DYNAMIC EFFECTS OF THE ORDER OF ENTRY ON MARKET SHARE. TRIAL PENETRATION, AND REPEAT PURCHASES FOR FREQUENTLY PURCHASED CONSUMER GOODS

by

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ABSTRACT

A time series cross sectional analysis of 18 successful later entrants in 8 categories of consumer packaged goods over the period from October 1983 to January 1988 confirms previous empirical findings that after correcting for differences in marketing effort and product quality, later entrants suffer a long term market share disadvantage. New evidence of the penalties associated with later entry are found in statistical estimation of models of cumulative trial, first repeat, and subsequent repeat purchasing. Significantly lower asymptotic levels are found in both trial and repeat behavior. However based on this data, the rate of approach of later entrants to their lower asymptotic performance measures is either equal to or faster than early entrants and provides evidence of a compensating partial effect accrued by later entrants.

INTRODUCTION

This paper expands the empirical base of knowledge on the effects of order of entry in the frequently purchased consumer products industry. A cross sectional analysis of market shares in package goods by Urban et al (1986) found persistent share advantages for pioneers -- later entrants had systematically lower long term market shares. The analysis reported here extends this previous study in three important ways. First, a cross sectional and time series data base is used to examine the dynamic effects of later entry. This allows one to address the question, do later entrants approach their asymptotic share at a slower or faster rate than pioneers? Second, this study examines the effects of order of entry on trial penetration and repeat purchases as well as share. Third, the use of UPC scanner data allows analysis of price, promotion, and distribution effects which were not included in the original cross sectional analysis by Urban et al.

Many theoretical economic (e.g. Schmalensee 1982) and behavioral (e.g. Carpenter and Nakamoto 1989) explanations have been given for order of entry advantages. We will not establish the behavioral causes for pioneering advantage in this work, but we will provide empirical evidence on purchase dynamics which can aid in the construction of a theory of entry advantage and the design of behavioral experiments to test it. For a more complete literature review see Lieberman and Montgomery (1988) and Robinson (1988).

In this paper we describe the structures for dynamic models for share, trial penetration, and repeat purchasing and then discuss their measurement and estimation. Next we present the empirical results and the implications of our study. We close with the identification of future research needs.

MODEL DEVELOPMENT

Market Share

We model overall market share in each period by an underlying share growth pattern which is modified by order of entry, distribution, price, promotion, advertising, and product quality effects. We posit that the underlying share will grow at a decreasing marginal rate to an asymptote. The growth is described by an exponential function which depends on the order of entry of the brand. All variables except order of entry are expressed as ratios to the first brand to enter the category. The formal equation is:

$$S_{it} = E_i^{\alpha} D_{it}^{\beta} P_{it}^{\gamma} M_{it}^{\delta} A_{it}^{\theta} Q_i^{\epsilon} \left(1-e^{-\phi t-(\psi/E_i)t}\right) \qquad (1)$$

S_{it} = Ratio of share of ith brand to share of first brand to enter the category as of period t

E_i = Order of entry of ith brand

D_{it} = Ratio of distribution of ith brand to distribution of first brand in period t

P_{it} = Ratio of price of ith brand to price of first brand in period t

M_{it} = Ratio of promotion of ith brand to promotion of first brand in period t

A_{it} = Ratio of advertisement of ith brand to advertisement of first brand in period t

