DO RETAILERS BENEFIT FROM THE LONG TAIL PHENOMENON?

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ABSTRACT

The Internet and related technologies have vastly expanded the variety of products that can be profitably promoted and sold by online retailers. As a result, while in most offline markets, a few best selling products (blockbusters) generate the bulk of demand, online demand for blockbusters is often accompanied by sales for a huge number of less-selling products (niches). In response to emerging long-tailed sales distribution patterns, Anderson (2004, 2006) coined the phrase Long Tail to describe the phenomenon that niche products can gain a significant share in total sales. Most important from a retailers' perspective is whether additionally offered niche products mainly substitute former existing ones or if consumers expand their demand. While the latter can generate additional profit, substitution is only beneficial if substitutes have higher margins than products that were purchased before. By using a unique data set of a monopolistic video-on-demand operator in Germany that covers all individual sales since its launch from December 2004 until August 2007, we disentangle demand for additional offered films into substitution and additional consumption. Our results reveal that demand of additionally offered films is driven by on average 86.10% additional consumption and only 13.90% substitution, suggesting huge profit potential for retailers by increasing their assortments.

KEYWORDS

Long Tail, Assortment Size, Additional Consumption, Substitution, Video-on-Demand, Electronic Commerce.

1. INTRODUCTION

The Internet and related technologies have vastly expanded the variety of products that can be profitably promoted and sold by online retailers (Brynjolfsson et al. 2006). Furthermore, as search and recommendation tools reduce consumers' search costs on the Internet, changes in the demand distribution patterns emerge: while in most offline markets, a few best selling products ("blockbusters") generate the bulk of demand, Internet markets offer a much greater variety of products and the demand for blockbusters is often accompanied by a demand for a high number of low-selling products ("niches"). The book market, for example, experienced a huge increase in the total number of books on offer (1.5 million books in print in 1990, versus 5.6 million in 2006 (Anderson 2006)), which, the example of online bookseller Amazon illustrates, also increased demand in niches: Books that are not even offered in traditional offline book stores

account for about 30 percent of Amazon's sales (Brynjolfsson et al. 2003). Amazon alone has an assortment size of 3 million books, which is about 30 times the average assortment size of a traditional book store such as Borders. A further example is the online music retailer, Rhapsody. While traditional music retailers like Wal Mart carry about 55,000 music tracks, Rhapsody's assortment size is about 1.5 million, or more than 27 times the size of Wal Mart's.

As a result of this huge increase in assortment size online, long-tailed demand distribution patterns emerge on the Internet, which are often characterized by a very high number of low-selling products. In response to these distribution patterns, Anderson (2006) coined the phrase "Long Tail" to describe the phenomenon that niche products gain a significant share in total demand (Brynjolfsson et al. 2007) with the concomitant decrease in the importance of blockbuster products. The idea of the Long Tail phenomenon hereby is that there is an under-exploited spectrum of customers' tastes to which pre-Internet retailers could not cost-effectively cater (Tucker and Zhang 2007).

While lower costs of supply have with no doubt enabled retailers and manufacturers to profitably promote and sell more of less popular products, most important from a retailer perspective is whether demand for these products is driven by substitution or additional consumption. The latter is hereby a crucial question for the current Long Tail debate: While additional consumption leads directly to more revenue for retailers, substitution is only beneficial if substitutes have higher margins than the products that have been purchased before.

Literature in the Long Tail area failed to address this issue so far and thus the aim of this paper is to disentangle demand for additionally offered products into substitution and additional consumption. Differently phrased, we analyse whether retailers can benefit of the long tail of sales.

To accomplish this, we structure the remainder of the paper as follows: Section two gives an overview of related literature. In section three we describe the empirical study by giving an overview of our data and our applied methodology. Section four presents our results. We conclude in the last section of our paper with a summary of our results and derive their implications.

2. RELATED LITERATURE

Basic theory of choice suggests that consumers might benefit from being able to find (more) products which better fit with their preferences (e.g. Iyengar and Lepper 2000, Kahn 1998, Kahn and Lehmann 1991). This suggests a shift and therefore substitution in demand to newly added products but also additional consumption because consumers may find more products which meet their taste. Consumers' demand might also surge because they might value diversity itself (Kahn 1995). This means that consumers not only value having more products, because this makes it more likely that they will find the "perfect" product, but also prefer diversity due to satiation, curiosity or fluctuating requirements.

