i.e., some uncertainty about future market-conditions. Second, the decision to enter a market must entail some irreversible commitment of resources, i.e., some of the investment-cost must be sunk. Finally, the potential entrant must have some discretion as to the timing of market entry. We argued that it is reasonable to assume that these three conditions hold when a chain-store operator plans to open a new store: 1) Future profits (which we proxied by current revenues per existing sales-area in the target-municipality) are uncertain (proxied by the varaince of this variable). 2) Building-costs are largely irreversible, and as land-values vary greatly with population density, the proportion of sunk costs also varies widely. 3) An operator can of course decide to wait, or to invest elsewhere. Under these conditions, Dixit and Pindyck (1994) showed theoretically that entry would be positively correlated with profits, but negatively with the level of uncertainty regarding profits and with the level of irreversibility of the investment.

These predictions were tested using a novel data-set covering all stores in the Swedish retail-food market during 1993-2002. We controlled for confounding factors at the muinicipality-level, such as the market-concentration, the purchasing power, the presence of a university, and political persuasion of the local government, as well as municipality and store-type fixed-effects. As the number of firms entering a market is a positive integer, a negative binomial fixed-effect model was used.

The results agreed with the theoretical predictions. First, entry was higher in municipalities with higher profit opportunities, but lower in municipalities with greater uncertainty. This suggests that chain-store operators in the Swedish retail-food industry take uncertainty into account when deciding whether or not to invest in a new store. These effects were rather small, however, and irreversibility of the investment, as well as an interaction-term between irreversibility and uncertainty, had no statistically significant effects. But high market-concentration greatly reduced entry. This might indicate entry-barriers in the Swedish retail food-market, with incumbents, for example, engaging in strategic behavior to prevent the entry of new competitors.

Relative purchasing-power in the municipality was positively correlated with entry, the effect being about three times as large as the effects of profit-opportunities and uncertainty. More entry also occured in municipalities with non-socialist local governments, suggesting that institutional factors might have an affect on entry. It is possible, for instance, that socialist local governments used the Plan and Building Act (PBA) more frequently to prevent entry of hypermarkets and out-of-town shopping centres. This question might be a topic for further research.

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Table 1: Means, definitions and data-sources of variables.

Variable	Mean (SD)	Definition and source
ENTRY	0.095 (0.542)	Number of entrants for each store-type j (j=1,...,12) in municipality m (m=1,...,290) at time period t (t=1994,...,2002). Source: DELFI
REVENUES	92,836 (193,025)	Revenues (in 1000 SEK) grouped in 19 classes; the average revenue in the first 18 classes is 750; 1500; 2500; 3500; 4500; 5500; 7000; 9000; 12,500; 17,500; 22,500; 27,500; 35,000; 45,000; 55,000; 67,500; 87,500; 100,000. Revenues greater than 100,000 were recorded as the true value. Source: DELFI
SALES-AREA	1794.38 (2974.33)	Internal floor area (in square meters) used for displaying and selling. Source: DELFI
REVENUES/AREA	30.31 (132.24)	*REVENUES /SALES-AREA*. Source: DELFI
UNCERTAINTY	48,597 (3,412,922)	The variance of *REV/AREA* for all stores in municipality m at time *t -1,* measured as the conditional-variance from an autoregressive conditional-heteroskedasticity (ARCH) model using the first five lags of the squared-error terms in the regression. Source: DELFI.
IRREVERSIBILITY	-726,144 (6,921,672)	-*POP-DENS*SALES-AREA*. Source: DELFI and Statistics Sweden.
POP-DENS	135.92 (435.59)	Population-density, the ratio of population to square kilometers in municipality m. Source: Statistics Sweden.
*UNC*IRR*	-5.83E+09 (1.9E+11)	Interaction-term of UNCERTAINTY and IRREVERSIBILTY. Source: DELFI
CONCENTRATION	0.390 (0.098)	Herfindahl-index, calculated from revenues of chain store concentration in municipality m (the sum of squared market shares) . Source: DELFI
INCOME	155.97 (24.24)	Per-capita income in municipality m (1000 SEK). Source: Statistics Sweden
PURCH-POWER	100.30 (43.76)	$(C_m/Pop_m)/(C_{swe}/Pop_{Swe})$, where C_m and C_{swe} is the retail-food consumption in municipality m and Sweden, while Pop_m and Pop_{Swe} are the corresponding population measures. Source: The Swedish Research Institute of Trade (HUI).
D-UNIVERSITY	0.18 (0.38)	Dummy-variable taking the value one if there is a university in the municipality, otherwise zero. Source: Statistics Sweden
D-NONSOCIALIST	0.27 (0.44)	Dummy-variable taking the value one if there is a non-socialist local government in the municipality. Source: Statistics Sweden
No. of obs.	14,209	Data were aggregated into store-type j (j=1,...,12) in municipality m (m=1,...,290) at time period t (t=1994,...,2002).

Table 2: Means of number of entrants, revenues and sales-area by store-type (SD in parenthesis).

