Estimating the effects of the entry of brands using a market share attraction model

Dennis Fok
Erasmus Research Institute of Management
Erasmus University Rotterdam
dfok@few.eur.nl

Philip Hans Franses
Econometric Institute
Erasmus University Rotterdam
franses@few.eur.nl

copy of poster available at http://www.few.eur.nl/few/people/dfok

Outline

Motivation

Usual assumption in market response analysis:
Number of brands remains constant

Usual assumption in competitive reaction:
Consumer preference structure and sensitivity to marketing efforts constant

In practice:
New brands are introduced into existing markets.

These introductions may ...

- ... change the competitive market structure
- ... change allocations of marketing efforts
- ... change consumer preferences
- ... change consumer responsiveness to marketing efforts

Literature

Studies on effects of entry can be divided into two categories:

1. (Non-cooperative) game theoretic approach
   - Market share attraction model + profit functions.
   - System is solved for a Nash equilibrium.
   - Usually not based on empirical data
   - Prescriptive
2. Time series/Panel data causal approach
   - Model is estimated on empirical data
   - Measures actual responses
   - Responses may not be optimal
   - Descriptive

Some examples of the Game theoretic approach:

- Basuroy and Nguyen (Man.Sc, 1998)
  Derive theoretical conditions for use of attraction model for equilibrium analysis.
- Gruca *et al.* (Mark.Sc., 1992)
  Reactions differ for dominant and non-dominant brands.

Some examples of the Time Series/Panel data causal approach

- Chintagunta (European Journal of Operational Research, 1999)
  Entry has largest impact on brand location importance weights. Sensitivity to marketing efforts and brand positions are relatively stable.
- Robinson (Mark.Sc., 1988)
  Most common reaction (among 115 entries studied): no reaction or a reaction with a single instrument.

Expectations

Based on the literature we may expect:

The entry of a new brand ...

1. ... likely lowers price levels
2. ... may increase or decrease marketing efforts
   Depends on
   - Fixed or expanding market
   - Dominant or non-dominant brand
3. ... likely affects base evaluation of brands
4. ... may affect sensitivity to marketing efforts

Methodology

Analyzing an entry:

- Test for constancy of prices and marketing efforts for incumbent brands using time series models
- Estimate market share attraction model for pre- and post-introduction period simultaneously.
- Test for constancy of different model parts concerning consumer reactions and market structure.

Our main contribution to the literature:

Development of measurement technique to examine the effects of entry and exit

Modeling approach

If both periods are estimated separately statistical testing is not possible.

→ Extend the attraction model to cope with changing number of brands

This model allows us to:

Test whether the competitive structure among the incumbent brands changed while controlling for the marketing efforts of the entrant.

Sales or market shares?

We choose to use market shares as ...

- ... they are generally insensitive to category expansion
- ... they usually do not show seasonal variation

Attraction model

Basic notation:

Indices	Brands	$i = 1, \dots, I$
	Time	$t = 1, \dots, T$
Entry	Entrant	brand 1
	Time of entry	T_1
Exogenous	Marketing efforts	$x_{k,j,t}$
Endogenous	Attraction	$A_{i,t}$
	Market Share	$M_{i,t}$

Market Share Attraction Model: (Cooper and Nakanishi, 1988)

The Attraction of brand i to consumers at time $t < T_1$

$$A_{i,t} = \begin{cases} 0 & i = 1 \\ \exp(\mu_i + \varepsilon_{i,t}) \prod_{j=2}^{I} \prod_{k=1}^{K} x_{k,j,t}^{\beta_{k,j,i}} & i = 2, \dots, I \end{cases}$$

The Attraction of brand i at time $t \geq T_1$

$$A_{i,t} = \exp(\mu_i + \varepsilon_{i,t}) \prod_{j=1}^{I} \prod_{k=1}^{K} x_{k,j,t}^{\beta_{k,j,i}}$$

Market Share theorem (Bell, Keeney and Little, JMR, 1975)

$$M_{i,t} = \frac{A_{i,t}}{\sum_{j=1}^{I} A_{j,t}}$$

Consumer reactions

Due to consumer reaction to the introduction:

- Change in marketing effort effectiveness ($\beta_{k,j,i}$, $i > 1$, $j > 1$)
- Change in base attractions (μ_i, $i > 1$)
- Change in brand similarity (Covariance matrix of $(\varepsilon_{2,t}, \dots, \varepsilon_{I,t})$)