Q_i = Ratio of quality of ith brand to quality of first brand in period t

i = Brand

t = Time period since the introduction of brand

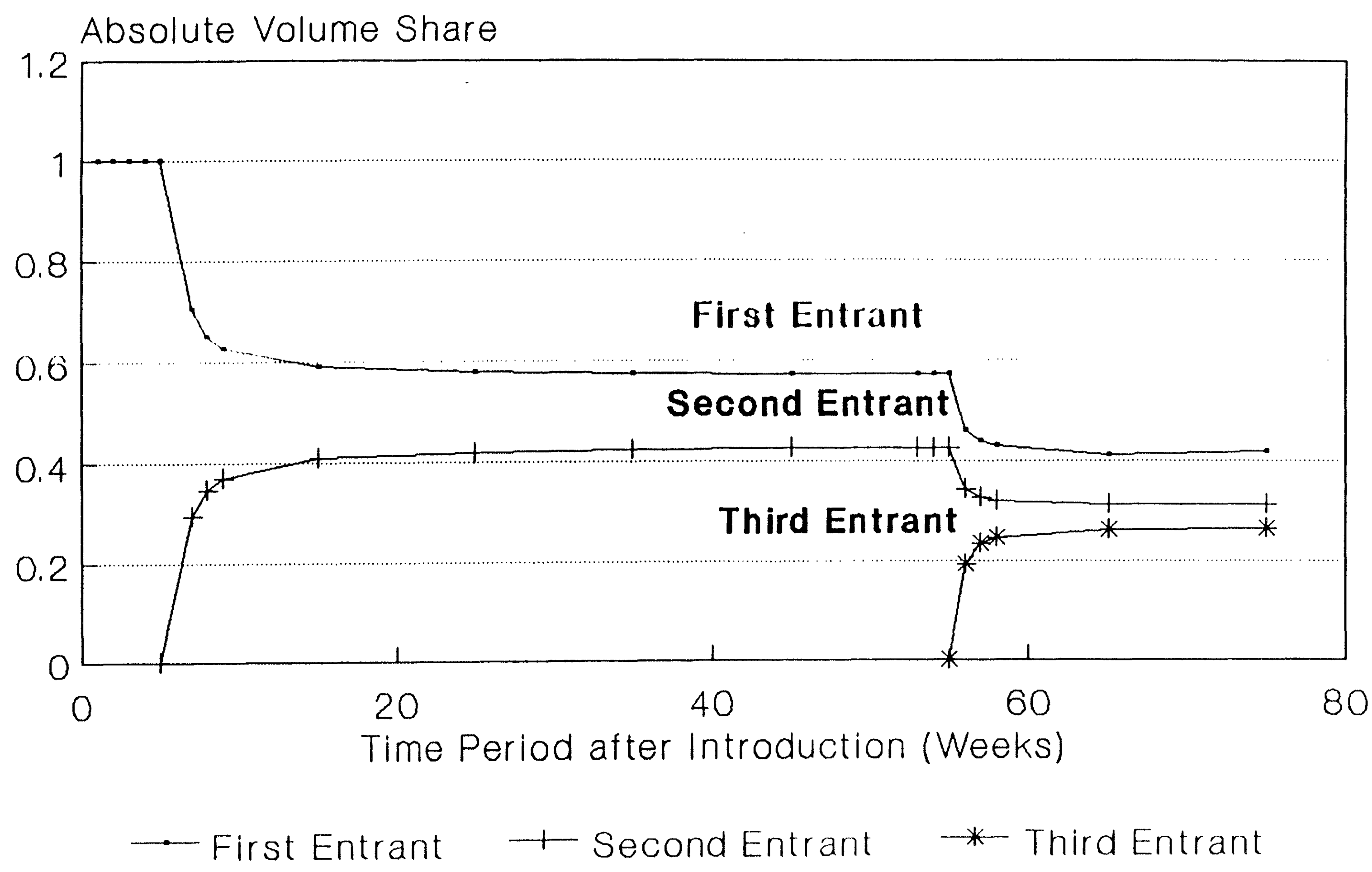
$\alpha, \beta, \gamma, \delta, \theta, \phi, \Psi, \epsilon$ = Parameters

We have suppressed a category subscript for notational simplicity.

Underlying Share Growth: The underlying market share for later entrants to enter a category relative to the pioneer is described by $(1 - e^{-\phi t})$. Figure 1 shows the typical underlying share pattern in a market as entry occurs. Initially the pioneer has 100 percent of the market but loses share as the second brand enters. We assume that the second brand's share grows at decreasing rate over time and approaches an asymptote. When the second brand enters, a discrete change takes place in the curve describing the pioneer because shares in the market must add to 100%. Similarly when the third brand enters, the share curves for the first and second entrants undergo a discrete change as the third entrant's share grows asymptotically. These curves are not smooth exponential functions, but if we assume that the third entrant takes share from brands one and two in a manner proportional to their shares, we obtain the desired smoothness in the share ratios of equation 1. This is the constant ratio model assumption of competitive interaction and it has the attractive property in our case that when we ratio the share of the i th brand to enter the market to the first entrant in the category, the curves of relative share versus time become

Figure 1

SHARE BY ORDER OF ENTRY



smooth and are consistent with our model of underlying share growth.[1]

One reason why we ratio the i th brand share to the first brand to enter the category is now evident, but another reason results from our desire to estimate equation 1 with time series and cross sectional data. Ratios allow reasonable comparisons across categories with different numbers of brands. In a three brand as well as in a two brand category we posit that the share ratio will be the same between the second and first entrants even though the absolute share may be very different (e.g. 40% vs. 60% in a two brand market and 33.3% vs 50% in a three brand market). A third reason is that the ratios are an appropriate way of eliminating cross category differences in marketing instruments, e.g., some categories have higher prices or promotional or advertisement expenditures and others have lower levels.

Share Growth and Asymptotic Effects for Later Entrants: The sub-model of underlying growth in share ratios described above $(1 - e^{-\phi t})$ is extended in equation 1 to allow the asymptotic level and the growth rate to the asymptote to be different for later entrants. The asymptotic effect is modeled by a mutiplicative factor (E^{α}). This allows the asymptote to be lower for later entrants if $\alpha < 0$ or higher if $\alpha > 0$.

