

**Brand Loyalty. *Plus ça change...?***  
**Using the NBD-Dirichlet parameters to interpret long-term purchase  
incidence and brand choice.**

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# **Brand Loyalty. *Plus ça change...?***

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### **Abstract**

*The NBD-Dirichlet model (Goodhardt, Ehrenberg & Chatfield, 1984) has recently been described as one of marketing's "true scientific theories" (Sharp, 2010) and yet its two assumptions of stationarity and non-partitioning cannot allow for customer or brand equity effects. The aim of this paper is first to describe the effects of brand loyalty on evolving long-term market structure, and then to extend uses of the model's parameters A, K and S as performance benchmarks. Using a six-year panel of continuous reporters we show that the normal heterogeneity in category purchase incidence remains approximately stable between six months and a year, but that brand switching greatly increases with time. One interpretation of a higher S parameter value might be that as loyalty decreases, brand shares become more dynamic, leading to sustained changes in market structure. By fitting the model we show that this is not so. The Dirichlet output fits brand performance measures well in both extended and short-term data, and although there is evidence of emerging triple jeopardy for the largest brands, this does not lead to sustained brand-share growth. Instead, it is a deviation from the fit of the NBD-Dirichlet, but a general characteristic of extended repertoire purchase. For managers, the main implication of such fixed and long-term propensities is that brand growth remains quite unlikely, but also that brand-share maintenance requires constant effort in the face of increased switching propensities over time.*

**Key Words:** Dirichlet Parameters, Double Jeopardy, Customer Equity, Brand Equity, Empirical Generalisations.

### **Introduction & Objectives**

Loyalty-building strategies are generally considered to deliver sustained growth (Day, 2002) but they are also believed to build shareholder value through customer equity (Blattberg and Deighton, 1996; Gupta, Lehmann and Stuart, 2004). We should therefore see the effects of successful loyalty-building manifested in long enough runs of consecutive panel data if more consumers buy more of a stronger brand more often over time.

In fact, the exact opposite appears to be the case. In this paper we discuss two startling results about the nature of long-term consumer behaviour. In considering just such data, aggregated to various equal period lengths, but running over several years we found no evidence whatsoever of increasing brand loyalty leading to growth. Perhaps more surprising, we observed a systematic and sizeable decline in levels of repeat-buying for all brands in very long runs of data. Over six years of continuous purchasing, average household repertoire size doubled, share of category requirement fell dramatically and levels of brand switching increased.

The astonishing fact is that these changes are all predictable. Although the distributions of purchase incidence and brand choice evolved with time, market structures in our data remained approximately stable, with brand shares very largely unchanged. Using the NBD-Dirichlet it was thus possible to describe observed purchasing closely in 18 different FMCG categories in time periods ranging from six months to six years.

In evaluating the long-run evolution of repeat-buying, our initial approach was to summarise category performance in various periods using the parameters of the model. There has been recent interest in this area of Dirichlet research. For example Sharp, Wright & Goodhardt (2002) used the so-called switching parameter,  $S$ , to distinguish repertoire and subscription market structures. Driesener, Rungie, Habel & Allsop (2003) later established some further benchmarks for the three main model parameters,  $S$ ,  $K$  and  $A$ , while Driesener and Meyer-Warden (2011) have recently found limited evidence of trending category loyalty in successive observations of  $S$ . The objectives of this study were two fold. The first was to investigate the evidence for brand and consumer equity in long term panel data sets. Second, we sought to replicate and extend earlier work on the parameters of the NBD-Dirichlet model in order to strengthen benchmarks for their interpretation and contribute to knowledge of Dirichlet theory.

The main managerial implication of our findings is that instead of share growth (which is likely to be followed in short order by share decline), the objective of effective marketing should be to maintain the brand's position. Although this may seem dull it is realistic. Sustained growth may be exceptional (Graham, 2009), but when marketers get it wrong brands decline. In repertoire categories, every brand predictably loses over half of its buyers from quarter to quarter, and while some will buy nothing the following quarter, many switch to competitors. Managers must therefore continuously find new ways to encourage their buyers back in order to maintain penetration from period to period. This mostly seems to be what happens, although the task may be greater than previously thought since in this

research the spread of brands each household switches between is observed to widen dramatically over time.

The structure of this paper is as follows. We begin by summarising the well-established empirical generalisations of repeat buying described in the NBD-Dirichlet. We next discuss the model itself, and its parameters, contextualising their use in describing category level purchasing. Following a brief discussion of the data and method, we demonstrate how the parameters can capture norms of long-term category buying and will describe important changes to loyalty over time. We finally fit the model to demonstrate the effects of these changes at the brand level, before concluding with a discussion of the implications of our results for Dirichlet theory, and new applications of the parameters for practitioners concerned about brand growth and long-term brand value.

## **Conceptual Framework**

### ***Empirical generalisations in patterns of repeat-buying***

Meticulous replication studies of consumer behaviour patterns in over fifty years of research (Ehrenberg, 1988; Sharp, 2010) have led to the empirical generalisations of marketing science referred to in this paper and described below. These recurring patterns are found in routine panel data metrics such as brand penetration and purchase frequency, and in loyalty measures such as repeat purchase and share of category requirement. They can be used by practitioners without the need for any advanced modelling, in order to evaluate, predict and understand brand performance.

Ehrenberg argued that for managers to interpret the data they routinely consider, benchmarks are needed that go far beyond “this time last year”. Is it for example “*only 35%*” or “*as many as 35%*” of their brand’s customers who repeated in this period (Ehrenberg, Uncles and Goodhardt, 2004)? Most brand performance measures are in fact just about normal most of the time, but it helps to be familiar with the main recurring patterns, for example that:

- *Brand share is constrained by the Law of Double Jeopardy.* Small brands suffer twice; compared with bigger brands they have fewer buyers who buy the brand slightly less often. In any category, although the market shares and penetrations ( $w$ ) of competing

brands vary considerably they are closely correlated. On the other hand, purchase frequency ( $b$ ) tends to be similar across competing brands, although slightly lower for smaller brands (Ehrenberg, Goodhardt & Barwise, 1990; McPhee, 1963). This law implies that in any category penetration accounts for market share far more than loyalty, in a relationship defined in the approximation;  $w(1 - b) = a$  constant.

