

NETWORK EXTERNALITIES AND SPILLOVERS IN THE EMAIL CLIENT SOFTWARE

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Abstract

This paper analyzes adoption decisions of email client software with the focus on network externalities, spillovers, and firms' strategies. Survey data are used to test the existence of network externalities and spillovers by studying the claimed reasons for adoption. Based on the GVV WWW User Survey data in 1997 and 1998, logit models are employed to test hypotheses. The results show that Eudora's competitive advantages were derived from its high quality product which was perceived by users, loyalty which was created from users' prior experience, and network externalities and spillovers which were driven by high market share. Sources of network externalities and spillovers are outside accessibility and others' recommendations, respectively. These advantages diminished when Netscape employed bundling with its suite, and when Microsoft employed bundling with its operating system and free strategies.

Keywords: Email client, network externalities, spillovers, firm strategy, predatory pricing, bundling

Introduction

This paper analyzes adoption decisions for email client software based on survey data. The purposes of this paper are to test the existence of network externalities and spillovers in the email client software, and to determine firms' strategies and effectiveness of those strategies.

Email Client¹

The history of electronic mail or email can be traced back to the 1960s when emails were used to send messages from mainframe to terminals or between terminals. Also, during the late

1960s, the U.S. Department of Defense created the Advanced Research Projects Agency Network (ARPANET) for the purpose of communicating between military and educational institutions until an engineer named Ray Tomlinson found a way to send email messages between two nodes of the ARPANET network in the early 1970s. Email usage rose rapidly and most of the ARPANET network's traffic was email.

The growth of the personal computer market in the late 1970s and 1980s, along with the development of the Internet in the 1990s have

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popularized email as a means of communication compared to normal mail and telephone calls. When the market was expanding, several email programs or clients were developed for the general public. Figure 1 shows the market share of email client software during 1997 and 1998.

Eudora was the first email client which provided a graphic interface. It was written in 1988 by Steve Dorner at the University of Illinois. At the time, there were two basic email systems in use, the Unix-based and the LAN-based. The Unix-based relied on the UNIX commands which could be perceived as hard to use while the LAN-based allowed users to communicate within the same network, but was isolated from other servers. Dorner successfully combined the strengths and eliminated the weaknesses in each of both protocols, and released Eudora for free to the Internet community in order to seek user feedback. After Qualcomm Incorporated purchased the rights to Eudora in 1991 for its internal use, the company decided to launch Eudora as a

consumer product. Eudora was widely accepted and became a market leader for a few years before Netscape's and Microsoft's email clients took over.

In 1996, Netscape introduced Communicator which is an intranet client suite consisting of Navigator browser, an email program, a HTML editor, and other applications. Netscape's email program, Messenger, quickly gained the market share along with its browser. Later, in November 1998, America Online Incorporated (AOL) announced its acquisition of Netscape, and the deal was eventually completed in March 1999. AOL was the largest Internet access provider (IAP) in the U.S. It serviced more than 10 million members in 1997 and the number rose to more than 15 million in 1998. Its email client, AOL Mail, was adopted by users who subscribed to AOL's Internet services.

Microsoft also offered its own email clients, Outlook Express and Outlook. Outlook Express is the email client included with Microsoft's Windows (operating system),

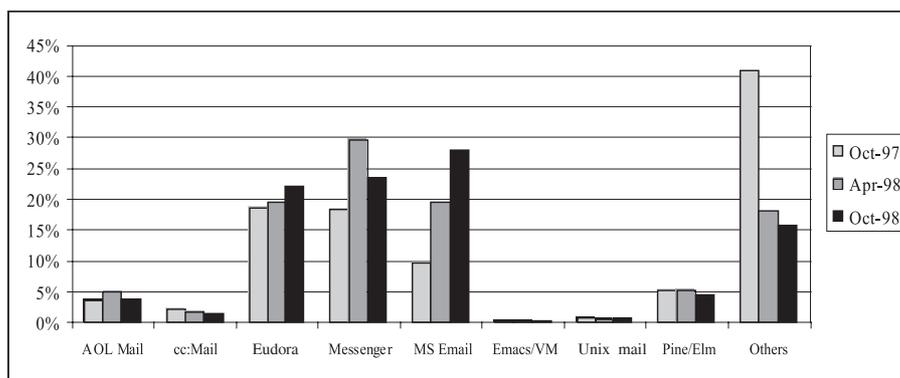


Figure 1. Market shares of email clients based on the GVV's eighth (October 1997), ninth (April 1998), and tenth (October 1998) survey