The effect of order of entry on the rate of growth in share is

[1] If the share of i th entrant (i greater than 2) is S_i'and S_1' and S_2'are the shares of the first and second entrants before entry of the i th brand, the ratio of the second to first entrant after entry is $S_2/S_1 = (S_2'/(1 + S_i))/(S_1'/(1 + S_i)) = S_2'/S_1'$.

modeled through the multiplicative factor and by adding an additional exponential term. The multiplicative effect E^{α} changes the growth rate because it effects each period's share estimate. When α is less than zero this component of the growth rate as well as the asymptote are lowered and vice versa. The additional exponential term is $-(\Psi/E_i)t$ and it increases the growth rate in share if Ψ is greater than zero and decreases it if Ψ is less than zero. When we divide the growth parameter Ψ by the order of entry we are assuming that this component of the growth effect is smaller for later entrants whether the effect is to increase or decrease the growth rate. When examining the effect of later entrants versus earlier entrants in this exponential term we must consider the effect of Ψ/E_i for E = i and i + 1 where i is greater than or equal to two. If Ψ is greater than zero the entry effect is a higher growth rate for all later entrants but the not as much higher for entrant i + 1 as for i, so the later entrant i + 1 is growing at a slower rate relative to entrant i. If Ψ is less than zero the entry effect is lower growth for all later entrants but not as much lower for entrant i + 1 as for i, so the later entrant i + 1 has a faster growth than entrant i. The total growth rate must be assessed by the combination of the components for the specific values of the parameter estimates (α, ϕ, and Ψ).

Effects of Marketing Variables: The effects of changes in distribution, price, promotion, advertising, and quality are modeled as multiplicative effects where each variable of the i th entry is defined as a ratio to the pioneer's level for the variable and raised to an exponent. This multiplicative form allows for nonlinear response and interaction effects between the variables. Major introductory campaigns that induce large trial sales are captured by the multiplicative promotion and advertising terms which are multiplied times the basic growth term. After the introductory campaign is finished the sales will be dominated by the underlying growth effects.

The model in equation 1 includes the critical asymptotic and dynamic share effects for order of entry and it can represent complex share patterns such as increases in share above the underlying growth rate by heavy promotion and advertising and then a share reduction as the trial stimulators are withdrawn and share growth renews due to repeat purchasing.[2]

Trial Penetration Model

We model trial penetration analogously to share. Underlying trial penetration is the fraction of the market who has ever tried a brand and typically this measure of trial displays asymptotic growth. We model order effects on the rate of growth and asymptotic level. Controllable variables of distribution, promotion, price, advertising, and quality modify this underlying growth in penetration.

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[2] Equation 1 has no constant (K) because we want to preserve for the case where only one brand is in the market the asymptotic property of the share ratio being 1. With only one brand all the independent ratios will be one and the share ratio will be one only if K is not included or its value is 1.

$$T_{it} = E_i^{\alpha'} D_{it}^{\beta'} P_{it}^{\gamma'} M_{it}^{\delta'} A_{it}^{\theta'} Q_i^{\epsilon'} (1-e^{-\phi' t-(\psi'/E_i)t}) \tag{2}$$

T_{it} = Ratio of cumulative penetration of ith brand to first brand in category

Repeat Purchasing Model

The cumulative percent of those who tried who ever repeat is modeled similarly to share and trial penetration with order effects on underlying repeat purchasing and marketing variables as modifiers of the underlying pattern.

$$R_{it} = E_i^{\alpha''} D_{it}^{\beta''} P_{it}^{\gamma''} M_{it}^{\delta''} A_{it}^{\theta''} Q_i^{\epsilon''} (1-e^{\phi'' t-(\psi''/E_i)t}) \tag{3}$$

R_{it} = Ratio of cumulative percent of triers who repeat by period t for ith brand to first brand in category

We also use this same form to model additional purchases after trial and first repeat. The cumulative number of additional repeat purchases per person who had repeated once after a trial purchase is used as the dependent variable in the same model form as described in equation 3.

MEASUREMENT AND ESTIMATION

Data

The data used in this study are based on UPC measures in eight markets for share, trial penetration, repeat purchases, distribution, price, and promotion supplied by Information

Resources Inc.[3] Advertising expenditure data was obtained from Leading National Advertisers. We found 28 new brand entrants across 8 frequently purchased categories over a time span of 220 weeks. We selected categories where new brand entrants (not new variants of existing brands) were present and at least 52 weeks of data were available for the new brand. Categories included tartar control toothpaste, hi-fiber cereals, frozen orange drink, frozen pineapple juice, wine coolers, microwave popcorn, gel toothpaste, and ibuprofen pain relievers. Two brands achieved measurable share and then fell to approximately zero sales levels (the second entrant in wine coolers and the fourth in microwave popcorn). We omitted these brands from the statistical analysis but kept them in the order of entry count for the category. If we had included them, their low sales levels would have overstated the penalties for late entry that successful brands would experience. Eight of the remaining 26 successful entrants were first entrants. Across the 18 successful later entrants there were 1241 weekly observations or on average 69 weeks per entry.