- *Your buyers are the buyers of other brands who occasionally buy you.* Most customers are experienced category buyers and choose over time from a portfolio of brands with which they are familiar. Competing brands are seen as largely substitutable, so that loyalty becomes polygamous, and in aggregate, any brands' customers buy competing brands more often in a period. The result is that categories are largely unsegmented and remain so over time (Kennedy & Ehrenberg, 2001) because any meaningful advance is quickly imitated leaving competing brands undifferentiated (Ehrenberg, Barnard & Scriven, 1997).
- *Hard-core loyalty exists, but mostly among light buyers.* Sole-brand buyers are relatively rare, tend to purchase less than the category average and their numbers decline over time with increasing opportunities to switch. Sole-loyal buyers are therefore better considered as light, rather than committed, consumers (Ehrenberg, 1988).
- *Duplication is in line with brand penetration.* Brands share customers predictably in line with penetration. More of any brand's consumers buy larger competitors, and fewer buy the smaller competitors in any period. This regularity is described in the Duplication of Purchase Law (Ehrenberg and Goodhardt, 1970).
- *Approximate stationarity is the norm.* Because households buy habitually, these patterns hold over time and are hard to shift permanently. Of course sales respond to marketing interventions, and sometimes dramatically, but any sustained change in market share is exceptional because of the inevitable off-setting competitive response (Bass & Pilon, 1980; Dekimpe & Hanssens, 1995; Graham, 2009).

### ***Normal loyalty or “anything-goes” marketing?***

The fact that there are “normal” levels of loyalty may still be surprising to some, but despite the scientific foundation for these benchmarks (Ehrenberg, 1995), it seems almost inconceivable that they could hold for very much longer than the year or two so far studied, given their fundamental implications – no segmentation, no differentiation, no added values, no sustained brand share growth! (Ehrenberg, 2001; Kennedy *et al.*, 2001). It is thus now desirable to extend the period of observation in order to resolve such divergence in expectation of long-term loyalty effects, particularly since there are some well-documented variances between theoretical and observed results in short-term data that might indicate evolving market structure. We next summarise these considerations, first outlining the traditional view of marketing.

In an analysis of the brand management function, Schultz (2010) agrees that market forces impose equilibrium, but suggests that in pursuing growth the marketer must create a differential advantage to destabilise it. The trick then is to re-stabilise the new structure by increasing brand loyalty to sustain the advantage. The literature commonly supports this, proposing that segmentation, targeting and positioning is the key to brand share growth.

In established markets, Levitt (1960), Webster (1986), Doyle & Stern (2006), McDonald and Dunbar (2004) and Aaker & McLoughlin (2007) all prescribe the strategic differentiation of tangible and intangible brand attributes to target the evolving needs and wants of an identified consumer segment, just as Schultz suggests. The aggregated effects of any resulting brand loyalty are then conceptualised as being cumulative and mediated by time, past marketing activity building into the added-values of brand equity (Aaker 2000; Keller & Lehmann, 2006; Reichheld, 2003). Consumers might therefore manifest the steady propensities usually seen in the short term, but in longer data sets the effects of brand equity must gradually become evident in the form of partitions around “strong brands” characterised by increasing purchase frequency and repeat, declines in switching, and subsequent shifts in market share.

Evidence for such effects is not yet clear, although any investment in brand or customer equity resulting in a heavier buying, non-duplicating customer base would necessarily violate the constraints of Double Jeopardy. This led Ehrenberg to describe such interventions as “anything goes” marketing (Ehrenberg *et al.*, 2004), and indeed where long-term share change has been reported in cross-sectional studies (e.g. Ehrenberg, Uncles, Carrie & Scriven, 2000; Golder, 2000), it so far suggests that brand growth is related more to penetration increases than to purchase frequency (Anschuetz, 2002; Baldinger, Blair and

Echambi, 2002; Bennett & Graham, 2010). However, if brand loyalty effects are cumulative and persistent but emerge only over the long-term, then a new type of research methodology is needed since standard panel data runs for just two or three years, limiting continuous purchasing studies.

Exceptions from behavioural norms that might eventually lead to the breakdown of Double Jeopardy have been well-documented. Perhaps the best known is the incidence of Triple Jeopardy (Battacharya, 1997; Fader & Schmittlein, 1993; Jung, Gruca & Lopo, 2010), cases of loyalty above the Double Jeopardy curve often reported for very large brands. Segmentation of this nature is thought to arise from a distribution bonus (if a small shop only stocks one brand in a category, it is usually the biggest), and if sustained over time might result in share growth. Partitions are also sometimes observed around brands with differing functionality; examples include diet and regular carbonated drinks, caffeinated and decaffeinated coffees or anti-dandruff and regular shampoos (Scriven & Danenberg, 2010). Such brands compete more strongly against each other than with the brands outside the partition, yet although they do not create exclusive segments (Kennedy *et al.* 2001), over time they too might grow at the expense of non-partitioned competitors.

So, despite the central role of brand loyalty in most marketing thinking, its effects still remain elusive (Dowling, 2004; East Hammond & Gendall, 2006). The first aim of this research is therefore to identify evolution in fundamental patterns of repeat-buying, evidence in panel data of consumers gradually drawn towards a tangible or intangible brand differentiation that cannot be imitated. Extended loyalty studies are still rare, and have faced methodological hurdles (e.g. Driesener *et al.*, 2011; Mela, Gupta & Lehman, 1997; Srinivasan, Leszczye & Bass, 2000; Stern & Hammond, 2004), but we now seek to address this, benchmarking both consecutive annual panel data reports and a specially constructed six-year panel dataset against theoretical output from the NBD-Dirichlet.