¹ The history of Eudora is summarized from "The Birth of Eudora" at <http://www.eudora.com/presskit/background.html#name>. The background of Netscape is from "Netscape Messenger" at <http://wp.netscape.com/communicator/messenger/v4.0/index.html>. The history of America Online is from "Who We Are" at <http://www.corp.aol.com/whoweare/history.shtml>. Details on Microsoft's products are from "Differences between Outlook and Outlook Express" at <http://support.microsoft.com/?scid=kb;en-us;257824&spid=2578&sid=global> and "What is Exchange Server" at <http://www.microsoft.com/exchange/evaluation/whatis.msp>.

Internet Explorer (browser), and Office. It is designed for home users who gain access to their email messages through an Internet Service Provider (ISP). Outlook is a messaging and collaboration client with features including email, calendaring, and contact management. It can be integrated into Office or into Exchange Server.

Microsoft Exchange Server is software that runs on servers which enable users to communicate interactively through networks. Its original version was Exchange Server 4.0 which came out in 1996. The program manages email, shared calendars and tasks; provides full support for mobile and web-based access to information; and can support large amounts of data storage. Its rivals include Domino server, Linux server, etc.

The history of email programs which run on the UNIX system is not discussed here in details since they are not the focus of the paper. However, it should be pointed out that UNIX mail is a basic email program which allows users to send and receive text-only email. Program for Internet News and Email (Pine) is a text-based email client which supports viewing and saving text attachments while graphical attachments can be viewed by external viewers. Editor MACroS (Emacs) is a text editor for UNIX while View Mail (VM) is an Emacs subsystem that allows users to read and delete mails within Emacs.

Network Externalities and Spillovers

The topic of network externalities has been studied for almost two decades, but has received more attention recently because many “high tech” products seem to exhibit some kinds of network externalities. A product creates direct² network externalities when the utility that an agent derives from consuming the product

increases with the number of other agents consuming the same product.

Similar to the network of telephone, the existence of network externalities in the email network is quite obvious since its value depends positively on the number of email users. Though users send and receive emails through email clients, the whole email network is linked through mail servers. In most cases, an email system³ consists of two different servers. First is the SMTP (Simple Mail Transfer Protocol) server which handles outgoing mails. The second one is either POP3 (Post Office Protocol) server or IMAP (Internet Mail Access Protocol) server which handles incoming mails. When a person sends an email, the email client interacts with its SMTP server, then the SMTP server contacts a DNS (Domain Name Server) in order to get the IP address of the recipient’s SMTP server, and the sender’s SMTP server connects with the recipient’s SMTP server to transfer the email. When an email arrives, POP3 server maintains a collection of text files containing messages for each email account. When a recipient checks email, the email client connects to the POP3 server and copies of email messages are brought down to the local personal computer. IMAP is a more advanced protocol that allows users to organize mails on the server, and manipulate remote mailboxes as if they were local.

The existence of network externalities in an email client may not be as obvious as the email network since email clients are compatible with each other in terms of sending and receiving emails. Network externalities in an email client may be derived from other reasons.

First, the value of an email client depends on which server software others are using. For example, if an enterprise uses Microsoft Exchange Server, users in that enterprise may likely be adopting Microsoft Outlook email client software. Since Outlook is integrated

² The term “network externalities” used in this paper means direct network externalities, as opposed to indirect network externalities. A product exhibits indirect network externalities when the utility is derived directly from consumption of a durable good (hardware) and indirectly from a set of complementary compatible goods (software).