Measures

The raw UPC store and panel measures were used directly or manipulated to correspond to the definitions in equation 1. Market

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[3] We would like to acknowledge and thank Information Resources Inc. for providing this data to us. The 8 cities represent IRI BEHAVIORSCAN® cities. The data includes store scanner records from over 75 supermarkets and 25 drug stores as well as panel records from over 2500 respondents in each market. Data from October 31, 1983 to January 15, 1988 were available.

share is obtained directly from the IRI weekly data reports and is ratioed to the first entrant to provide the dependent measure S in equation 1. Order of entry (E) is not completely defined in the UPC data. For brands that entered in our 220 week span of UPC data, the order of entry of each brand was obtained by observing the week in which the brand first appeared in the UPC store data. In cases where existing brands entered the market before the beginning of our data (October 31, 1983), we interviewed brand managers in the respective category and reviewed trade publications (Advertising Age and Marketing News) to determine order of earlier entrants.

Distribution in the IRI data is measured by the occurrence of some sales movement in a store over a week. The percent distribution is the proportion of the stores recording sales of the brand weighted by the volume of that store relative to the total market volume. This "all commodity weighted volume" measure is used as the distribution variable in the ratio D.

Suggested retail price is not reported directly in the UPC reports but can be derived from the weekly reported check out prices per unit volume (these include promotion effects) by considering the IRI measures of "deal volume percentage" (average percent of volume purchased on any deal) and "promotional price cut" (the average percentage of suggested price cut per unit volume of purchase). The check out price is suggested price weighted by the deal volume percentage and promotional price cut:

$$P_{it}^{C} = P_{it}\ (1-L_{it}) + L_{it}\ \ P_{it}\ (1-C_{it}) \tag{4}$$

where

P^{c}_{it} = Check out price per unit volume

P_{it} = Suggested price per unit volume

L_{it} = Deal volume percentage

C_{it} = Promotional price cut

and the suggested price is therefore:

$$P_{it} = P_{it}^{C}\ /(1-L_{it}\ C_{it}) \tag{5}$$

The dollar promotional expenditure is constructed from the deal volume percentage and promotional price cut variables.

$$M_{it} = P_{it}\ C_{it}\ V_{it}\ L_{it} \tag{6}$$

where

M_{it} = Promotional expenditure for a brand at period t

V_{it} = Unit volume sales at time period t

Advertising expenditure from <u>Leading National Advertisers</u> is based on audits of seven media (magazines, newspapers, newspaper supplements, network television, spot television, network radio, outdoor, and cable TV). The ratio of the nth entrant to the first entrant (A) is calculated from the reported magnitudes. The absolute magnitude of this measure is not required in this model so we need only assume that the audit data is correctly representing the relative expenditures. Advertising is the last measure required in the share model equation 1.

Dependent measures of trial and repeat for equations 2 and 3 were obtained directly from IRI panel reports. In contrast to the share data which was available weekly, the trial and repeat data were available only on a five week basis. The price and promotion variables were aggregated to the five week interval for the trial and repeat calculations, but in other respects the independent variable for equations 2 and 3 were defined as above. The total number of five week observations for later entrants was 330 or 18 five week periods per entry on average.

Two repeat measures were available. Equation 3 represents one of them -- cumulative number of triers who repeat by period t. The second measure is the number of "repeat purchases per repeater" or the number of purchases in the panel that reflect the second or higher repeat purchases divided by the number of people who have repeated at least once at time t. In the results section we report the use of both measures as dependent measures of repeat purchasing.

Limitation and Strengths

One variable is missing from our measures -- product quality (Q). In the Urban et. al. (1986) a constant sum preference measure was available based on survey measures from pretest market research, but in our case such measures were not available. To compensate in part for this limitation, a dummy variable to represent quality will be estimated statistically.

Despite this limitation, the data base is attractive because it measures not only share but also trial and repeat behavior, includes price, promotion, and distribution variables, and reports store level marketing activity on a weekly basis.

Estimation

The share, trial, and repeat models developed above are nonlinear time series cross sectional models from the estimation point of view. We linearize the basic terms of equations 1,2, and 3 by taking logs of both sides of them. Because we do not have a quality measure in our data base we use a brand specific constant (Q) to account for quality and other variations unique to the brand. In the log-log versions of the equations the term $(1-e^{-\phi t-(\Upsilon/E)t})$ represents the dynamics. We employ nonlinear least squares estimation methods (SYSNLIN OLS in SAS) to estimate the coefficients.

