"Follow the free" – who, why, and how much longer?

Preliminary version – comments welcome

Joachim Henkel*

University of Munich

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Abstract

Much valuable information on the internet is provided to the user for free, i.e., without monetary compensation. Examples are online news, search engines, price comparisons, and stock quotes. This phenomenon raises the questions of who provides this information, why it is provided, and how much longer this will be the case. In this article, a framework is developed to analyze information provision on the web, and the question if the user is charged for it or not. First, the motives to supply information on the internet are classified qualitatively. The starting-point is an analysis of the *user's* behaviour, which provides a clearer picture than starting directly with firms' revenue models. Second, a mathematical model of information production and distribution cost, user's utility, transaction cost, and competition is developed. This model sheds light on the question what factors influence if information is free or not. Based on the qualitative as well as the mathematical analysis, the options of an information supplier are discussed, i.e., the levers she has to influence her situation. Finally, the question "how much longer" is discussed.

Keywords: internet, free information, pricing, micropayments

* Institute for Innovation Research and Technology Management, University of Munich, Ludwigstr. 28 RG, 80539 München; henkel@bwl.uni-muenchen.de, +49 – 89 – 2180 2986, www.inno-tec.bwl.uni-muenchen.de/mitarbeiter/henkel

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1. Introduction

Giving away valuable information for free – that is, without monetary compensation from the user – has become the dominant way of information provision on the internet. Most online news are available for free (e.g., New York Times, Financial Times, Süddeutsche Zeitung), and even detailed industry specific sources such as, e.g., TechWeb and Semiconductor Supersite for the chip industry are free.[1] Real-time stock quotes, city maps, phone directories all are free. Services such as search engines and portals (Yahoo, Lycos, Altavista, Google, etc.) do not charge their users, neither do shopping intermediaries such as price comparison sites (e.g., www.dealtime.com, www.guenstiger.de, www.ucompare.de). There are also widely used software programs that can be downloaded for free (Netscape Navigator, Internet Explorer, Acrobat Reader, RealPlayer, etc.), and many useful services exist that do not charge their users (e.g., e-mail by Yahoo, Gmx, Hotmail, or storage space on the web by www.driveway.com or www.freedrive.com).

It is true that the user often has to "pay attention" to advertising, thus paying for the information she receives in a non-monetary currency. However, this is more the point of view of information providers and advertisers, while this article starts from a user's perspective. Hence, the term "free" will be used synonymous with "without monetary compensation from the user".

In some cases, the user not only gets information for free, but is even paid for surfing the web. The users' attention is so valuable for advertising that e.g. MyPoints Cybergold, FairAd, and Cyber Profit pay the surfer cash if she accepts to be shown adverts.[2] These adverts are targeted to the user's interests, revealed by her surfing behaviour, and, hence, are both more valuable for the advertiser and potentially less nagging for the user. By adding their own adverts to screens with information supplied by others, these advertising firms in fact free ride on the information supplier. If this externality is internalized, then a site will actually *pay* a user for her visits, while still providing her valuable information.

Of course there remain instances where information on the web is sold. Research reports by, e.g., Forrester Research or Gardner Group still cost many hundreds of dollars, no matter if delivered offline or online. Most parts of the Wall Street Journal's online edition are only accessible to subscribers[3], and the German "knowledge portal" Xipolis.net charges by article download. However, examples abound of given up attempts to charge for information on the web. Encyclopedia Britannica (www.britannica.com) used to charge a fixed access fee per year, and is now freely available. Real-time stock quotes used to be costly, but they no longer are.

This trend towards the free is, of course, due to the very small marginal cost of information (re-)production on the internet. The resulting ease of information dissemination was unheard of before the widespread adoption of the internet. It has made possible whole new ways of value creation for companies, and it also changes many traditional ways.

The high importance of the phenomenon of free information provision raises the question *why* it is that so much of the information on the web is for free. Four main reasons can be identified: Alternative revenue sources, high transaction costs for payments, strong competition (for information commodities), and the early stage of internet business.

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[1] See www.nytimes.com, www.ft.com, www.sueddeutsche.de, www.techweb.com, and semiconductor.supersites.net, respectively.

[2] See www.cybergold.com, www.fairad.de, and www.cash-machine.de, respectively.

[3] See www.wsj.com. An annual subscription to the online edition costs 59 US$ (as of November 2000).

Alternative revenue sources: Many business models rely on third-party advertising (e.g., search engines and many online newspapers). Others sell information on user behaviour to third parties. Revenue can also be more indirect, when spreading the information is useful for the sale of other products or the company's reputation in general (e.g., user guides, timetables, reduced versions of software, complements to other products, or a market study by a consulting company).

High transaction costs for payments: With traditional payment methods, it is too costly and complicated to make the user pay small amounts. It would be a way out to add up the user's bills over a month, say, but this would require user loyalty. It is not suited for occasional users.

Strong competition: For information commodities such as stock quotes or average quality news, competition on the internet is strong. If there is one costly offer and a comparable offer for free, then users switch relatively quickly to the free one. For non-commodity, premium information (e.g., market research reports by Forrester or Gardner Group, or the Wall Street Journal), competition is lower, making a costly information offer more likely.