### **Model Description: The NBD-Dirichlet**

The NBD-Dirichlet (Goodhardt, Ehrenberg and Chatfield, 1984) is a stochastic model of choice probability distributions for stationary, non-partitioned categories. Its output specifies market structure in detail for any fixed period, from just a handful of inputs. Since its publication over twenty five years ago, an intense process of scientific replication and testing

has led to the Dirichlet being described as “one of marketing’s true theories” (Sharp, 2010) because it continues to capture repeat purchase behaviour under many varying conditions of category, country and time. The model has five assumptions for any chosen period;

- i. That category purchasing for each consumer follows a Poisson process.
- ii. That the purchase rates of different households follow a Gamma distribution.
- iii. That the choices each household makes from the available brands follow a multinomial distribution.
- iv. That these choice probabilities follow a Dirichlet distribution over the households.
- v. That purchase incidence (i & ii) and brand choice (iii and iv) are independent.

The Dirichlet combines these assumptions in two probability density functions, the negative binomial distribution (NBD) describing purchase incidence, and the Dirichlet multinomial distribution (DMD) for brand choice, to simultaneously model the numbers of purchases for each brand in a category over a fixed time. In order to fit the Dirichlet, three parameters S, M & K, are usually estimated from some period of panel data through the method of means and zeros or the method of moments, or using the more efficient likelihood theory (Rungie & Goodhardt, 2004). The model can then be calibrated from just four inputs (two describing category buying and two for a single brand), and the theoretical output then evaluated.

There has been increasing recent interest in understanding the Dirichlet parameters, and in establishing benchmarks for their interpretation. Because they parsimoniously summarise category purchase incidence and brand choice patterns we use them here as an initial indicator of market stationarity, and then demonstrate their use in enhancing evaluation and interpretation at the brand level. Other replications are progressing, but the second aim of this paper is to generalise recent findings and to extend them in the interpretation of new long-term observations. Empirical generalisations might then emerge offering norms of category performance for marketing strategy development.

In building the model, its authors did not originally envisage that its parameters might be useful metrics in their own right (Driesener, 2005), but recent work has demonstrated that they offer rich insights about category buying, and findings have already established useful benchmarks for marketers. Table 1 reiterates and expands the summary of the parameters found in Driesener *et al.*, (2003).



**Table 1: Dirichlet Parameter Descriptions & Definitions**

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- S** The S statistic describes the brand choice probabilities in the Dirichlet multinomial distribution (DMD). S reflects the extent to which people differ from each other in their propensities to buy each brand (Goodhardt, Ehrenberg & Chatfield, 1984). It is calculated from the sum of the brand *alphas* (the measure of the population's propensities to buy each brand in the category), where the higher the *alpha*, the more popular the brand. At one extreme, if S is very high the variance is near-zero, meaning everyone has a similar probability of buying brands X or Y, and switching is therefore "normal". In this case there are usually many brands in the category, and each is popular. If S is low, the polarity is at its maximum, meaning a proportion of buyers *always* buy brand X, while a proportion *never* do; this implies low switching, high levels of sole buyers and has led to the definition in Sharp, Wright & Goodhardt (2002) of subscription ( $S < 0.2$ ) and repertoire ( $S > 0.6$ ) markets. S has been described as the switching statistic, but it also encapsulates repertoire size, both of which are loyalty measures. In theory, S should not change with longer T, although Stern & Hammond (2004) found that it does in practice.
- M** The mean of the distribution of total household purchases of the category in the chosen period of analysis T. This increases with the length of T, given the increase in A ( $M = AK$ ).
- K** The equivalent of the *alpha* parameter of the gamma distribution, K describes the heterogeneity of category purchase rates across consumers. When K is low, households differ greatly in purchase rates, but when K is higher they differ less. According to Driesener, Rungie, Habel & Allsop (2003), K describes the attractiveness of the category, having a critical value of 1. When  $K > 1$  (for example in categories such as toothpaste or salt) it would be expected that given a long enough time period, and therefore a large enough A, every household will eventually purchase. When  $K < 1$  (for example with ground coffee) it implies that a certain proportion of households have such a low propensity to purchase that they can be described as "hardcore non-users" (Morrison, 1969), although over long enough time periods some might eventually buy. K describes a characteristic of category buying that is not expected to change with time in a near-stationary situation.
- A** The equivalent of the *beta* parameter of the gamma distribution (Driesener *et al.*, 2003) controlling the scale of the purchase frequency distribution across households. It should increase linearly with the length of T since the same households make cumulatively more purchases in longer periods, but in stationary markets A should remain stable in equal time periods. Increases in category purchase rates (for example in an emerging product-class such as flexi-pack pet food) would lead to increasing A values in consecutive and equal periods.
- B** The category penetration expressed as a percentage and defined as the proportion of the population buying the product-class at least once in a period. B increases with longer T, but not *pro-rata* since it reaches a ceiling of buyers in established categories, or 100%.
- W** The average purchase frequency of the product-class per buyer of the product class in T. This too increases with longer T, but not *pro-rata*, and not as quickly as B.
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## **Method and Data Description**

The research approach adopted in this study of evolving brand loyalty was inductive, the replication and extension of established empirical generalisations in Marketing Science. Results from such an approach are descriptive by nature, but build over time into explanatory theories that are strengthened when exceptions to established norms are observed. The required research design is therefore one of methodical, differentiated replication, in order to establish varied conditions under which a law-like relationship does or doesn't hold. An important feature of replication studies is that they do not rely on tests of statistical significance or best-fit for a single set of data (Ehrenberg, 1995). The criterion for judging an empirical generalisation is that it should fit, or approximately describe, a regular relationship between two or more variables in many different sets of data. As Barwise points out (1995), in this way it becomes useful as a benchmark for evaluating or understanding new or unfamiliar results, and for predicting outturns under similar conditions, so in conducting this research it was necessary to have access to not one, but to many different sets of data.