EMPIRICAL RESULTS

The statistical results of estimating the share, trial penetration, and repeat equations are shown in Table 1. The fits are good with R squared values in the range of .81 to .93 and the correlations of actual to predicted in the range of .97 and .89. The share and trial models show the best fits.

In the share, trial, cumulative repeat, and repeat per repeater models the alpha parameter is negative and significant at the five percent level in all cases. This indicates that later entrants achieved lower asymptotic performance. Order of entry

Table 1: Share Trial and Repeat Model Estimation Results

Parameters (t)	Estimates: Share	Estimates: Trial	Repeat: Cumrep	Repeat: Repper
Asymptotic Entry (α)	-0.39639	-0.50603	-0.19242	-0.10240
	(-14.02)***	(-7.54)***	(-2.69)***	(-2.26)**
Distribution (β)	0.69832	0.69423	0.14745	0.17307
	(13.74)***	(7.02)***	(1.39)	(2.50)**
Suggested Price (γ)	-0.30987	-0.02836	-0.39650	-0.27095
	(-8.18)***	(-0.21)	(2.74)***	(2.09)**
Promotion Dollars (δ)	0.32972	0.17497	-0.05770	0.01062
	(30.97)***	(8.18)***	(-2.54)**	(0.74)
Advertising Expenditure (θ)	0.03703	0.02745	0.00453	-0.01116
	(6.71)***	(2.71)***	(0.43)	(-1.65)*
Constant (ϕ)	2.92505	0.50871	0.64141	0.34911
	(1.94)*	(2.34)**	(4.09)***	(4.50)***
Rate of Growth (Ψ)	-5.63811	-0.18045	-1.02640	-0.27095
	(-1.87)*	(-0.28)	(-3.04)***	(-1.33)
Brand Specific Constants:				
Brand 1	-0.42088	-0.85134	-0.14983	-1.00591
	(-7.45)***	(-5.86)***	(-0.74)	(-9.28)***
Brand 2	-1.11144	-1.77551	-0.68310	-1.82243
	(-13.38)***	(-8.44)***	(-3.02)***	(-12.28)***
Brand 3	-0.85077	-1.58395	-0.97308	-3.09808
	(-8.57)***	(-6.87)***	(-3.95)***	(-9.90)***
Brand 4	-0.33686	-1.21115	-0.27177	-1.47906
	(-4.67)***	(-5.90)***	(-1.26)	(-10.57)***
Brand 5	0.02670	1.11331	-0.40288	0.36102
	(0.40)	(9.58)***	(-2.84)***	(4.45)***
Brand 6	0.49094	0.01315	-0.07796	-0.83335
	(5.58)***	(0.08)	(-0.43)	(-7.10)***
Brand 7	-0.82766	-1.07723	-0.56647	-1.84406
	(-8.71)***	(-4.56)***	(-2.25)**	(-11.12)***
Brand 8	-0.45605	0.87590	-0.78589	-0.38543
	(-7.25)***	(7.08)***	(-5.98)***	(-4.72)***
Brand 9	-0.67243	-1.04946	-1.03058	-1.53269
	(-7.61)***	(-5.38)***	(-4.85)***	(-10.77)***
Brand 10	0.39481	1.75289	0.58704	0.66871
	(4.49)***	(11.80)***	(3.69)***	(6.75)***
Brand 11	0.30934	1.51696	0.26032	0.35939
	(3.59)***	(10.37)***	(1.65)*	(3.62)***
Brand 12	0.35853	1.33961	0.36920	0.28759
	(4.14)***	(7.68)***	(2.00)**	(2.42)**

Brand 13	-0.28596 (-2.66)***	1.26679 (6.57)***	0.46003 (2.24)**	-0.06205 (-0.48)
Brand 14	0.53459 (6.08)***	1.48551 (7.13)***	1.04443 (4.40)***	0.42889 (3.02)***
Brand 15	-0.78833 (-13.77)***	-0.79877 (-5.92)***	-0.25990 (-1.82)*	-0.15906 (-1.78)*
Brand 16	-0.61924 (-10.31)***	-0.97167 (-6.55)***	-4.03122 (-24.91)***	-1.00408 (-9.61)***
Brand 17	-0.32124 (-8.32)***	0.10011 (1.09)	0.19397 (1.70)*	0.06890 (1.09)
Number of observations:	1241	333	330	316
R-Square:	0.9046	0.9327	0.8138	0.8814
Correlation between actual & predicted	0.95	0.97	0.89	0.94

The "T" ratio values are shown in the parentheses. CUMREP and REPPER refer to repeat models with cumulative repeaters as a percent of triers and average additional repeats per repeater as the respective dependent measures.