³ Summarized from Brian (2006).

into Exchange Server, using Outlook with Exchange Server allows users to fully use workgroup information sharing, group scheduling, public folders, etc. Other examples include Notes which is attached to Domino server, or Apache which is attached to Linux server. UNIX mail and Pine are also used by many academic servers. On the other hand, certain email clients like Eudora which has no direct attachment with its own server could be in a weaker position. As a result, if more workplaces, universities, schools, and libraries are using a particular server software, users should be familiar with the corresponding email client.

Second, a large installed base of an email client may improve the firm's ability to launch an upgraded version more frequently. Many consumers prefer to use the most updated version. On the other hand, an upgraded version can be thought of as a strategy to attract users because it is a sign of continuous innovation and superior technology.

Third, network externalities in an email client may come from the fact that the most-installed email client may also carry a high-quality image such as superior product characteristics or ease of use.⁴ The image may not be true, it can be just a perception, or so-called bandwagon effect as mentioned by Katz and Shapiro (1985). This high-quality image can be forwarded through many channels such as through vendor's reputation. Additionally, the general information about a product with a larger network is more easily available (Katz and Shapiro, 1985). When users are kept informed about a particular email client, they may decide to try or even adopt the product.

Another closely related concept to network externalities is "spillovers". A product exhibits spillovers when its value depends on other users who use the same product and influence

the adoption decision by providing recommendations. Prospective users learn from existing users who could be friends or even neighbors, as suggested by Goolsbee and Klenow (1999). Although network externalities and spillovers usually exist in the market leader's product, both concepts can be different. For example, when a user joins a network, he/she automatically receives externalities benefits, but the recipients of spillovers benefits may have to compensate the providers. For the email client, a person may decide to use an email client because he wants to use what his friends are currently using, or because he can seek some assistance from his friends regarding how to use the program.

Not only do industry's characteristics play a crucial role during the competition, firms' strategies must also be considered as well. Two important strategies employed by the software industry are bundling and predatory pricing. See Economides (1998) for the formal model of product bundling. Predatory pricing is defined formally as "a response to a rival that sacrifices part of the profit that could be earned under competitive circumstances, were the rival to remain viable, in order to induce exit and gain consequent additional monopoly profit" (Ordover and Willig, 1981). See Katz and Shapiro (1986, 1992) and Farrell and Saloner (1986) for the formal models analyzing pricing strategies for the purpose of increasing the network size.

Empirical Studies on Network Externalities and Spillovers

Previous tests on the existence of network externalities and spillovers are presented in Table 1. Papers about network externalities are grouped according to methods of testing, adoption decision or hedonic price model.

Instead of focusing on the observable variables such as prices and quantities, other

⁴ Barrett and Yang (1999) state that food safety standard may exhibit network externalities because general acceptance of the product is taken as a signal of safety and quality. Another example is Berndt et al. (1999) who study how the diffusion of antiulcer drug is affected by other patients' influences on the drugs' acceptability.

articles study consumers' motives when purchasing (or adopting) a product (or a technology). These studies rely on consumer survey data to test the existence of network externalities. Capello (1994) compares the effects of network externalities of the Special Telecommunications Action for Regional Development (STAR) program in Southern Italy and in more highly developed Northern Italy. The STAR program has been initiated with the objective of developing advanced telecommunication technologies in less developed regions of the European Community. A sample of seventy (half in Southern, another half in Northern Italy) small- and medium-sized firms from different sectors were interviewed.

The issue is whether the adoption process of these technologies is associated with network externalities. Another example is Mahler and Rogers (1999) who study banks' adoption decisions of 12 telecommunication services, based on the survey data of 392 German banks.

Though there is an enormous amount of theoretical work on networks and strategic behavior, there are very few articles that empirically analyze firms' strategies when network externalities are assumed to exist. Examples include Dranove and Gandal (1999) who analyze the impact of preannouncing Digital Video Express (DVIX) technology on the adoption of the Digital Video Disc or Digital Versatile Disc (DVD) technology.