### ***Data description***

We used two separate data types both provided by *Kantar WorldPanel*. In our first replication we examined six consecutive annual summaries of UK shampoo category buying derived from standard household panel data. Household panels are recruited as a quota sample of the national population, and purchasing is reported in rolling two or three year runs. A proportion of respondents normally leaves the panel, but is replaced in order to maintain the quotas. This process creates two sources of error in any loyalty research. First, in studies of continuous, individual-level purchasing, panel defection can be confounded with brand defection. Recent increases in panel size have also introduced sample error in comparable aggregated measures. Second, loyalty studies are limited by report length.

In order to address these problems, a new panel was configured, consisting of only continuous respondents, amounting to nearly 4,000 UK households, reporting between 1999 and 2005 (six years). The panel is smaller than standard, but the important difference is that continuous repeat purchase analysis is possible at both brand and individual household level for a dramatically extended period. From the data, a range of marketing metrics was extracted for eighteen frequently purchased categories with widely varying purchasing characteristics.

## Methods

We first replicated prior research by estimating and comparing the Dirichlet parameters in six sequential and equal periods of standard FMCG panel data in one category, before extending observations of category buying to the long-term continuous panel in periods of three different lengths, six months, one year and six years, and in 18 categories. We then calibrated the model to assess fit to observed data, and in the following section we report the findings from these different analyses.

## Findings

We first obtained results from six consecutive annual periods of standard panel data. Table 2 gives the four Dirichlet parameters in each year, followed by category penetration (B), purchase frequency (W), and average repertoire size. On prior inspection of the data it was observed that no single brand held more than a 10% share in any year, and although there were fluctuations, no sustained share trend emerged. We therefore expected the parameters to capture these characteristics of intense competition and approximate stationarity.

**Table 2: Dirichlet parameters and descriptive statistics for 6 consecutive years of UK Shampoo category buying. Parameters in Full Annual Panel Data.**

Dirichlet Parameters	52 weeks ending:						Average
	March 2000	March 2001	March 2002	Feb 2003	Feb 2004	Feb 2005	
S	2.9	2.6	2.7	3.0	2.7	2.8	<b>2.8</b>
M	2.5	2.4	2.6	2.7	2.8	2.8	<b>2.6</b>
K	0.67	0.66	0.68	0.64	0.68	0.67	<b>0.67</b>
A	3.7	3.6	3.8	4.2	4.1	4.1	<b>3.9</b>
B	65%	63%	66%	65%	67%	67%	<b>65%</b>
W	3.9	3.7	3.9	4.1	4.2	4.1	<b>4</b>
Avg. brands bought	2.1	2.1	2.1	2.1	2.2	2.2	<b>2.1</b>

*Data Source: Kantar WorldPanel*

From Table 2 we see approximately stable measures, fluctuating by a point or two each year around the marginal averages shown. The two category purchase incidence parameters (K and A) show that household shampoo buying habits look almost unchanging.

This implies that no particular group of households is emerging as a heavier (or lighter) than expected buying segment, as would become evident given increases in customer equity for one brand or another if certain households began to increase purchase frequency around a new brand (or category) attribute.  $K$  here is almost in the mid-point of the range from 0 to 1.5 identified in Driesener *et al.*, (2003) but at  $< 1$ , there are clearly a number of households with such low purchase propensities that they will never buy in even the longest time frames, thus limiting cumulative penetration over years.

As to the distribution of brand choices, shampoo is clearly a repertoire market, with  $S$  values far greater than 0.6 (Sharp *et al.*, 2002), implying many popular brands and extensive switching between them. This confirms the expected effects of the low concentration of shares, which are seen in the average category purchase frequency ( $W$ ) of four and the average number of brands bought (over two). In other words even a “favourite” brand is being bought less than half the time in any year, a normal pattern of polygamous loyalty in repertoire categories, but slightly above the average repertoire size of two established by Banelis (2008). Repertoire is an important measure of loyalty; fewer brands indicate higher loyalty, more brands imply greater competition. Extensive switching appears to be a category characteristic here, but the stable  $S$  indicates no strong brand or brand segment is emerging.

However, in comparing average values of the metrics in the two panel series it is apparent that the data is split in character between its two constituent panels. For example average category purchase frequency ( $W$ ) in series one was 3.8, while in series 2 it was 4.1. Penetration ( $B$ ) was 64% and then 66%. Parameter  $M$ , the mean of the NBD distribution was 2.5 but rose to 2.8 in series 2 (This increase would be expected since the higher penetration reduces the number of non-buyers in  $M$ ). We concluded that these differences might even confound some trends apparently present, and consequently turned to the new continuous panel to further the study, first using the parameters to establish variances in habitual household buying between each category. This was important in order to ascertain the boundary conditions for any emerging generalisation of evolving brand loyalty effects.

#### ***Dirichlet parameters in continuous data.***

Table 3 shows three descriptive measures of category buying, penetration ( $B$ ), purchase frequency ( $W$ ), and average household repertoire size ( $\#$ ), comparing them with the four Dirichlet parameters, and is ordered by category penetration. From this analysis a very wide variance in category purchasing styles became apparent. For example, almost every household bought wrapped bread almost every week, but only one in four households bought

ground coffee at all, and only once a quarter on average. Other extremes in the data included canned cat foods, bought over once a week but only by a few households, and hair conditioner, a very occasional purchase.