At the same time, huge assortments can also be overwhelming, confusing and frustrating to consumers and even lead to consumption avoidance (Broniarczyk et al. 1998, Chernev 2003, Dhar 1997, Huffman and Kahn 1998, Iyengar and Lepper 2000, Lehmann 1998). Assortment sizes in offline channels even became so excessive in the last two decades that reducing the assortment not necessarily decreases demand (Broniarczyk et al. 1998). However, these effects are less likely to occur in online channels since searching in huge assortments online can be supported by search technologies like filters or recommenders, which make huge assortments manageable for consumers. In contrast to literature dealing with increasing assortment size in offline channels which finds empirical evidence for the presence of substitution effects between products of the assortment[1], Anderson (2006) therefore claims in his seminal book "The Long Tail" that endless choice is creating unlimited demand in online channels. Lacking an empirical verification of his claim, Anderson argues that assortments online are no longer overwhelming if appropriate search technologies help consumers to handle the large number of choices. If this is true, reducing the assortment is not necessary for online channels.

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[1] For an extensive review of this stream of literature see Kök, A.G., M.L. Fisher, and R. Vaidyanathan, *Assortment Planning: Review of Literature and Industry Practice*, in *Retail Supply Chain Management*, N. Agrawal and S.A. Smith, Editors. 2006, Kluwer: Amsterdam. p. 99-154..

3. EMPIRICAL STUDY

3.1 DATA

We use transactional data from a video-on-demand (VoD) market leader in Germany. The operator provides access to films from different genres via a platform on the Internet. Once consumers have registered on the platform they are able to watch films on demand by streaming the content onto their computers on a fee per film basis. The VoD operator applies a download-to-rent policy and the film is watchable for 24 hours after the payment transaction. The operator was a quasi monopolist in the observation period until mid of 2007. Video-on-demand relies on broadband Internet which was available to more than 20% of the German population in 2007. This case is thus very interesting because similar development can be expected in other countries that lag behind (see http://www.internetworldstats.com/dsl.htm for a comparison of broadband Internet subscribers worldwide).

The data was collected daily from the start of service in December 2004 until August 2007. In total 171,808 different consumers generated over 1 million purchases in the given period. We aggregated the sales data on a weekly time base and eliminated the first 13 weeks, because demand during that period was highly volatile. We further removed 2 weeks (week 114 and 115) during which there were major technical problems on the operator's web side making the platform often not accessible for consumers. This yielded 126 weeks for the observation period. The property of the data that makes it especially useful for our research is that assortment size changed over time, growing six-fold from 376 to a total of 1247 films.

3.2 METHODOLOGY

To disentangle demand of additionally offered films into substitution and additional consumption we estimate a linear regression. We use weekly demand of films that were added from one week to another as dependent variable. Equation (1) shows our model.

(1) $y_{nf,t} = \beta_0 + \beta_1 \cdot t + \beta_2 \cdot cust_t + \beta_3 \cdot (y_{f_{t-1},t} - y_{t-1}) + \beta_4 \cdot nf_{,t} + \varepsilon_t$

with :

|	
$y_{nf.t}$:	demand of newly added films in week t
$\beta_0 - \beta_4$:	function parameters
$cust_t$:	number of active customers in week t
$y_{f_{t-1},t}$:	demand of films in week t that were also offered in week t - 1
y_{t-1} :	demand in week t - 1
nf_t :	number of newly added films in week t
ε_{t+1} :	residual of week t + 1

We check with our model whether a reduction in demand of films that already existed in the week before may explain (at least partly) demand of newly added products. If consumers substitute former existing films with newly added films we expect a negative and significant parameter β_3. We control for factors which might also influence demand in newly added products other than substitution. Demand in newly added films might simply be driven by time trends, the number of newly added films from week t-1 to week t and by a varying number of active consumers in the market.

We determine the number of active consumers per week by using the model of Reinartz and Kumar (2000): This model calculates the probability that a consumer is active by calculating T^n, where n is the number of purchases in a given period and T is the time of the last purchase (expressed as a fraction of the

observation period). Consumers with a probability higher than 0.5 are then classified as active, whereas consumers with a probability below 0.5 are classified as inactive.

Figure 1 illustrates the number of calculated active consumers across weeks.