*Significant at the 10% level
**Significant at the 5% level
***Significant at the 1% level

penalties are found in not only trial, but also in repeat behavior. The share model asymptotic result confirms previous work (Urban et. al., 1986) but is smaller in magnitude (-.4 in this study versus -.49 in the Urban et. al. study). The trial and repeat estimates provide new evidence to suggest that order of entry penalties will occur in trial and repeat behavior when all other variables are equal. The order effect is observed on both first repeat and subsequent repeat purchases by those who have repeat purchased once. The market reward evident in share is the result of first mover advantages in all phases of the purchase sequence.

The effects of the multiplicative and exponential growth parameters (α, ϕ, Ψ) can be most easily interpreted by the values in table 2 which show the overall growth progression of the share ratio for second, third, and fourth entrants based on the estimated parameters and the assumption that the price, promotion, distribution, and advertising are equal to the first brand entry's levels. The table shows the fraction of the asymptotic share ratio achieved in each period as well as the magnitude of the share ratio itself. The data in part a of table 2 indicates that the rate of convergence to the asymptotic value is faster for entrant 3 than 2, 4 than 3, and 5 than 4. Later entrants approach their eventual share levels faster than early entrants all else being equal. However, the asymptotic values for later entrants are lower (see

Table 2: Share Growth for Later Entrants With Price, Promotion, Advertising and Distribution Equal to Pioneer

a) Estimated Fraction of Symptotic Share Ratio Level Achieved at Time t (Weeks)

Time	Entry 2	Entry 3	Entry 4	Entry 5
1	0.100	0.648	0.780	0.834
2	0.550	0.824	0.890	0.917
3	0.700	0.882	0.926	0.944
4	0.775	0.912	0.945	0.958
5	0.820	0.929	0.956	0.966
6	0.850	0.941	0.963	0.972
7	0.871	0.949	0.968	0.976
8	0.887	0.956	0.972	0.979
9	0.900	0.960	0.975	0.981
10	0.910	0.964	0.978	0.983
11	0.918	0.968	0.980	0.984
12	0.925	0.970	0.981	0.986
13	0.930	0.972	0.983	0.987
14	0.935	0.974	0.984	0.988
15	0.940	0.976	0.985	0.988
16	0.943	0.978	0.986	0.989

b) Estimated Share Ratio Values Achieved at Time t (Weeks)

Time	Entry 2	Entry 3	Entry 4	Entry 5
1	0.076	0.419	0.450	0.441
2	0.418	0.533	0.514	0.484
3	0.532	0.571	0.535	0.499
4	0.589	0.590	0.545	0.506
5	0.623	0.601	0.552	0.511
6	0.646	0.609	0.556	0.514
7	0.662	0.614	0.559	0.516
8	0.674	0.618	0.561	0.517
9	0.684	0.621	0.563	0.518
10	0.691	0.624	0.564	0.519
11	0.697	0.626	0.566	0.520
12	0.703	0.628	0.566	0.521
13	0.707	0.629	0.567	0.521
14	0.711	0.630	0.568	0.522
15	0.714	0.632	0.569	0.522
16	0.717	0.633	0.569	0.523

part b of table 2)[4].

In the trial model the exponential growth parameter psi is not significant so the null hypothesis of equal rates of growth to the asymptote for later entrants cannot be rejected at the 10 percent level. The later entrants would not achieve trial penetration faster or slower than the earlier entrants, but they would achieve lower levels of asymptotic trial penetration if all else were equal. The trial penetration ratios are shown in table 3. In both repeat measures (cumulative repeat and repeats per repeater) the asymptotic and exponential growth parameters are significant at the ten percent level. This indicates that later entrants achieve lower asymptotic results but at a faster rate than early entrants. The pattern of growth is analogous to the share patterns and is shown in table 3 for twelve five week periods.

The elasticities of price, promotion, distribution, and advertising are all significant in the share equation with distribution and promotion being most responsive. The trial behavior is similar and the repeat models show low significance and mixed results.

Eighty nine percent of the dummy variables are significant at the ten percent level. An ANOVA analysis indicates significant differences across the brand constants (F (16,51) = 6.14 and

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[4] Note that the slope of the share ratios for later entrants is not higher for all periods relative to the earlier entrants, but they do grow at a faster rate in terms of proportion of their asymptote.