Early stage of internet business: Internet business is still young. Hence, firms accept losses in the attempt to gain a strong position in a growing market. They "buy market share" by an extreme kind of penetration pricing.

In this paper, a long term perspective is assumed. I analyze a steady state, in which the cost of providing information on the internet must be covered by revenues of some kind. Hence, the last of the above reasons to supply information for free, the *early stage of internet business*, does not apply. The other three points, 'alternative revenue sources', 'transaction costs for payment', and 'competition' are analyzed in this paper.

The analysis starts from the perspective of a user who is looking for information on the web. In contrast to starting directly with web revenue models, this has the merit of providing a clearer and more complete understanding of information provision on the web.

In the sequel, the following questions are addressed:

- What are the different motives to provide information on the internet, in particular for free? If the information is free: where do revenues come from? A classification and examples are given, starting from an analysis of user behaviour. (Section 2)
- Who pays for a certain piece of information – the user, no-one, or the supplier? What does this depend on? A mathematical analysis of information production and distribution cost, user's utility, payment transaction cost, and competition sheds light on this issue (Section 3).
- What choices does an information supplier have to alter her position? Levers to influence information provision cost, utility, and payment transaction cost are identified and discussed (Section 4).
- How much longer will so much information on the internet be for free? (Section 5)

2. Motives to supply information on the internet – a classification

The analysis starts from the consideration of what happens when a user searches successfully for information on the internet (see Figure 1). Having searched for the information (box 1), the user U gets to the site www.xyz.com (box 2), where she finds the desired information (box 3). This has the following five implications: U derives utility

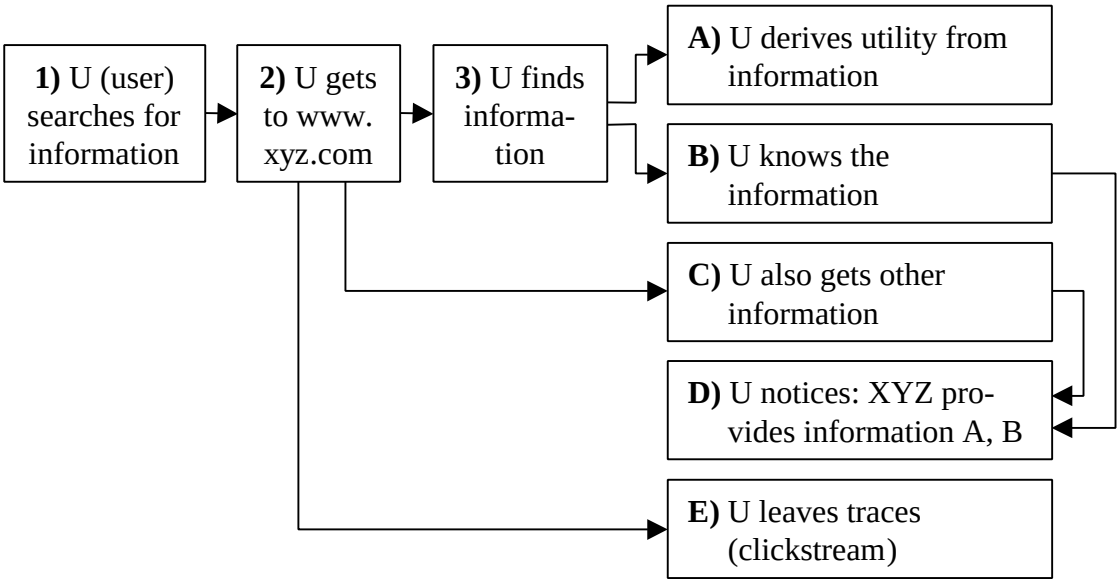

Figure 1: steps of a successful information search on the WWW

from the information (A) and, obviously but nonetheless important, *knows* the information (B). U also gets other information that is presented on the site (C), and notices that both the searched-for and the not-searched-for information are provided by XYZ (D). While navigating on the site, U finally leaves traces (E). Such traces may range from the simple observation that, e.g., U chooses the information www.xyz.com/article5 instead of any other article, to sophisticated user or usage profiles that contain a whole clickstream and/or personal information on U.

Each of the five implications A) – E) of U's information search provides a possible motive for information provision on the web, as summarized in Table 1. Below, each motive is discussed in detail and substantiated with examples.

Implication of U's information search	*Corresponding motive to supply information*
A) U derives utility from information	Sell the information to U (if competition allows)
B) U knows/uses information	Inform U (e.g., to boost related sales)
C) U also gets other information	Advertise own or foreign products/brands
D) U notices: XYZ provides infos B, C	Signal XYZ's competence
E) U leaves trace (clickstream, profile)	Learn about users' preferences

Table 1: Possible motives to supply information on the www

A) *Sell*: The user expects to derive utility from the information, otherwise she would not search for it. Disregarding competition for the moment, this implies a willingness to pay for the information. Hence, a possible motivation for the information supplier corresponding to box A is to earn money directly from the user. Examples are the Wall Street Journal (www.wsj.com) or research reports from Forrester Research

(www.forrester.com). Also providers of storage space on the web, appart from offering a limited space for free, sell their space.[4]