Table 1. Previous empirical studies on network externalities and spillovers

Network externalities	Reference	Study
Adoption decision		
There is a relationship between the adoption decision of current users and the size of the network or the cumulative number of existing users.	McAndrews and Kauffman (1993)	Banks' decisions to join an automated teller machine (ATM) networks.
	Saloner and Shepard (1995)	Banks' adoption rates of ATMs depend on the number of banks' branches.
	Gowrisankaran and Stavins (1999)	Bank's adoption of the automated clearing-house (ACH) electronic payments system.
	Weber (2004)	Brokerage firms' adoption of the International Securities Exchange (ISE) trading platform.
	Iimi (2005)	Consumers' adoption decisions of cellular phone carriers in Japan.
Greenstein (1993)	Federal agencies' acquisition of the mainframe computer systems from vendors in 1970s.	
Hedonic price model		
Consumers' willingness to pay (WTP) of a network good depends on whether the product is compatible with other existing products.	Gandal (1994, 1995)	Consumers' WTP depends on the compatibility of the spreadsheet and database management software.
	Brynjolfsson and Kemerer (1996)	Consumers' WTP depends on the compatibility of the spreadsheet software.
Spillovers	Reference	Study
Adoption decision		
An individual's adoption decision depends on influences by existing users.	Goolsbee and Klenow (1999)	The diffusion of home computers based on influences by friends.

Data

Survey data can be used to test network externalities more explicitly by studying the claimed reasons for adoption. The survey data is obtained from the Graphic, Visualization, and Usability Center's (GVU) WWW User Survey.⁵ GVU conducted this survey in April and October of each year from 1994 to 1998. The latest edition is the Tenth User Survey which was run from October 1998 to December 1998. All ten surveys were conducted over the Web. Participants respond to questionnaires posted on the Web. The surveys employ non-probabilistic sampling. Participants are solicited through announcements on Internet's newsgroups, WWW-surveying mailing list, popular media such as newspaper or trade magazines, banners randomly rotated through high-exposure sites such as Yahoo, CNN, Excite, Webcrawler, etc., and through advertising networks such as Double Click.

Each survey's questionnaire is grouped into different sections. More sections were added in the later surveys. I am interested in the technology demographics section. Each respondent can choose to complete some or all sections of a survey. As a result, the number of respondents is not the same for each section and for each survey. Those who completed at least four sections (out of eight sections in the tenth survey, for example) were eligible for random awards. These incentives were also different across each survey.

Hypotheses and Methods

The following hypotheses are proposed since there is a reason to believe that network externalities and spillovers exist in the email client software.

H1: Email client software exhibits network externalities through outside accessibility, and network externalities exist in the market leader's product.

H2: Email client software exhibits spillovers through recommendations by friends, and spillovers exist in the market leader's product.

For the first hypothesis, outside accessibility proxies network externalities because the value of an email client increases when an individual can also use the program that others have installed at workplaces or schools. When an enterprise uses a particular server software, users in the enterprise are more likely to use the attached email client, and users should be familiar with this program. Though other sources of network externalities were stated, measuring them can be ambiguous with this survey question. Influences or recommendations by friends and experts are a proxy of spillovers or informational externalities. As a result, it can be seen whether spillovers exist in the email client software, then friends' recommendations are determinants of consumers' adoption decisions.

In general, firms in the network industry generally compete for the installed base or market share, and the market is normally represented by "winner takes all" or "winner takes most". As a result, if the market leader's position shifts from one product to another, then network externalities and spillovers are expected to shift accordingly. This can be tested by observing whether the network externalities and spillover variables are significantly positive with the market leader's product. Specifically, Eudora was the leader during late 1997, then Messenger became the leader during beginning 1998, and Microsoft's email clients led the market during late 1998.

Additionally, the same data contains how certain strategies affect users' adoption decisions. Much of the literature discuss the rationale behind several firms' strategies. The first important strategy is to offer the product for free, regardless of the firm's actual predatory intention. What is uncertain is how users value those strategies. The second strategy is

⁵ The website is http://www.gvu.gatech.edu/user_surveys/.