Table 3: Trial and Repeat Ratios for Later Entrants With Price, Promotion, Advertising and Distribution Equal to Pioneer

a) Estimated Trial Ratio (5 Week Time Periods)

Time	Entry 2	Entry 3	Entry 4	Entry 5
1	0.240	0.207	0.183	0.166
2	0.472	0.390	0.339	0.304
3	0.549	0.451	0.391	0.350
4	0.588	0.481	0.417	0.373
5	0.611	0.500	0.433	0.387
6	0.626	0.512	0.443	0.396
7	0.637	0.521	0.451	0.403
8	0.646	0.527	0.456	0.408
9	0.652	0.532	0.461	0.412
10	0.657	0.536	0.464	0.415
11	0.662	0.540	0.467	0.417
12	0.665	0.543	0.469	0.419

b) Estimated Cumulative Percent of Triers Who Repeat (5 Week Time Periods)

Time	Entry 2	Entry 3	Entry 4	Entry 5
1	0.105	0.209	0.244	0.259
2	0.490	0.509	0.505	0.496
3	0.618	0.609	0.592	0.575
4	0.682	0.659	0.635	0.615
5	0.721	0.689	0.661	0.638
6	0.746	0.709	0.678	0.654
7	0.765	0.723	0.691	0.665
8	0.778	0.734	0.700	0.674
9	0.789	0.742	0.707	0.680
10	0.798	0.749	0.713	0.686
11	0.805	0.754	0.718	0.690
12	0.810	0.759	0.722	0.694

c) Estimated Repeats Per Repeater (5 Week Time Periods)

Time	Entry 2	Entry 3	Entry 4	Entry 5
1	0.179	0.203	0.212	0.216
2	0.555	0.548	0.540	0.532
3	0.680	0.663	0.649	0.637
4	0.743	0.721	0.703	0.690
5	0.781	0.755	0.736	0.721
6	0.806	0.778	0.758	0.742
7	0.824	0.795	0.774	0.757
8	0.837	0.807	0.785	0.769
9	0.847	0.816	0.794	0.777
10	0.856	0.824	0.802	0.784
11	0.863	0.830	0.808	0.790
12	0.868	0.836	0.813	0.795

significant at the 1% level), but no significant differences across the models ($F\ (3,64) = 1.22$ and not significant at the 10% level). The variables appear to capture meaningful brand specific effects, but the variation evident by inspection suggests that more than quality effects may be represented in the coefficients.[5]

DISCUSSION AND FUTURE RESEARCH

Asymptotic Order of Entry Penalties

The reported analysis indicates substantial order of entry penalties for market share. Table 4 gives the asymptotic estimates for share in 2, 3, 4, 5, 6, and 7 brand markets based on the order of entry penalty parameter of -.4 . Substantial rewards are granted by the market for early entry. Late entrants should expect lower shares unless they market their products more aggressively or have better quality. If a firm is contemplating entry in a category, equation one can be used to calculate the effects of alternate advertising, price, distribution, and promotion. For example it is doubtful that the 3rd brand to enter can justify the same advertising as the first brand. The share reduction due to lower advertising can be estimated by equation one. If the advertising and promotion of the third entrant is .65 of the first brand, price is equal to the pioneer, and distribution is .9 of the first entrant, the long run share potential is 22%

[5] Dropping the dummy variables in the share equation reduces the R square from .90 to .85 and the asymptotic share parameter increases in magnitude from -.39 to -.66. This suggests the estimates with dummies is conservative with respect to estimating the order of entry penalty.

Table 4: Order of Entry

	1st	2nd	3rd	4th	5th	6th	7th
	100						
	57	43					
Market	42	32	26				
Share	34	26	22	18			
	29	22	18	16	15		
	25	19	16	15	13	12	
	23	17	15	13	12	11	9

rather than 26% and the weekly market share is reduced proportionally in each period.

The statistical analysis of trial and repeat models indicates that the overall order of entry penalty is manifest in trial, first repeat, and subsequent repeat purchase behavior. Schmalensee (1982) modeled the source of order advantage based on the notion that once buyers use the first entrant's product, they will be unwilling to buy a second entrant without a price concession because they are not certain the second product will work. This would suggest the order effect will be seen only on trial. A number of authors (Hauser and Shugan 1983, Lane 1980, and Prescott and Visscher 1977) suggest that if the early entrant takes the premier positioning in a space of heterogeneous preferences, the later entrants will have to settle for lower shares. This again suggests a trial penalty. It would not posit a repeat order effect because those consumers who try the product do it because the product does match their preferences and we therefore would expect to have normal repeat rates.

Horsky and Mate (1988) find an order of entry advantage in the initial purchases of consumer durables due to goodwill generated by the larger stock of previous adopters possessed by first entrants. Such a trial effect also could be true in packaged goods if diffusion phenomena are present.