B) *Inform*: The information supplier may have an interest in the user's knowing the information. This interest may be more or less closely related to selling a product. Ordered roughly by decreasing "closeness" to the intention of selling something, the motives subsumed to *inform* can be categorized as follows:

i. Inform potential buyers about a product, about its features, usage, and advantages. If this information is about digital goods (information goods), then it often comes in the shape of reduced value versions (e.g., the restricted selection of articles provided for free by The Economist, or freeware versions of computer games).
ii. Educate customers: When the information provided is not specific to a particular product, but rather general background information about a whole class of products, then it helps to 'educate' customers and to make them more knowledgeable. An example is a comprehensive wine guide provided by a wine shop.
iii. Make users acquainted to a certain software (system) in order to create lock-in, and generate revenues by selling updates or complements. This is what Adobe quite effectively did with the Acrobat Reader.
iv. Inform actual users of a product about its usage, service, and trouble-shooting. Examples are user guides, printer drivers, or help pages for software.
v. Inform cooperation partners, e.g., suppliers. For example, a software manufacturer may provide information on interfaces and other product characteristics.
vi. Inform about a certain standard, in order to benefit all participating firms. The UMTS forum, for example, does this for the third generation (3G) mobile telecommunication standard UMTS (www.umts-forum.org).
vii. Idealism: Valuable information is often provided by organizations or individuals intending to spread a certain idea. Examples are football fan clubs or the group of Munich railway enthusiasts who provides train timetables.[5]
viii. Public information mission: Much useful information is provided by public authorities such as the Federal Reserve (www.bog.frb.fed.us) or the Federal Trade Commission (www.ftc.gov) in the US. Universities have a similar public information mission.

Several of those motives i – viii may be relevant at a time. For example, a value reduced version of a software program may serve both the purposes of informing about the product features (i) and of creating lock-in (iii).

C) *Advertise*: Looking at a web page, the user not only reads the searched-for information, but also notices other information that is displayed. Banner advertisements and links to shops, e.g., are omnipresent on the web. Both may belong to the information supplier herself, who thus achieves a gain in brand recognition or turnover. Or it may belong to a third party, who pays the information supplier for the advertising.[6] Examples of advertising banners are ubiquitous.[7] Also the widespread practice of online retailers such as Amazon or BOL to provide news on music or literature falls into this category: the news make the site more attractive for the user, which in turn promotes sales.

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[4] E.g., www.driveway.com charges 107.95 US$ per 100 MB per year (as of November 2000).

[5] Interessengemeinschaft S-Bahn München, www.igsbahn-muenchen.de.

[6] See Novak and Hoffman (1997) on the different ways of charging for advertising on the web.

[7] One should note that, while the user indeed does not pay money for the information, she does "pay" with her attention. The information supplier, in turn, sells this attention to advertisers. As Owen et al. (1974) put it for the case of television economics: "TV stations [are not in the] business to produce programs. [...] TV stations are in the business of producing *audiences*. These audiences, or means of access to them, are sold to advertisers."

D) *Signal*: Finding statistics or a research report on e-commerce on the site of consultancy XYZ signals to the user that XYZ is involved and knowledgeable in this topic. Similarly, a comprehensive wine guide on the site of an online wine shop indicates that this is a professional shop whose recommendations can be trusted. This increases the authority of the information provider and indirectly benefits her business. Other examples are academics who put their publications for download on their web sites, in order to signal their competence in the respective field. Also contributions to the code or to user support of open source software such as Linux or the server software Apache are mainly driven by this motive, since the signal "I made this contribution" entails recognition by the user community.[8]

E) *Learn*: By surfing on XYZ's site, the user leaves traces from which XYZ can learn about her users, her site, and her products. In the simplest case, she learns how many users are interested in which information unit. Beyond that, she can follow the user's clickstream or even require a user profile to be filled in. This allows the information supplier to tailor advertisements to the users' interest, which makes advertising space more valuable. It also helps to optimize the site, and usage profiles can be sold to third parties.

The above five motives, or rather categories of motives, rarely occur isolated from each other. In many cases, more then one of them will be relevant. This is all the more so since the main effect of some piece of information on the user may vary between different users. E.g., for one user 'inform' (B) may be dominant, for another user 'advertise' (C). As an illustration, Table 2 shows an illustrative analysis of the importance of motives A – E for selected examples of information provision on the web.

It is important to stress that the above classification of motives originates from an analysis of the *user's* behaviour. Hence, motives that may look alike from the supplier's perspective are in fact different. In particular, "Inform U to boost related sales ..." (B) and "Advertise own ... products" (C) are different. In the first case, the user visits the site for the very same information which, from the supplier's point of view, shall make her buy some related product. In the second case, in contrast, the user is lured to the site by some information which is not necessarily related to the promoted product. While the underlying intention in both cases is the same – boost sales – the ways to get there are completely different.

For similar reasons it makes sense to differentiate between "Advertise" (C) and "Signal" (D). While one could argue that a positive signal about the information supplier basically amounts to advertising, from the user's perspective there is a difference: "Advertise" builds on the fact that the user not only notices the desired information, but also advertisements on the site. "Signal", however, concerns the desired information itself. It must be both valuable to the user and send a positive signal about the supplier. Hence, as in the paragraph above, the intentions are similar – brand building, say – but they are accomplished by different means.

