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Physical space and long-tail markets

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ABSTRACT

The Internet is known to have had a powerful impact on on-line retailer strategies in markets characterised by long-tail distribution of sales [C. Anderson, Long Tail: Why the Future of Business is Selling Less of More, Hyperion, New York, 2006]. Such retailers can exploit the long tail of the market, since they are effectively without physical limit on the number of choices on offer. Here we examine two extensions of this phenomenon. First, we introduce turnover into the long-tail distribution of sales. Although over any given period such as a week or a month, the distribution is right-skewed and often power law distributed, over time there is considerable turnover in the rankings of sales of individual products. Second, we establish some initial results on the implications for shelf-space and physical retailers in such markets.

1. Introduction

A recent book [1] qualitatively reviews how the Internet changes the dynamics of markets characterized by long-tailed distributions of sales, such that a few titles sell enormous amounts and most titles (the long tail) sell very little (Fig. 1). Recognized at least since the early 20th century [2] long-tailed distributions (and, specifically, power law distributions) in economics and society have been an exceedingly popular subject in the last 15 years.

Although power law distributions have become a well-worn subject, with multiple potential causes recognized [3], for retailers the phenomenon has come to represent a profound transition associated with the rise of Internet retailers, who can exploit the long tail of the market, as they are effectively without physical limit on the number of choices they can offer [1]. A retailer in a physical building, of course, cannot afford the space to stock the low-selling items beyond some point in the long tail (Fig. 1).

In a simplified sense, if a retailer has space for y different items in the store, then a reasonable strategy is to stock the top y best-selling items, as determined by market data. In contrast, an Internet retailer *can* sell items within the long tail, which can yield sales (area under the curve) comparable to those of the physical retailers selling the blockbusters at the top end (Fig. 1).

Of course, in practice a retailer may want to follow alternative strategies from the one of stocking the top y products. Profit margins, for example, might be higher on certain products with low sales, the retailer may feel that specializing in a 'niche' in the particular market may increase the chances of survival, and so on. But for a retailer selling into the mass

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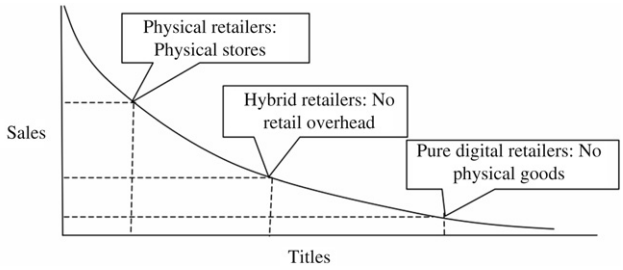

Fig. 1. Schematic model [1] of profit thresholds in an economy characterised by power law sales distributions, and physical retailers (real items from real shelves), digital retailers (digital goods from digital shelves) and hybrid retailers (physical goods from digital shelves).

market, a good initial strategy to consider is one of selling the top y items. It is this strategy which we analyse and for which we establish initial results.

A crucial factor to take into account is the turnover in the sales (and hence the rankings) of individual products. The distribution in Fig. 1 is of course a stylized representation of the power law distribution of sales at a *given point in time*. Over time, the relative popularity of the sales of the individual products will change. So although the distribution of sales may look very similar over time, taking snapshots of it at different points in time, the positions of the individual items within it will vary. Indeed, in most fashion markets new items will constantly enter the market.

We consider a fashion-based model of consumer choice which is capable of generating power law distributions of sales such as those observed in practice, and which takes into account both turnover over time in the relative sales of a given set of items, and innovation in the sense that entirely new items become offered for sale. The model has antecedents in the neutral model of population dynamics in biology [4,5], but its relevance to long-tail consumer markets has been demonstrated by studies that show that the model is capable of explaining both the distribution of outcomes and the turnover over time in, for example, pop music, first names and dog breeds in the United States [6–8].

A specialist retail-oriented literature does exist on shelf space strategy. But in general this is highly specific to particular markets, with the findings appearing in practitioner journals such as *Advertising Age, Supermarket Business* and *Beverage World* [9]. There is a limited literature which addresses more general issues [e.g., Refs. [10–14]], though this tends to be focused on issues such as the location of brands on shelves, and the location of the shelves themselves.

These models are usually rich in parameters, ten or more being typical [10,13], and generate turnover only by making explicit assumptions on product ageing [14]. In contrast to the existing shelf space literature, our model is parsimonious. Even more importantly, it addresses the general issue of the long tail, and in addition continual turnover is generated by the simple behavioural rules followed by consumers rather than by explicit assumptions on product ageing.

2. A fashion-based model of consumer choice

Standard consumer choice theory in economics assumes atomised individuals exercise choice in an attempt to maximise utility subject to a budget constraint. In this approach, given an individual's tastes and preferences, decisions are taken on the basis of the attributes of the various products, such as price and quality.

In recent decades, the conventional theory has been extended to allow for factors such as the cost of gathering information [15], imperfections in the perception of information and limitations to consumers' cognitive powers in gathering and processing information [16]. So decisions are not necessarily made in a fully rational way, but are nevertheless based on the (perceived) attributes of the products, without direct reference to the choices of others (which can affect choice indirectly by their effect on relative prices).

Almost 50 years ago [17], classical consumer choice theory was extended by assuming that individual utility depended not merely on an individual's consumption, but on the consumption patterns of other people. This extension introduced far greater indeterminacy into the signs of income and price elasticities than standard theory.

In general, however, economists have paid little attention to markets in which fashion is important; i.e., markets in which the decisions of others can affect directly the choices made by an individual. Social influences are generally only invoked for cases considered exceptional, such as 'irrational' stock market bubbles or real estate crises.

Interest in such markets has, however, been much greater outside of economics. There is strong empirical evidence that in markets where the decisions by others strongly influence individual choice, products that are superior in terms of their attributes may do no better than ones which are worse [18,19]. Even charitable donations can be highly subject to fashion [20]. Such markets are characterised by randomness and inherent unpredictability [18].

An important development has been models of 'binary choice with externalities' [19,21,22]. In many social and economic contexts, individuals are faced with a choice between two alternative actions, and their decision depends, at least in part, on the actions of other individuals [23]. An important feature of such systems is that they are 'robust yet fragile'. In other words, behaviour may remain stable for long periods of time and then suddenly exhibit a cascade in which behaviour changes on a large scale across the individuals within the system [19,22,24].