Figure 1: Development of the number of active consumers over time
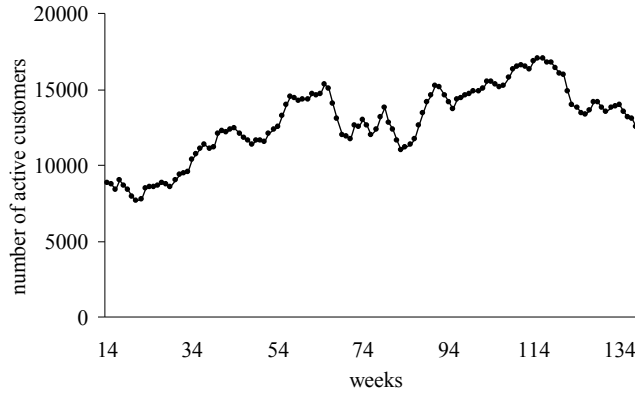
In case we detect substitution effects (significant and negative parameter β_3), we can decompose the demand of newly added films in substitution and additional consumption by applying equation (2) und (3) based on a weekly time base:

$$(2) \quad \text{substitution}_{t-1,t} = \frac{\beta_3 \cdot (y_{f_{t-1},t} - y_{t-1})}{\hat{y}_{nf,t}}$$

$$(3) \quad \text{additional consumption}_{t-1,t} = 1 - \frac{\beta_3 \cdot (y_{f_{t-1},t} - y_{t-1})}{\hat{y}_{nf,t}}$$

with :

$\hat{y}_{nf.t}$:   estimated demand of newly added films in week t

Equation (2) gives us the percentage of demand of newly added films that is generated by a reduction of demand in films that were offered before and therefore represents the substitution rate. The additional consumption rate is then just the result of one minus the substitution rate.

4. EMPIRICAL STUDY

4.1 RESULTS

Table 1 shows the estimation results of our model according to equation (1). The significant and negative parameter β_3 verifies the existence of substitution effects. Demand of newly added films is at least partly driven by a shift in demand from films that were already offered before to newly added films.

Table 1: Results of the estimation of the demand of newly added films

	$y_{nf,t}$	t[F]-value
β_0 [constant]	-271.536	-1.038
β_1 [time]	-11.181	-2.651**
β_2 [$cust_t$]	.103	3.431**
β_3 [$y_{f_{t-1},t} - y_{t-1}$]	-.132	-2.815**
β_4 [nf_t]	9.238	3.345**
adj. R^2	0.265	12.158**
n		125

*with **p<0.05 and *p<0.1*

All other parameters have also reasonable values. Parameter β_1 shows that we have a negative time trend in the demand of newly added films in our data. Parameter β_2 indicates an increasing demand in newly added films if the number of consumers in the market increases. Parameter β_4 illustrates an increasing demand in newly added films as a result of an increase in the number of new films.

Table 2 shows the results for some exemplarily weeks if we apply equations (2) and (3) on our estimates.

Table 2: Results of the decomposition of demand of newly added films in substitution and additional consumption

Week	$\beta_3 \cdot (y_{f_{t-1},t} - y_{t-1})$	$\hat{y}_{nf,t}$	Substitution: $\dfrac{\beta_3 \cdot (y_{f_{t-1},t} - y_{t-1})}{\hat{y}_{nf,t}}$	Add. Consumption: $1 - \dfrac{\beta_3 \cdot (y_{f_{t-1},t} - y_{t-1})}{\hat{y}_{nf,t}}$
15	65.15	536.54	12.14%	87.86%
...	...	...	...	...
25	122.52	610.05	20.08%	79.92%
...	...	...	...	...
35	137.82	695.51	19.82%	80.18%
...	...	...	...	...
45	262.59	916.73	28.64%	71.36%
...	...	...	...	...
55	5.14	644.18	0.80%	99.20%
...	...	...	...	...
65	36.53	932.22	3.92%	96.08%
...	...	...	...	...
75	291.74	988.35	29.52%	70.48%
...	...	...	...	...
85	120.41	663.44	18.15%	81.85%
...	...	...	...	...
95	220.25	845.76	26.04%	73.96%
...	...	...	...	...
105	200.34	1073.42	18.66%	81.34%
...	...	...	...	...
115	159.19	1121.69	14.19%	85.81%
...	...	...	...	...
125	129.25	1142.68	11.31%	88.69%
...	...	...	...	...
135	209.31	855.01	24.48%	75.52%
Average across all weeks			13.10%	89.90%

The results in Table 2 show that demand in newly added films is on average across all weeks driven by 89.90% additional consumption and only 13.10% substitution. Thus, retailers can directly benefit from adding new products to their assortment.

Figure 2 depicts resulting substitution and additional consumption rates graphically and illustrates a fairly stable pattern over time. Even though additional consumption (and consequently substitution rate) varies from week to week, it stays in a bandwidth between 80% and 95% for most of the weeks.