Finally, it should be noted that the motives A – E are interdependent. Revenues from advertising (C) depend on how much the information supplier knows about her customers (E), how good a signal about herself she sends (D), and on the quality of the information provided (B).

[8] See Lakhani and von Hippel (2000) on user help desks for open source software.

	A) Sell	B) Inform								C) Ad-vertise	D) Signal	E) Learn
		i	ii	iii	iv	v	vi	vii	viii			
Forrester	++											
The Economist	+	++								++		
Microsoft.com / downloads					++							
Federal Trade Com.									++			
Yahoo										++		+
Driveway (free storage space on the web)		++		++						+		+
Free research report by a consulting firm[9]											++	

Table 2: Illustrative examples for relative importance of motives to provide information. ++ = high importance, + = medium importance, blank = low importance

3. Who pays? An analysis of information provision cost, user's utility, payment transaction cost, and competition

The examples of free as well as costly information on the web raise the question which factors determine if the user is charged for information or not, or if she is even paid for surfing the respective site. This question is particularly relevant in the long run, since penetration pricing, as discussed in the introduction, can not go on forever. At some point in time, revenues will have to cover cost. In order to analyze the drivers behind the decision to charge for information or not, a mathematical model is developed. It is characterized as follows.

The units of analysis are "single acts of information provision". E.g., one use of a search engine, one article in an online-newspaper, or one web page with telephone rates. This will be called an *information unit*.

A long-term perspective with a hypothetical steady state is assumed, such that the average cost of providing the information unit must not be larger than the average revenue that is generated by it. The term "revenue" is used here in a very general meaning, including payments by the user, payments by third parties, and indirect benefits for the information supplier herself.

For the analytical description of the problem, the following variables are used:

- p denotes the average profit for the information supplier from supplying one information unit, *excluding* possible direct payments from or to the user. Hence, p includes, on the positive side, gains through benefits for related products, payments from third parties for advertising, and other benefits as discussed in Section 2. Cost items enter negatively into p: the first copy cost and the cost of making the information available on the web. The assumption of a steady state allows to calculate the average contribution of fixed cost items to each information unit. Fractions of fixed cost items

[9] E.g., The Boston Consulting Group at http://www.bcg.com/publications/publications_splash.asp.

that are allocated to later points in time have to be suitably discounted. It is assumed that all information units are identical with respect to p.

- u stands for the average utility the user derives from one information unit, measured in monetary units. Any one-off cost or hassle, e.g. for providing a user profile, is averaged over all uses, where a suitable discounting has to be applied. u can become negative if, e.g., a very extensive user profile is asked for, or if there is too much nagging advertising on the page. All users under consideration receive the same utility u from one information unit.
- p denotes the average price paid by the user for the information unit. It can be charged as pay-per-use or as a fixed subscription fee, or as a mix of both. The assumption of a steady state allows in both cases to calculate the average price per information unit. The question if aggregation or disaggregation of the information goods is preferable is not the subject of this article.[10] If the supplier pays the user, then p becomes negative.
- t_S, t_U are the average transaction costs per information unit that the supplier (t_S) resp. the user (t_U) have to incur in case a payment is made. For simplicity it is assumed that their value does not depend on who pays. However, allowing for differing values would not alter the analysis qualitatively. Any transaction costs that are also present in a transaction *without* payment are already taken into account in p and u. If the user pays by means of a subscription or of a credit or debit account, then t_S and t_U obtain as the total transaction cost per year of running the account, divided by the number of information units used per year (and taking discount factors into account).

Payment by the user

One obvious condition for viable transactions with payment in a steady state is that the sum of the profit contribution for the supplier and the utility for the user is at least as large as the total transaction cost:

$$p + u \geq t_S + t_U . \tag{1}$$

If the user is to pay a positive price for the information unit, then her participation constraint is that her utility more than covers the transaction cost:

$$u > t_U . \tag{2}$$

If these conditions are fulfilled, then transactions with payment by the user are possible in which no participant loses. But in some cases – whenever a price $p \leq t_S$ is paid – a Pareto improvement is possible: doing the transaction without a payment makes the supplier gain the non-negative amount $t_S - p$, while the user gains $t_U + p > 0$. Since in cases where $u < t_U + t_S$ the user would not be willing to pay a price above t_S, a transaction with payment is Pareto-inferior to one without payment whenever $u < t_U + t_S$. Assuming that the info supplier is clever enough to avoid Pareto-inefficient situations, this implies that the constraint (2) is tightened to

$$u > t_U + t_S . \tag{3}$$

For the price p, this implies

$$p > t_S . \tag{4}$$

Figure 2 illustrates the above inequalities in the p-u-plane. Any transaction, with or without payment, is restricted to the half-plane top right of the downward sloping line through the origin, since in any case the user's utility plus the supplier's profit must not be

[10] For a discussion of aggregation versus disaggregation see Bakos and Brynjolfsson (1999, 2000).