**Table 3: Average Annual Dirichlet Parameters & Descriptive Metrics in 18 Categories. Six-Year Continuous Panel Data**

Category	Average Year						#
	B	W	S	M	K	A	
	%						
Wrapped Bread	99	49	3.0	48	1.2	40	3.5
Margarine	95	16	1.4	15	1.1	14	2.6
Everyday Biscuits	90	17	2.5	15	0.74	21	2.7
Instant Coffee	87	9	1.0	7.5	0.92	8	1.9
Male Deodorant	85	7	2.0	5.6	1.1	5	2.1
Female Deodorant	85	6	1.9	5.2	1.1	5	2.0
Crackers	84	9	2.5	7.2	0.79	9	2.5
Shampoo	70	4	2.1	2.9	0.77	4	1.7
Butter	68	12	1.1	8.1	0.35	23	2.0
Toilet Soap	66	4	1.2	2.3	0.80	3	1.6
Still Water	61	10	1.5	6.0	0.32	19	1.8
Analgesics	61	6	1.2	3.4	0.42	8	1.7
Vitamins	40	4	0.8	1.7	0.25	7	1.4
Hair Conditioner	39	3	1.8	1.3	0.31	4	1.6
Canned Cat Food	28	56	8.4	16	0.06	262	3.4
Ground Coffee	24	4	1.0	1.1	0.12	9	1.5
Canned Dog Food	22	35	1.7	7.7	0.05	151	2.7
Flexi Pack Cat Food	21	47	1.9	10	0.05	221	2.6
<b>Average</b>	<b>62</b>	<b>16</b>	<b>2.1</b>	<b>9.2</b>	<b>0.58</b>	<b>45</b>	<b>2.2</b>

Data Source: Kantar WorldPanel. Data rounded. Table ordered by category penetration (B)

Two questions now arose; could we confirm recently reported benchmarks for the Dirichlet parameters, and would they add new insight to the interpretation of category level buying? First we consider the S parameter. The mean annual value of S in Table 3 was 2.1, with a variance between 0.8 and 3. Since S was above 0.6 in every case, these categories could be described as repertoire (Sharp *et al.*, 2002), although there were three outliers. Vitamins had a low S at 0.8 and Wrapped Bread and Canned Cat Food had far higher than average values at 3 and 8.4. These latter categories had both the highest purchase frequencies in the table, and the highest repertoire size, while the reverse was true of Vitamins. A strong correlation was noted ( $r = 0.9$ ) between purchase frequency and repertoire size, and replicating Bound (2009), between S and repertoire size ( $r = 0.7$ ). This confirmed the nature of polygamous loyalty and brand substitutability; the more chances to switch there are, the

more switching is likely to take place. S therefore emerged as a potentially useful benchmark, but what was its “normal” value?

The range for S in this table was far lower than in the meta-analysis reported in Driesener *et al.*, (2003), where S reached a mean of 6.5 in a wide array of categories from aviation fuels to breakfast cereals. However, that earlier table included five categories of prescription drugs with values of 20 or more, and a UK confectionery category with a value of nearly 40. Excluding these outliers, average S was 2.6, far closer to the mean in Table 3. So while  $>0.6$  may be a cut-off for repertoire categories, “normal” polygamous loyalty can have a wide range of values. For most FMCG markets however, it seems to have a mean value of about 2.5 where average repertoires are about 2. Further replications would be useful here, to enable managers to benchmark the S-value of the category they operate in. As a measure of switching propensity, S is an indicator of competitive intensity and could be used to evaluate and compare category attractiveness for strategic purposes such as in planning brand acquisition or extension.

If S describes loyalty, K describes the differences between buyers in the category; the higher the value of K, the more similar the buyers are in their purchase propensities, and the more attractive the category is to them. Large numbers of non-buyers decrease the value of K. For example, in Table 3 we saw that the mean value of K was 0.58, lower than the mean of 1.1 reported in Driesener *et al.*, (2003). However, our smaller dataset contains three categories of pet food, each with extremely low K values. These reflect the 75% to 80% of UK households that are hardcore non-users of pet food, and for whom the category is obviously “unattractive”. In addition, with values well below 0.1, these categories will clearly never reach a significantly larger population of buyers, even over decades. The data consequently support prior interpretations of K.

For the highest K values in the data, Deodorants, Wrapped Bread and Margarine (all over 1), it was easily conceivable that household penetrations might reach 100% with time. Indeed, bread was already at that level. The interpretation for these higher values was a far lower variance in purchase frequency from household to household and therefore less clearly defined segments of heavy and light buyers, and fewer non buyers (in fact, less than 15% of the population). Customer equity might therefore emerge strongly in these markets if existing category-buying propensities could be harnessed in favour of one particular brand, across already high penetrations. We concluded that our data replicated prior findings for K, observing both its range from 0 to 1.5, and its ability to discriminate between different household propensities of category purchasing.

Finally, for the A parameter we observed an extreme variance across the categories with annual values ranging from 3 to 262. The scale parameter controls the range of the gamma distribution of purchase rates. In three pet food categories, we saw very high A-values coupled with very low K parameters and these are clearly outliers. On further investigation, the low K value is a function of the low category penetration defined by pet ownership previously alluded to, and the high purchase rates amongst buyers. The high A-parameters describe an extreme scale of distribution, but were found to be a function of prevalent multipack buying, since in this analysis petfood multipacks had been disaggregated to individual units, thereby greatly extending purchase weights. For Wrapped Bread, the gamma distribution was of a different shape (high K and average A), indicating less heterogeneous spread of purchase frequencies, and a more bell-shaped distribution. This implied lower numbers of both heavy and light buyers and less heterogeneity in purchase rates across the category. The A-parameter might therefore inform marketers about tactics: for large brands competing in low-A categories such as soap or crackers the objective may be to pioneer distinctive brand attributes that might increase the purchase frequency of most buyers. The high A and low K parameters in categories such as pet food suggest a small number of very heavy buyers, the marketer's ideal loyalty-building target. The innovation of flexi-pack pet food traded consumer convenience benefits against an increase in price, but while the pioneering cat and dog food brands exploited category buying characteristics to establish a strong market share they were swiftly imitated, and so the innovation attracted no sustained competitive advantage or long-run loyalty effects. It is clear to see this outcome, since the category parameters in Table 3 reflect higher than average household repertoires in the flexi-pack catfood category, with above average S values describing brand switching.

The three parameters were thus found to summarise repeat-buying well at the category level in a single period, and these replications strengthened interpretation of the benchmarks. We next turned to the investigation of emerging brand equity in continuous long-term analysis.