Figure 2: Development of additional consumption and substitution rate over time
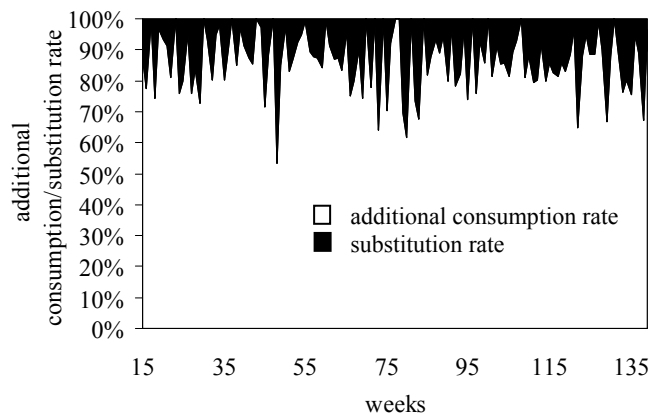
4.2 DISCUSSION OF FINDINGS

Our results show that on the one hand consumers seem to find films that match better with their preferences so that they partly substitute films that were offered before. On the other hand, consumers seem to find more products which fit with their preferences if they have more options to choose from (Iyengar and Lepper 2000, Kahn 1998, Kahn and Lehmann 1991) or value diversity itself according to variety seeking behavior (Kahn 1995).

The example of the video-on-demand market illustrates that the market is not yet saturated. Additional products on offer in the assortment, increase demand in about 80-95% of all cases. 5-20% of the newly created demand is based on substitution effects. These results thus suggest that the retailer in this study can benefit from further increasing the assortment size.

It seems that the overchoice problem (see Iyengar and Lepper 2000) reported in consumer behaviour does not occur in this particular case. We rather find evidence for the claims by Anderson (2004, 2006) and Brynjolfsson et al. (2007) that for online markets search filters might mitigate the disadvantages associated with huge assortments.

Based on these results, we expect that the tail should get longer by adding new products but we do not expect that blockbusters lose in importance as augured by Anderson (2004, 2006). We observe only a very small fraction that is responsible for a shift of demand.

5. CONCLUSIONS, IMPLICATIONS, AND FUTURE RESEARCH

This study investigates the origin of demand for products in the long-tailed demand distributions. Using a unique dataset of a monopolistic video-on-demand operator in Germany that covers all individual sales since its launch from December 2004 until August 2007, we disentangle demand for additionally offered films into substitution and additional consumption. The results of our linear regression show that demand of newly added films in our data set is surprisingly driven by a remarkable amount of additional consumption: on average only 13.90% is based on a shift in demand from former existing films to newly added ones and thus 86.10% is due to additional consumption. Thus, it seems like there is still an underexploited spectrum of

consumers' preferences that has – even by the huge variety that long-tailed assortment sizes offer – not been met yet. Our results are in line with a previous study by Hinz and Eckert (2010) who conceptually derive that growing assortment size can lead to substantially more additional consumption if the market is not saturated and search technology supports browsing huge assortments. Our results also contribute to the current debate about the Long Tail phenomenon. Previous studies in the Long Tail framework (Brynjolfsson et al. 2007, Elberse 2008, Elberse and Obergolzer-Gee 2006) haven't clarified to what degree demand of additional offered products is based on substitution or additional consumption and our study thus provides new insights into the LongTail phenomenon. While a recent article by Elberse (2008) rather extenuates the profitability of adding more products to the assortment, our findings show that extending the assortment size generates additional consumption and therefore potential additional profit for retailers.

The results of this study imply that retailers can directly benefit from adding new products to their assortment since demand for these new products is generated by additional consumption rather than by substitution. Thus, adding new products to their assortments enables them to better address consumers' heterogeneous preferences and generate additional sales. Given that substitution is only beneficial if substituted products have higher margins than former purchased ones whereas additional consumption always leads to additional revenue for retailers, this finding provides a very positive outlook for retailers operating in the long-tailed online environment.

Given that we analyse only sales from a rather monopolistic VoD operator a fruitful area for future research would be to validate our findings in a competitive environment when – from the retailer's perspective – unexploited consumers' needs might be already met by competitive offers. At the same time validating our results in different categories and different countries would provide additional insights into the generalizability of our results. Particularly since the VoD market is still emerging and it is hence not saturated, the studied assortment size of about 1300 films might not yet be overwhelming. It would thus be very interesting to run our proposed analysis for the assortment of e.g. Amazon, where we expect that the additional consumption rate will turn out to be much lower given Amazon's assortment size of 3 Million products.

Finally, our model was based on aggregate sales data. Future models should investigate individual differences in demand patters to help retailers in targeting their offers to the right customer segments.

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