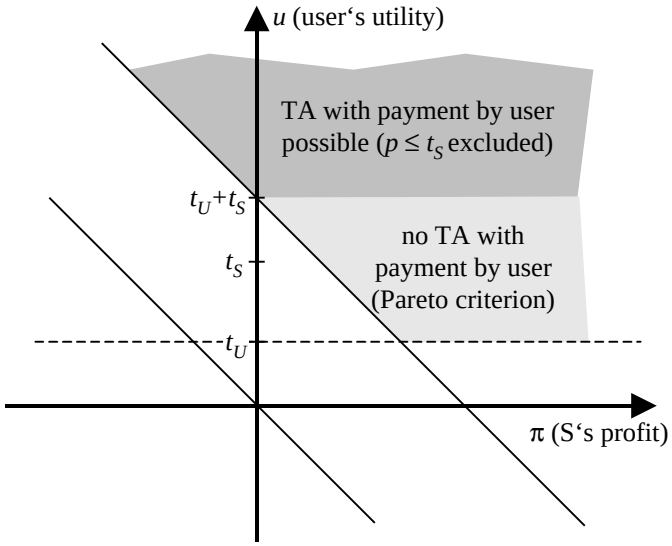

Figure 2: Transactions with payment by user

negative. For transactions with payments, condition (1) pushes this line upwards (or to the right) by the amount $t_U + t_S$. Inequality (2) limits the area of possible transactions from below (dotted line), while the stronger inequality (3) additionally excludes the shaded area where $t_U < u £ t_U + t_S$. Finally, inequality (4) excludes prices below or equal to t_S in the grey area in the top right part of the diagram, where transactions with payment by the user are possible.

Transactions without payment

Obviously, the necessary and sufficient conditions for a transaction without payment to be acceptable for both user and supplier are $\pi \geq 0$ and $u \geq 0$.

Payment by the supplier

Also in this case, condition (1) must be satisfied. Corresponding to condition (2) for the case of payment by the user, one obtains the supplier's participation constraint

$$p > t_S \ . \tag{5}$$

In parallel to the above, a Pareto improvement is possible whenever $|p| \leq t_U$: doing the transaction without a payment makes the supplier gain $t_S + |p| > 0$, while the user gains $t_U - |p| \geq 0$. Hence, since with $p \leq t_S + t_U$ the supplier would not be willing to pay a price $|p|$ above t_U, the constraint (5) is tightened to

$$p > t_U + t_S \ . \tag{6}$$

In analogy to condition (4), for the price p the condition

$$|p| > t_U \tag{7}$$

obtains. Figure 3 shows these conditions in the p-u-plane. Apart from the fact that t_U ¹ t_S, Figure 3 is identical to Figure 2 when reflected at the main diagonal. Figure 4 summarizes

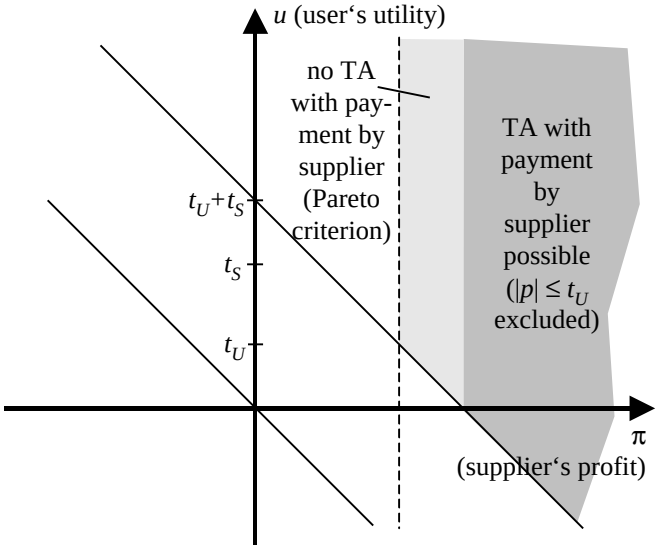

Figure 3: Transaction with payment by supplier

which kind of transaction is viable in which part of the *p*-*u*-plane. Again, the symmetry between transactions with payment by the user resp. the supplier is obvious.

The upper right quadrant in Figure 4 carries the most structure of all quadrants. This is the reason why it is depicted so prominently in the figures. It is not implied that most relevant cases would lie in this quadrant. The area top left, where only transactions with payment by U are viable, is much more important than the small shaded triangle in Figure 4 seems to indicate.

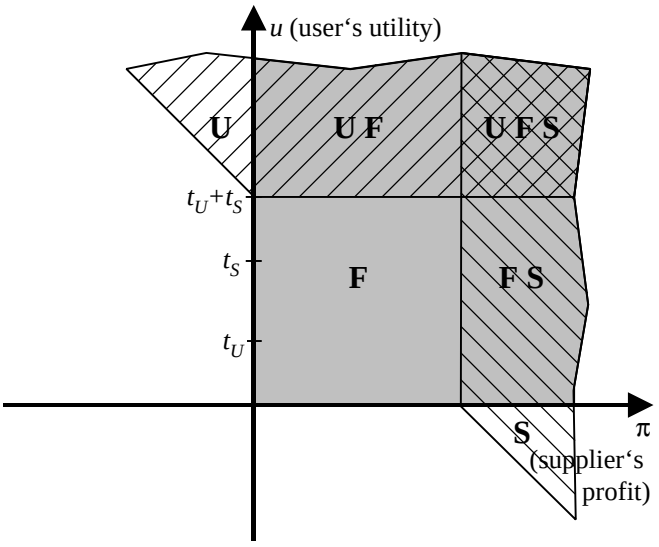

Figure 4: Overview of transaction possibilities (U = user pays; F = free; S = supplier pays)