### ***Indicators of approximate equilibrium***

Any evolution in parameter value between consecutive periods might indicate emerging loyalty effects (e.g. lower A, lower S, changes in K), and changes in market structure. Following the earlier analysis of stability, we next compared the average annual parameters from the continuous data and their mean absolute deviations over the six-year period (Table 4). Long-term category purchasing remained approximately stable. The

biggest variance was seen in S, indicating that stable purchase incidence may have been distributed over a changing repertoire of brands, possible early evidence of emerging loyalty effects at the brand level. Inspection of individual category averages showed the main variance to be in just four datasets; canned & flexi pack cat food, canned dog food and wrapped bread. The greatest turbulence occurred in the cat food market, and was driven by the changes in pack format previously noted, where one brand gained eleven share points in the new category, but lost almost the same in the old one.

In consecutive periods of equal length and over long spans of data, it was concluded that the Dirichlet parameters identified approximately stable conditions well, supported the empirical findings in the long term analysis of Driesener *et al.*, (2011), and extended the theoretical assumptions of stationarity in Goodhardt *et al.*, (1984). This is important, because it confirms the empirical generalisations described in the model under a new condition of continuous and long-term competition.

**Table 4: Stability in Annual Parameters**

Parameters	Average Annual Value	Mean Absolute Deviation
S	2.1	0.3
M	9.2	0.5
K	0.58	0.01
A	45	2
B (%)	62	1
W	16	0.4
Avg. brands bought	2.2	0.04

*Data Source: Kantar WorldPanel. Data rounded.*

Nevertheless, the changes observed in the S parameter independent of A & K suggested that stability in purchase incidence might be coupled with dynamics in brand choice that could only be identified in brand level analysis. The possibility still remained that “strong” brands might emerge with time and in order to examine this, continuous purchasing was next analysed cumulatively over longer periods, comparing parameters in six-month and single six year spans with the annual results already reported.



### ***Long & Short Term Category Buying***

When comparing parameters in longer time periods, the literature suggested that S and K might remain invariant, with linear increases in A. In other words, household category purchase incidence is established quickly and latent brand choice probabilities in the market can be captured in their manifestation over a quarter or six months. The model should then capture stable market structure in consecutive and equal time periods, and in cumulative time periods through increases in A. There is evidence for this in observed close fitting Dirichlet output, and in reports of purchase incidence to new brands (Ehrenberg & Goodhardt 2000) that are rapidly established. What we found was rather different.

Between six months and a year (Table 5), there was indeed an almost linear growth in A, although this slowed in time to a four-fold increase between one and six years. The average value of K remained relatively stable between six months and a year, but over six years it increased by nearly a third. At the same time, the distribution of brand choices described in S changed considerably, growing by a third from six months to a year, and then more than doubling between one year and six years. In other words, the distributions of brand choice *and* purchase incidence all shifted in cumulative data, but changes in S were the most substantial. In order to interpret this change quickly, a glance at average household repertoire showed that it doubled in six years - loyalty declined dramatically. Far from building loyalty and retaining customers in the long term, brands appeared to have lost them in a switching free for all. Categories also continued to attract many more buyers over time, as average penetration grew by 60%. Could this be the result of the “*anything goes*” marketing policies Ehrenberg referred to, a cumulative breakdown of the known laws of marketing, or even perhaps evidence of the often-reported general decline in loyalty perennially discussed in the literature (e.g. Johnson, 1984; Kapferer, 2005; Driesener, 2011)?

In fact, such a decline in loyalty has already been reported. When Stern and Hammond (2004) examined long-term repeat buying in two categories, they found that it decreased sharply as the number of purchase occasions increased to around 15, but slowed between 15 and 60, stabilising at that point. Data in Table 5 replicate this rapid increase in switching. Changes to S over time were also observed in Goodhardt et al., (1984), but not explained. It now appears that in long periods, brands continue to enter household repertoires infrequently, leading to continued increases in switching. This is congruent with the cumulative growth in penetration observed here. As for K, this too would increase with a growing number of category buyers especially if they were exceptionally homogeneous in their purchasing; if new buyers were very occasional users, this would be the case.

The question is, do these new distributions support the established laws of marketing, or in the long term are some brands developing above average customer equity? To investigate this, the six-month and six-year fit of the Dirichlet to observed data were then compared.

**Table 5: Dirichlet Parameters in varying periods in 18 categories of continuous data.**

Category	Average Six Months			Average Year			Six Years		
	S	K	A	S	K	A	S	K	A
Wrapped Bread	2.2	1.2	20	3	1.2	40	9.2	1.2	243
Margarine	1.1	1.3	6	1.4	1.1	14	3.2	1.1	83
Everyday Biscuits	1.9	0.66	12	2.5	0.74	21	7.7	0.94	99
Instant Coffee	0.86	0.90	4	1	0.92	8	2.4	1.1	43
Male Deodorant	1.8	0.91	3	2	1.04	5	3.7	1.4	23
Female Deodorant	1.7	0.93	3	1.9	1.06	5	2.8	2.5	13
Crackers	2.0	0.68	5	2.5	0.79	9	5.4	1.0	43
Shampoo	1.9	0.76	2	2.1	0.77	4	3.7	0.82	21
Butter	0.89	0.34	12	1.1	0.35	23	2.5	0.48	102
Toilet Soap	1.0	0.80	1	2.5	0.74	21	2.5	0.93	15
Still Water	0.9	0.14	8	1.5	0.32	19	2.6	0.33	38
Analgesics	1.0	0.39	4	1.2	0.42	8	2.4	0.59	35
Vitamins	0.74	0.22	4	0.85	0.25	7	1.4	0.40	25
Hair Conditioner	1.5	0.29	2	1.8	0.31	4	3.5	0.40	19
Canned Cat Food	3.1	0.06	132	8.4	0.06	262	24	0.08	1237
Ground Coffee	0.78	0.10	5	1.0	0.12	9	1.7	0.21	30
Canned Dog Food	1.4	0.05	82	1.7	0.05	151	2.8	0.08	553
Flexi Pack Cat Food	1.5	0.04	124	1.9	0.05	221	3.1	0.08	792
<b>Parameter Average</b>	<b>1.5</b>	<b>0.54</b>	<b>24</b>	<b>2.1</b>	<b>0.58</b>	<b>45</b>	<b>4.7</b>	<b>0.76</b>	<b>190</b>
<b>Average B %</b>		<b>52</b>			<b>62</b>			<b>80</b>	
<b>Average W</b>		<b>9.4</b>			<b>16</b>			<b>72</b>	
<b>Average #</b>		<b>1.8</b>			<b>2.2</b>			<b>3.7</b>	