Store type	Entrants	Revenues	Sales-area	No. of obs.
Under construction	0.8 (0.45)	80,700 (114,510)	3,604 (3,506)	5
Hypermarket	0.04 (0.23)	184,597 (91,705)	2,542 (1,888)	794
Department store	0.09 (0.10)	61,483 (34,555)	807 (773)	408
Supermarket	0.01 (0.11)	64,507 (54,170)	1,326 (1,009)	2,113
Grocery-store	0.07 (0.31)	80,125 (55,679)	1,369 (726)	5,953
Small supermarket	0.006 (0.08)	25,856 (13,259)	496 (267)	1,483
Small grocery-store	0.03 (0.26)	30,567 (17,519)	543 (247)	8,792
Convenience store	0.14 (0.75)	5,174 (4,441)	114 (117)	12,191
Gas-station store	0.23 (0.65)	4,932 (4,202)	69 (228)	11,907
Mini-market	0.10 (0.79)	8,958 (9,017)	181 (140)	25,647
Seasonal-store	0.02 (0.15)	2,436 (2,201)	114 (93)	379
Other	0.33 (0.48)	102,205 (146,131)	4,055 (4,237)	39
All stores	0.10 (0.54)	20,784 (37,106)	371 (619)	69711

Table 3: Market-shares in the Swedish retail food-market, 1994-2002 (number of stores in parenthesis).

Operator	1994	1995	1996	1997	1998	1999	2000	2001	2002
ICA	44.2	43.9	43.6	44.0	44.7	44.1	43.4	43.6	43.9
	(2653)	(2546)	(2378)	(2258)	(2179)	(2090)	(2000)	(1870)	(1861)
COOP	24.9	25.2	25.2	23.9	23.5	22.5	22.3	22.4	22.4
	(1447)	(1436)	(1353)	(1321)	(1337)	(1057)	(1009)	(924)	(903)
Axel Johnson	5.5	5.2	5.1	4.6					
	(522)	(488)	(437)	(270)					
D-group	17.0	17.2	17.3	18.0					
	(856)	(815)	(785)	(884)					
Axfood					22.9	22.7	23.3	23.0	22.7
					(1110)	(1069)	(1027)	(917)	(903)
Bergendahls	1.9	1.8	1.9	2.1	2.0	2.1	2.3	2.8	2.9
	(87)	(67)	(60)	(56)	(60)	(55)	(55)	(78)	(83)
Others	6.6	6.7	6.8	7.4	7.1	8.4	8.7	8.2	8.1
	(2044)	(2056)	(2159)	(2146)	(2209)	(2651)	(2618)	(2433)	(2448)
All stores	(7589)	(7408)	(7172)	(6935)	(6895)	(6922)	(6709)	(6222)	(6198)

Table 4. Estimation results, t-values (Robust -White) in parenthesis.

Variable (Parameter)	Coefficient	Marginal effect
REVENUES/AREA (β_1)	1.8E-04***	1.12E-06
	(2.74)	
UNCERTAINTY (β_2)	-7.25E-09**	-4.57E-11
	(-2.18)	
IRREVERSIBILITY (β_3)	-3.49E-09	-2.20E-11
	(-1.07)	
*UNC*IRR* (β_4)	2.59E-15	1.64E-17
	(0.03)	
CONCENTRATION (β_5)	-2.61**	-0.0164
	(-2.54)	
INCOME (δ_1)	5.9E-04	3.71E-06
	(0.06)	
D-UNIVERSITY (δ_2)	-0.80**	4.00E-03
	(-2.21)	
D-NONSOCIALIST (δ_3)	0.58***	4.21E-03
	(3.64)	
P-POWER (δ_4)	1.9E-03**	1.22E-05
	(2.26)	
Log Likelihood	-3128.89	

***significant at the 1% level.

**significant at the 5% level.

*significant at the 10% level.

Table 5. Estimation results, store-type indicators, t-values (Robust -White) in parenthesis. Hypermarkets included in the intercept.

Variable (Parameter)	Coefficiens	Marginal effect
Intercept (α)	-2.35	-
	(-1.37)	
Under construction (γ_1)	3.30***	0.16
	(6.24)	
Department store (γ_2)	-2.20**	-5.9E-3
	(-2.36)	
Supermarket (γ_3)	-0.74**	-3.5E-3
	(-2.05)	
Grocery-store (γ_4)	1.30***	0.014
	(5.04)	
Small supermarket (γ_5)	-1.22***	-4.8E-3
	(2.63)	
Small grocery-store (γ_6)	0.24	1.6E-3
	(0.80)	
Convenience store (γ_7)	1.82***	0.025
	(7.33)	
Gas-station store (γ_8)	2.66***	0.055
	(10.91)	
Mini-market (γ_9)	1.58***	0.018
	(6.25)	
Seasonal-store (γ_{10})	-0.10	-6.1E-4
	(-0.18)	
Other (γ_{11})	1.49***	0.022
	(3.33)	

***significant at the 1% level.

**significant at the 5% level.

*significant at the 10% level.