The above analysis shows what kind of transaction is *possible* in the respective areas of the *p*-*u*-plane. Disregarding competition, the *optimal* kind of transaction from S's point of view obviously is the one where she receives the highest payment from U. However, competition does matter. For example, the decision to charge the user when both 'payment by U' and 'free' are possible, might lead to a heavy loss of users when a competitor offers comparable information for free. To analyze this in detail would require to model demand for substitutes in an oligopoly, which is beyond the scope of this article. Here, it shall just be noted that what eventually happens in a particular case depends on competition. The stronger competition between information suppliers, the less likely becomes a transaction with payment by the user, provided a free transaction is possible.

If competition is very strong, then prices will be as low as possible. Where "payment by the user" is the only viable type of transaction – to the left of the vertical axis in Figure 4 – the price p_U obtains from the condition that the supplier's profit contribution p plus the price p (be it positive or negative) just cover the supplier's transaction cost:

$$p + p_U = t_S \Rightarrow p_U = t_S - p \ . \tag{8}$$

When both "payment by the user" and "free information provision" are viable (for $u > t_S + t_U$ and $0 \le p \le t_S + t_U$) then, assuming strong competition, the latter should prevail. If, finally, "payment by the supplier" is a viable option ($p > t_S + t_U$), then this is what should be observed. The resulting price p_S also obeys equation (8), with the difference that p_U is positive, while p_S is negative. Figure 5 illustrates which prices obtain, for strong competition, in which areas of the *p*-*u*-plane. The vertical axis shows the user's utility u and the price p. The "plateau" where $p = 0$ nicely shows that, assuming p was continuously changed with u held constant, the price is "sticky" at zero, due to the transaction cost.

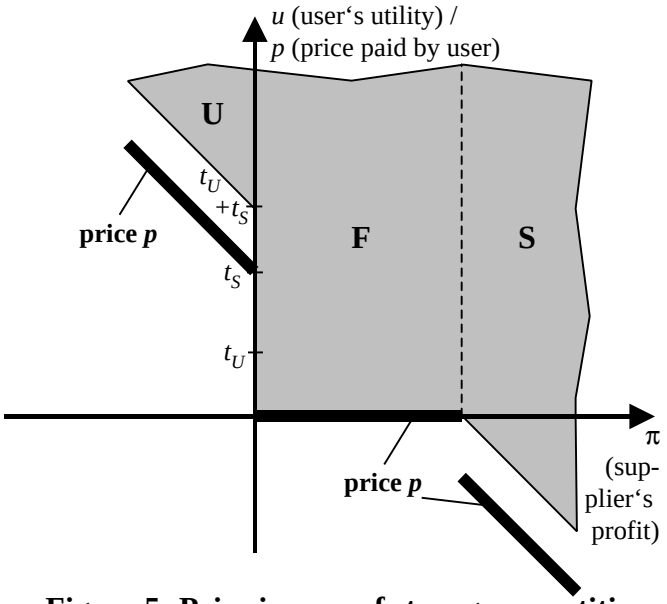

Figure 5: Price in case of strong competition (U = user pays; F = free; S = supplier pays)

4. Options of an information supplier

The above analysis leads to the question how an information supplier can improve her position in the *p*-u-diagram. More precisely, what are the levers to influence the supplier's profit contribution *p*, the user's utility *u*, and the payment transaction costs t_S and t_U? Table 3 shows in the left-hand column those determinants of *p* and *u* that the information supplier S can directly influence. The items on the right-hand side characterise the demand that S is facing. These quantities are indirectly influenced by her, via the levers on the left.

Information supplied by S	*Demand faced by S*
• Characteristics of offered information (quality, quantity, selection) • Convenience (speed, features such as search engine and index) • Public awareness of the site (advertising, partnering) • Advertising (quality, quantity, fit with information and users) • Learning about the users (how much and what is learned, what use is made of the insights) • Price *p*, pricing scheme	• Number *N* of users • Frequency *f* of each user's usage, per period of time • "Quality" of users (income, willingness to spend) • Selection of users (match with information offered)

Table 3: Determinants of the supplier's profit contribution *p* and the user's utility *u*

For most items on the left their direct influence on *p* and *u* is obvious. Offering more and better information as well as increasing the user's convenience benefits the user (*u* increases) and increases revenues linked to motives A – E (see Table 1), but is in general costly for the supplier (*p* decreases). The indirect effects on the items in the right-hand column translate into a positive effect on *p* : if the number and/or average "quality" of users is increased, or the frequency of use goes up, then the average benefits per information unit might stay the same or even increase. The average cost entering in *p*, however, *de*creases, since most cost items are independent of the number *N* of users (see discussion below). Hence, the net effect on *p* may be positive. The same is true for increasing public awareness of the site. Advertising and learning (motives C and E in Table 1), on the other hand, can be assumed to have a positive direct effect on *p*, while there is a possible negative effect on *u*. This, in turn, leads via *N* and *f* to a negative indirect effect on *p*. The same holds for the price *p*. In addition, the pricing scheme (e.g., subscription or pay-per-use) has an influence. Ideal are improvements of fit between the information offered, the advertising, and the users' taste: they benefit both S and U, and do not even have to be costly.