*Data Source: Kantar WorldPanel. Table ordered by mean annual category penetration (B). Data rounded.*

### ***Fitting the NBD-Dirichlet: an example***

Table 6 summarises the two fittings of the model, comparing observed (O) and theoretical (T) measures of penetration and purchase frequency in the shampoo category, as an example of the general picture observed. We note that market shares, although an input of

the model, remained unchanged and category structure therefore remained in equilibrium. The parameters of category buying were seen to evolve considerably however; S nearly doubled (1.9 to 3.7), K shifted slightly (from 0.76 to 0.82) and A increased ten-fold. What effects did these changes exert on brand level purchasing and on the fit of the model?

Generally the fit was good for both datasets. In six months, correlations between O and T were high and mean absolute deviations low. The Double Jeopardy relationship seen in observed data was thus clearly captured in the model, as penetration declined with market share and purchase frequency remained close to the average for all brands except Pantene. Smaller brands suffered twice as expected, having fewer buyers, who bought those brands less often. It was however clear that the model had under-predicted purchase frequency for Pantene by about 10%, and slightly over-predicted its penetration.

**Table 6: A Comparison of observed and theoretical long & short term BPM's**

Brands	Six Years					Average of 12 Six Month Periods				
	Market Share %	Penetration %		Purchase per buyer		Market Share %	Penetration %		Purchase per buyer	
		O	T	O	T		O	T	O	T
	100	92		18.6		100	55		2.6	
Pantene	10	35	<b>39</b>	5.0	<b>4.4</b>	10	8	<b>9</b>	1.8	<b>1.6</b>
Head & Shoulders	9	29	<b>35</b>	5.1	<b>4.2</b>	9	8	<b>8</b>	1.6	<b>1.6</b>
L Oreal Elvive	6	31	<b>28</b>	3.5	<b>3.9</b>	6	6	<b>6</b>	1.5	<b>1.5</b>
Herbal Essences	6	27	<b>25</b>	3.6	<b>3.9</b>	6	5	<b>5</b>	1.5	<b>1.5</b>
Organics	5	24	<b>22</b>	3.5	<b>3.8</b>	5	4	<b>5</b>	1.6	<b>1.5</b>
Fructis	4	21	<b>18</b>	3.1	<b>3.6</b>	4	4	<b>4</b>	1.5	<b>1.5</b>
Timotei	4	20	<b>17</b>	2.9	<b>3.6</b>	4	3	<b>3</b>	1.5	<b>1.5</b>
Vosene	3	16	<b>13</b>	3.0	<b>3.5</b>	3	3	<b>3</b>	1.5	<b>1.5</b>
Wash & Go	1	9	<b>6</b>	2.2	<b>3.3</b>	1	1	<b>1</b>	1.3	<b>1.5</b>
Other	53	84	<b>85</b>	10.9	<b>10.8</b>	53	38	<b>37</b>	2.0	<b>2.0</b>
Average	10	30	<b>29</b>	4.3	<b>4.5</b>	10	8	<b>8</b>	1.6	<b>1.6</b>
MAD		3		0.5			0		0.1	
Correlation		0.99		0.97			1.00		0.84	

Source: Kantar WorldPanel

Over six years, the fit was also generally good, but the model again under-predicted purchase frequency and over-predicted penetration for the brand leader Pantene with a similar variance of around 10%, perhaps a systematic deviation related to the triple jeopardy

phenomenon identified by Fader and Schmittlein (1993). Head & Shoulders emerged in the six-year data as a partitioned brand, although its fit was good to the six months dataset. In the long-term, its purchase frequency was far higher than its penetration suggested, yet this did not constitute exclusive segmentation since average purchase frequency for the brand remained at around 25% of average category usage.

In comparing the two periods, the normal Double Jeopardy relationship was approximately maintained, but the important additional point is that for Pantene and for the partitioned Head & Shoulders, *triple jeopardy* did not result in sustained brand share growth. It was simply a reflection of the steady way in which households continued to buy this category year after year. This leaves the two critical Dirichlet assumptions, stationarity and non-partitioning, largely inviolate in both datasets. Although the model did not quite describe the cumulative observed data, it was very close even over the many thousands of category purchases reported, suggesting the conclusion that loyalty is an effect and not the cause of market share even over the very long term.

### ***Loyalty, and the changing shape of purchase distributions.***

All brand loyalty metrics decreased dramatically with time, as reflected in the category parameters. Share of Category Requirement for Pantene dropped from about two-thirds in a year to about a quarter in six years, smaller brands from around 50% to about 17%. At the same time, penetration increased for all brands, but not at the same rate. As a result of the law of natural monopoly (Ehrenberg, 1988), small brand penetrations grew proportionately faster (about five times) than big brands (about four times). What appears to happen cumulatively is that the increasing number of very light category buyers pick up the big brands before the smaller ones, adding to their penetration slowly, but constraining their growth in purchase frequency. Heavier category buyers can switch more frequently between the larger and smaller brands because they purchase more often, and this builds the smaller brand penetrations faster, but again, not their purchase frequencies since switches are individually infrequent. Average purchase frequency is after all only 2.6 in six months. The important finding here is that repertoires continue to expand over several years, so that for some households the full repertoire may not be captured even in annual panel data. We discuss the implications of this in the concluding sections of this paper.