Statistical testing

1. Estimate model assuming no change → $\mathcal{L}^r$
2. Estimate model allowing for change → $\mathcal{L}^u$
3. Calculate likelihood ratio statistic $-2(\mathcal{L}^r - \mathcal{L}^u)$
4. Compare statistic to $\chi^2_{(\#\text{restr.})}$ critical value

Competitive reaction

Incumbent brands may respond to entry by adapting their marketing strategy

Examples of reactions:

- Change in the level of prices
- Change in the frequency of display
- Changes in the dynamics in pricing/display

For example:
Gruca *et al.* (Mark.Sc. 1992) pose that brands with $M < 50\%$ should

- reduce prices
- reduce marketing efforts as display and feature

Testing of competitive reaction

General specification $y_t^* = \alpha + \sum_{p=1}^{P} \phi_p y_{t-p} + \varepsilon_t$

Specific model depends on the measurement of marketing instrument.

- Continuous measurement (eg. prices)

  $$y_t = y_t^*$$

- Binary measurement (eg. display)

  $$y_t = \begin{cases} 0 & y_t^* < 0 \\ 1 & y_t^* \geq 0 \end{cases}$$

- Weighted binary (eg. store weighted display)
  Measurement on [0,1] interval with many zeros.

  $$y_t = \begin{cases} 0 & y_t^* < 0 \\ y_t^* & y_t^* \geq 0 \end{cases}$$

Using the Chow break point test [or a LR variant of this test] we test for constancy of the marketing efforts.

Illustration - Entry

Table 1: Data characteristics of detergent market

	Brand				
	Surf	Tide	Cheer	Ox	Rest
Pre-introduction period					
Average Market Share	-	29.6%	14.0%	10.0%	46.3%
Average Relative price	-	1.000	0.981	1.136	0.884
Average Display	-	0.127	0.051	0.005	0.045
Average Advertising	-	0.147	0.063	0.016	0.051
Post-introduction period					
Average Market Share	10.6%	29.9%	11.5%	9.8%	38.2%
Average Relative price	0.956	0.958	1.054	1.114	0.918
Average Display	0.205	0.153	0.030	0.082	0.069
Average Advertising	0.119	0.186	0.062	0.069	0.057

Competitive reaction

Table 2: p-values of Chow-tests on structural breaks in the marketing efforts using AR(2) models for prices and Tobit models with 1 lag for display and advertising.

	Tide	Cheer	Ox	Rest
Price	0.015	0.221	0.373	0.590
Advertising	0.752	0.176	0.135	0.602
Display	0.083	0.705	0.004	0.069

Conclusions:

- In only 2 cases we find a change (Price "Tide" & Display "Ox")
- For the Display of "Tide" and "Rest" we have some indication of a change.
- Price "Tide" decreased
- Display "Ox", "Tide" & "Rest" increased

Consumer reactions

Testing for changes in competitive structure

Table 3: Test results for constancy of competition in detergent market

	Price	Display	Adv.
$\Delta \log \mathcal{L}$	2.003	5.022	1.768
Δ #par	4	4	4
p-value	0.405	0.040	0.472

Conclusions

- Competitive structure concerning display changed.
- Reactions to price & advertising unchanged.

Further testing for this market

Imposing constancy of price and advertising competition we find:

- Constancy of brand intercepts rejected (p-value 0.013)
  → No IIA in this market.
  Competition between incumbent brands cannot be considered without taking into account the entrant.
- Constancy of covariance matrix accepted (p-value 0.554)
  → Brand positioning remains unchanged.

Concluding remarks

General results of empirical study

- In general response with marketing efforts less than might be expected.
- Use of promotion/advertising insensitive to introduction
- In all cases at least part of the competitive structure changed. (these changes are usually ignored in game-theoretic analyses.
- In all markets the brand intercepts change
  → IIA does not hold

General contribution of our research

- Provides a strategy to statistically test for breaks in competitive structure.
- Methodology considers both consumer and competitor reactions.
- Competitor and consumer reactions have to be considered jointly.
  Within the attraction model we have to test for constancy of parameters and of levels of marketing efforts

Limitations

- No empirical generalizations possible
  → Need for more applications to more datasets.
- Competitor effects does not include cross-brand reaction patterns.

Future research

- Analyze more cases to get a good overview of general effects.
- Include dynamics in the market share/attraction specifications.