While the direct effects of the left-hand items are mostly on cost and user's utility, the right-hand items mainly affect the supplier's benefits (positively). It is true that the issue of capacity and bandwidth also affects S's cost and U's utility: more users imply either higher cost for servers etc., or lower utility because of delays, or both. However, since the cost of

serving *N* users with a given quality of service level increases slower than linearly with *N*, the average cost of providing one information unit (which enters in *p*) *de*creases with *N*.

Finally, the determinants of the average payment transaction cost per information unit have to be discussed.[11] Table 4 gives an overview. First, technical features of the respective payment system matter. For both S and U, the adoption of the payment system requires a certain one-off cost and effort. For S, this transaction cost is spread over all users who pay S with this system, and all uses of information units. For U, it is spread over all information suppliers the user contacts and pays with this system, and over all her uses. Hence, the more widespread a certain payment system, the lower both t_S and t_U.

Supplier's transaction cost t_S	*User's transaction cost* t_U
• One-off cost of adopting the payment system	• One-off cost of adopting the payment system
• Fixed cost per user paying with this payment system	• Fixed cost per supplier paid with this payment system
• Marginal cost per information unit sold	• Marginal cost per information unit bought
• Number *N* of users paying with this payment system	• Number of information suppliers the user pays with this payment system
• Frequency *f* of use per time period	• Frequency *f* of use per time period

Table 4: Determinants of supplier's and user's payment transaction costs t_S, t_U

Next, the fixed cost (independent of the frequency *f* of uses per time period) of serving one more user with the payment system matter for S, while for U there is a fixed cost of doing payment transactions with one more supplier. These costs are caused, e.g., by registering, providing data, or checking a user's credit record. Both S and U spread their respective costs over the number *f* of U's uses of S's information offer in a given time period.

Finally, there is a marginal payment transaction cost for each information unit. This may be zero (when payment is made by a subscription) or positive.

The discussion shows that what kind of payment mechanism prevails on the internet, depends on user behaviour: If an information supplier is visited regularly, then a subscription system or one with a debit or credit account for each user will yield the lowest average transaction cost. However, if S's service is used only sporadically, then a "cash-like" micropayment system, which requires no registration of the user at the supplier's site, will minimize t_S and t_U.[12]

Figure 6 demonstrates how the mathematical model developed in Section 3 can be used to illustrate the effects which the levers discussed above have on a point in the *p*-u-diagram. A point represents the information offered by supplier S. Increasing the number

[11] Of course, transaction costs are not purely monetary, but also contain hassle, effort, and time.

[12] Examples of micropayment systems for Germany are CyberCoins by CyberCash GmbH, eCash by Deutsche Bank, and the phone-bill-based system Net900 by In Medias Res and Deutsche Telekom.

a) more users *N*
b) higher usage frequency *f*
c) better selection of users
d) higher convenience of site
e) more valuable information
f) more advertising
g) adverts better matching users' interests
h) learn more about users
i) reduce payment transaction cost

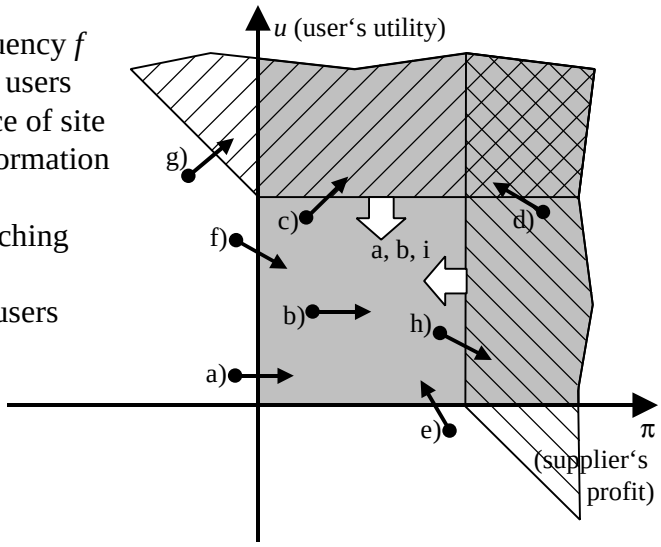

Figure 6: Illustration of how different levers influence the position in the *p*-u-diagram

of users (a) or the frequency of usage (b) has the effect of moving the point to the right. In addition, it decreases average payment transaction costs. This shifts the borders of the shaded areas inwards, as indicated by the white arrows. In the same direction works a direct reduction of the transaction cost by, e.g., a more suitable payment system (i). The arrows (c) to (h) illustrate the effects of the other levers, as discussed above.

5. Free information – how much longer?

The analysis above should have helped to clarify the questions "who" and "why", posed in the title. The third question – "how much longer" – is discussed below. Kelly (1998), enthusiastically, predicts that all prices will converge towards zero. This is certainly overoptimistic, since the average cost of information provision is positive, even if the *marginal* cost is zero. In the following, five developments are discussed which influence the issue of free versus costly information on the internet in the future.