Carpenter and Nakamoto's experimental work (1989) suggests that early entrants enjoy an advantage by influencing the preference structure so that it favors the pioneer in situations in which preferences are ambiguous (not well formed attribute importances). If this is true, the preference structure (brand attribute weights and ideal points) could favor early entrants in both trial and repeat behavior. Hoch and Ha (1986) argue repeat purchasing reinforces judgements that state that the early entrants have preferred attribute combinations. Samuelson and Zeckhauser (1988) suggest that the risk and utility argument proposed by Schmalansee may persist because the utility of the status quo is greater than other alternative choices if consumers do not have fully formed beliefs.

Carpenter and Nakamoto (1989) also identify the prototypicality of the pioneer as another source of advantage. If the pioneer becomes the prototype of the new category customers may use it as a cognitive referent and the brand can gain accessibility advantages in memory. Such superiority in a schema in memory is an advantage (Sujan 1985) that could affect trial and repeat behavior. Other principles of generalized learning can produce similar phenomena (Alba and Hutchinson 1981, Marks and Olsen 1981, and

Meyer 1986). Kardes and Gurumurthy (1990) find in a behavioral experiment that pioneers benefit from more extensive recall of attribute information that is transferred to a persistent attitudinal advantage over later entrants.

Hauser and Wernerfelt (1990) argue that an order of entry advantage can accrue from the consumers' decision to include a brand in the their consideration sets. As more brands enter, the value of adding another brand decreases so earlier entrants are likely to be in more customers consideration sets. This advantage particularly would affect repeat purchase rates.

Our work provides evidence of order effects on both trial and repeat and many behavioral phenomena could explain this. Behavioral experimentation is needed to isolate the determinants of these effects, the relative importance of each of the determinants, and the product situations where they operate.

Rate of Approach to Asymptote

The results on the dynamics of the order effects are mixed. The share equation identifies significant parameters that suggest later entrants approach lower levels of share but at a faster speed (see Table 2a and Figure one for the share dynamics and asymptotes based on the share parameter estimates and the price, promotion, distribution, and advertising equal to the pioneer). In the trial model, however, we do not find significant dynamic effects, while the cumulative first repeat and repeat per repeater models show significantly faster approaches to lower levels of repeat for later entrants. We would have expected the trial dynamics to be significant because it is a large part of the overall share behavior of a new product. More empirical analysis is needed to clarify this question. It may be that the mixed result in the trial and repeat equations is due to the five week basis of the data for these estimations. Larger sample sizes and improved nonlinear estimation algorithms may be needed. Given the available evidence in this paper either there is no difference in the approach to the lower asymptotic share, trial, and repeat values or later entrants approach a lower asymptote at a faster rate.

Future Research

In addition to the need for the statistical and behavioral experimentation analyses indicated above, it would be desirable to extend the models to include the effects of entry on price, promotion, advertising and distribution. If later entry is significantly correlated to the level of these variables, it may indicate the order of entry penalty is not innate, but rather due to later entrants charging higher prices and having lower promotion, advertising, and distribution levels. Entry penalties may also be affected by the defensive reactions of pioneers rather than the basic market granted advantage. Although Robinson (1988) finds limited competitive reactions in his analysis of 199 entrants in new start business areas, it would be worth examining the phenomena in our consumer packaged goods data. A simultaneous equation extension of our model to include competitive reactions and entry on marketing mix variables is needed.[6] Such a model would allow a comparison of the results to Robinson and Fornell's (1985) simultaneous modeling of consumer durable and nondurable goods data obtained from the PIMS business level data base.

Brown and Lattin (1990) have hypothesized and find "head start" advantages (e.g. prototyping) for pioneers related to the number of months one proceeds another in the market. In our analysis we did not include the time between entrants as a variable because we did not have a reliable measure of when the previous brand had entered if it entered before the beginning date of our UPC data was available (October 31, 1983). We had only 18 brands in the data base and in eight cases the previous brand entered before October 1983. Based on the UPC measures and rough estimates we got for the ten brands (we asked brand managers and examined advertising initiation), we found no significant effect for the time between entries. If a larger longitudinal data base were available we could examine this effect more accurately. The presence of national UPC data bases such as INFOSCAN should make this kind of estimation possible in the future.

It would be interesting to test the share model on consumer durables, industrial products, and services to see if order of entry penalties are evident. Data may be difficult to collect, but ethical pharmaceuticals could provide a fertile empirical data base. Cross category differences in the order of entry effect must

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[6] See Gurumuthy Kalyanaram and Glen L. Urban (1990) for preliminary exploratory results.

be examined and an appropriate behavioral mechanism to explain these cross category differences must be studied. We are not able to undertake such a study in our data base because we do not have enough data within any one category to obtain convergence of the non-linear share or trial or repeat models. Much remains to be done in calibrating the size of the advantages of early entry, the determinants of such effects, and when they can be expected to occur.

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