## Discussion

This paper has extended work in establishing benchmarks for the Dirichlet parameters and demonstrated their use, investigating both stability in long-run category purchasing, and the cumulative effects of time on behavioural brand loyalty. The following empirical generalisations have been established, extended or confirmed through the replications conducted in this research:

- ***The S parameter*** is a potentially useful indicator of category competitiveness, since it reflects both repertoire size and switching. It stays approximately stationary from period to period. We confirmed findings in Bound (2009) that it is highly correlated with the average number of brands bought, and in Sharp *et al.*, (2002) that it distinguishes repertoire from subscription markets. We established that it varies greatly between categories, but appears to have an average annual value of around 2.5 in FMCG markets. Importantly, we extended the suggestion in Goodhardt *et al.* (1984) that S does not remain invariant, but increases with T. This has implications for our understanding of loyalty, and for the fit of the NBD-Dirichlet.
- ***The K Parameter*** indicates the extent to which household purchasing differs, and it too remains stable from period to period, and approximately stable between six months and a year in cumulative data. While K should theoretically remain unchanged with time, over six years it showed a marked increase in response to penetration growth. We extended earlier work in Driesener *et al.*, (2003; 2011) that K is a measure of category attractiveness, and confirmed that the established range from 0 to 1.5 appears to contain a useful benchmark for market potential in predicting high cumulative penetration levels for K values > 1.
- ***The A parameter*** remains stable from period to period and expands as expected in cumulative data, although not linearly, its rate of growth slowing over six years. In conjunction with K it has uses in benchmarking and identifying extremes of household purchase patterns with implications for strategy. For example, A was noted to fluctuate from period to period in the dynamic pet food categories, indicating growing or declining category penetration, an important context for brand tracking.

- ***Long-term near-stationarity*** is an established empirical generalisation (Dekimpe & Hanssens, 1995; Srinivasan & Bass, 2000), but here we have extended that to at least twice the period previously reported. Since we now see that assumptions of stationarity and non-partitioning appear to hold over years rather than just quarters, this represents an important extension of established empirical generalisations of repeat buying and of Dirichlet theory. Since no brand or customer equity effects thus emerged in our dataset, loyalty, constrained by Double Jeopardy, must simply be an effect of market share and not its cause.
- ***Declining Loyalty*** Although purchase propensities appeared largely stable over periods of equal length, by increasing the length of observed time it was seen that brand loyalty metrics such as repertoire size, switching and share of category requirement, all decreased dramatically causing the continuous increase in observed S. As loyalty decreased, so both brand and category penetrations increased. Small brands gained customers faster than big brands, indicating that growth was a function of very occasional buyers coming slowly into the market, and the low brand loyalty of heavy category buyers. The rate and nature of customer acquisition constrained growth in purchase frequency. Against these changes, market shares remained largely stable between long term and short term, indicating that the changing shape of the purchasing distributions had no effect on market structure, confirming the absence of either brand or customer equity.

## **Limitations and Further Research**

There are a number of limitations with this long-term study. First, the findings relate solely to repertoire categories and not subscription markets. Second, while the dataset includes a large sample of brands representing a range of buying intensities, it only covers a small proportion of total household expenditure. Finally, the long-term panel was selected on a single variable, its continuity of reporting. As a sub-sample of the full *Kantar* panel it may not be quite representative of the UK population.

Further research is now required in more long-term panels, across a wider selection of categories to expand the technique and strengthen the empirical generalisations presented to date. The parameters appear to have uses in evaluating category attractiveness that would be

relevant where firms are considering brand acquisition, extension or market entry strategies, and parameter benchmarks could now be strengthened with further replication studies. More research is also required into the evolution in the S parameter to assess its relationship with known deviations between observed and theoretical Dirichlet data, such as “*The Leaky Bucket*”, and the variance discrepancy (Ehrenberg, 1988; Ehrenberg et al., 2004) since it is clear that the latent choice probabilities in a population are not entirely captured in six months’ of panel data. Further loyalty studies are also required, since there is still no sign of brand equity or of customer equity, either in short or long term panel data. We might have expected to see loyalty evolving over six years of continuous purchasing. Instead, even where brands were observed to have higher than expected purchase frequencies, no growth in market share resulted. The fact that we did not find growth from a better than average customer base is not a reason to call off the search. Empirical generalisations must always be falsifiable (Wright & Kearns, 1998) and customer equity is an intuitively powerful story.

### **Managerial Implications**

Implications from these findings affect brand growth, brand loyalty and the Dirichlet parameters. As to brand growth, despite the fact that it is an almost universal marketing objective, it is almost unattainable, since immutable competitive forces keep habitual buying propensities in equilibrium. A more realistic objective is brand share maintenance. This requires consistent effort to maintain penetration from period to period and, since category and brand penetrations grow slowly and cumulatively, by attracting the brand’s share of new buyers. This mostly appears to be what happens, since shares and the relationships between penetration and purchase frequency remain stable over time.

As to the loss of loyalty, this is an undisputable empirical fact. Repeat-purchase is not time bounded; it is both cumulative and stochastic in that households keep buying a brand as part of a repertoire over years until their circumstances change, or they experience a terminal loss of satisfaction. Brand management imposes fixed time boundaries onto this process, and in such equal periods most performance metrics are stationary. However, we found no emerging loyalty-effects in unbounded data either. Cumulatively, buying behaviour became less, rather than more heterogeneous, as the distributions of purchases across households became less extreme for all brands. Two traditional marketing principles are thereby brought

into question; first, heavy category buyers are the least loyal, and therefore an unlikely lever for customer equity. Second, changing parameters imply that brand differentiation, however it is attempted, is unlikely to succeed, since all brands remain stubbornly substitutable.

Finally, these parameters can be calculated from panel data fairly easily, and have strong benchmarking potential. They summarise competitive category characteristics such as normal switching behaviour, category attractiveness and stationarity and therefore have many potential uses in evaluating strategic brand management decisions.

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