(i) *Early phase over*: The start-up phase of internet business, where firms accept losses to gain market share, will be over at some point in time. The average cost of an information unit will have to be covered by a corresponding revenue. Advertising, even though it is an important revenue source – in particular since the internet allows a better targeting than traditional media – will in many cases not be sufficient as the sole source. Neither will the sources behind the motives B – E (see Table 1) together suffice in all cases. This should result partly in a consolidation of the internet's information offer, and partly in a migration from free to costly information provision (provided suitable payment systems are established).

(ii) *Growing number of users*: Both the total number of internet users as well as the intensity of individual usage are still increasing. This supports free information on the web, since all revenue sources without payment by the user (linked to motives B – E) depend positively on the number of users and the frequency of usage.

(iii) *Habits are formed*: It seems reasonable to assume that, as internet users get more experienced, they develop habits concerning the sites they visit. A parallel in TV usage would be someone who tried the news program at several of the new private TV stations introduced in Germany in 1980s, before settling to watch the news on the same station every evening. This would imply, *ceteris paribus*, that the number N of users per site goes down, while the frequency f of usage goes up. A certain negative effect on revenues from B (inform), D (signal), and possibly E (learn) seems likely, since repeated informing, signaling, or learning from the same person has decreasing benefits. On the other hand, loyal users may sooner accept an account-based payment system, since the average payment transaction cost goes down with f.

(iv) *Consolidation*: As mentioned above, consolidation is to be expected in many areas of internet business. Information offers may be closed down completely, or they may be acquired by a bigger firm (e.g., Fireball, Hotbot, Tripod and several more sites now belong to Lycos Europe). This implies a higher number of users for the surviving firms, as well as lower average cost per information unit. Both implications favor free information provision. On the other hand, a lower number of firms in a certain segment of internet business should lead to reduced competition, such that a coordination on charging for the service might be easier.

(v) *Micropayment systems*: If one micropayment system gets widely adopted, payment transaction costs for small amounts will fall sharply. It is true that neither eCash nor CyberCash nor any other system was very successful so far, but chances still are that there will be a viable micropayment system. This can be expected to contribute to a larger information offer with cost on the internet.

The above developments (i) – (v) have different effects on different information suppliers. The question "how much longer", more precisely, should thus rather be "who provides information for free *also in the long run*, and who will not". In the long run, those firms are likely to provide information for free whose information is used often (high number N of users and/or high frequency f of use), which makes advertising a viable source of revenue (C in Table 1). Additionally, information well suited for generating related sales (B) or signalling the supplier's qualities (D) will remain free. If the information offer on the site is such that the surfer's behaviour gives valuable insights about her, then the benefits from "learning" about the user (E) tilt the balance towards a free offer. Also, the cheaper the information is to produce (and, hence, the lower quality it is), the sooner a free provision can be expected. Finally, strong competition between information suppliers works in this direction, which is more likely for information commodities.

6. Discussion and summary

In order to keep the mathematical model tractable and clear, simplifications have been made. To start with, the analysis assumes homogeneous users as well as information units, such that the supplier's information units can be represented by a point in the p-u-plane. In reality, both p and u differ between different information units and different users. This turns the point in the p-u-plane into a smooth distribution, such that for some users and/or information units, other types of transactions will be be viable than for others.

The assumption of a steady state where both supplier and user know their average revenue resp. utility is another simplifying assumption. When a user decides about subscribing to some web information offer, she is usually not fully informed about its quality, since

information is an experience good.[13] Neither can she exactly anticipate her usage frequency *f*. Furthermore, she might shy away from initial expenses because she discounts strongly. These problems can be alleviated by making the user pay only after a period of free access to the information, and by gradually moving from a pay-per-use pricing scheme to a flat fee. The supplier may also have the possibility to bear initial one-off costs (and, hence, risk) for the user.

The analysis in Section 3 describes comparative statics for one information supplier. It does not model competition explicitly. For example, if an information supplier with N users finds herself in the area UF in Figure 4, then free information provision as well as payment by the user are in principle possible. With strong competition, only free provision allows to keep the users – any positive price would make them visit a competitor's site (see Figure 5). With weak competition and heterogeneous consumers, however, the number N of users may remain at a positive value when the price p is increased from zero, and it will decrease only *gradually* when the price is further increased. To properly describe this situation, an oligopoly model of information provision with payment transaction cost is required.

To summarize, in this article a framework for the analysis of information provision on the internet has been developed. Starting from a qualitative analysis of user behaviour, possible motives to provide information on the web have been identified. Using a mathematical model, relations between information provision cost, user's utility, payment transaction cost, and competition have been deduced. In Sections 4 and 5, the qualitative and the formal analysis have been brought together to discuss the levers available to an information supplier, and the future prospects of free information on the web.

Competition between information suppliers is an important determinant of the web's information offer. Its bearing on free versus costly information has only been touched upon in this article. To explore competition in the presence of alternative revenue sources and payment transaction cost further seems an interesting avenue for further research.

[13] On the issue of information being an experience good see, e.g., Shapiro and Varian (1999), pp. 5.

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