“bundling”. In the questionnaire, the word “integration” with other programs or applications does not have the same meaning as bundling in the literature. An email client can be integrated with an operating system (i.e. Microsoft’s Windows) or into a suite (i.e. Netscape’s Communicator). Unfortunately, these two categories of integration were not distinguished in the survey. It should also be noted that the line between free and integration strategies can be blurred since some users may regard integrating an email client into other software as getting that client for free.

According to economic theory of utility, consumers try to achieve maximum utility or satisfaction, given their resource limitations. Satisfaction can be derived from adoption, and receiving benefits from product’s attributes (i.e. usefulness) or even network externalities, while consumers’ decisions are also affected by firms’ strategies. Assuming the objective of maximizing utility, an individual makes his/her email client decision (called Y_i). The following

logit model is based on this assumption:

$$\text{Probability}(Y_i = 1) = \beta x_i^b + t + u_i$$

for each survey respondent i who selects one primary email client choice. It should be noted that users could be using more than one email client software. Unfortunately, the eighth and ninth survey focused only on the reasons of adopting “primary” email client. Only the tenth survey asked questions about both (all) email client(s) and primary email client that users were using. Comparisons are shown in Figure 2. x_i^b represents individuals’ differences in email client usage. t are time dummies, each dummy for a survey. And finally, u_i are error terms. Only the eighth (October 1997) to the tenth (October 1998) survey are included in the analysis because these last three surveys contain all relevant variables. Acronyms of all variables and their explanations are presented in Table 2 while Table 3 shows variables’ descriptive statistics.

There are more than ten email client

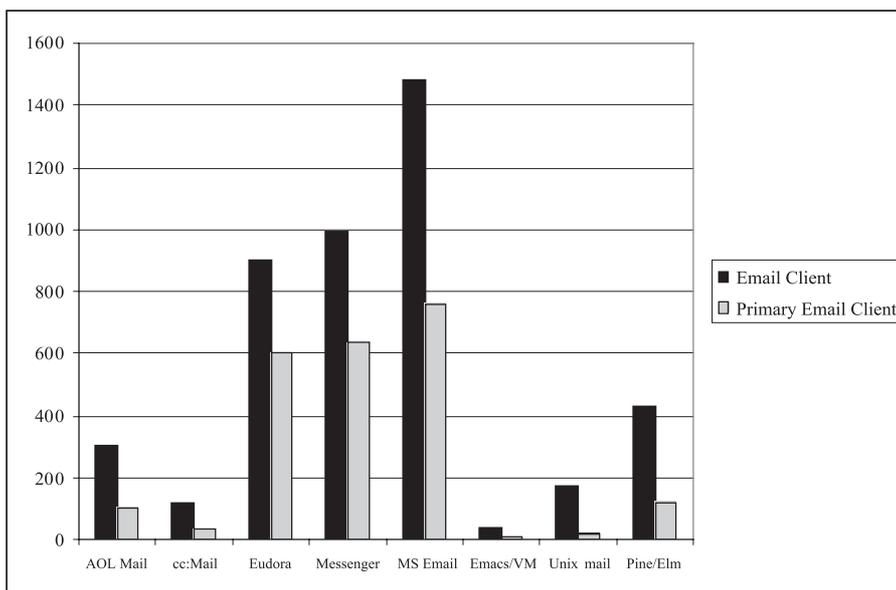


Figure 2. Comparisons between users of email clients and primary email client based on the GVU’s tenth survey during October 1998

Note: Respondents might answer more than one email clients for the question about which email client(s) they were using, but could answer only one email client for the question about primary one.

Table 2. Variables and explanations

Variable	Explanation
The following dummies represents important reasons of choosing a particular email client:	
Accessibility	Accessibility at work and/or school.
Recommend	Recommendations by friends and online discussion.
Marketing	Recommendations by trade magazines, trade shows, and websites.
Reputation	Reputation of vendor.
Experience	Prior experience.
Feature	Characteristics include 1) best features and 2) easiest to use.
Free	Email client offered for free.
Integration	Email client integrated into other programs/applications.
The following dummies represent time:	
Eighth	Eighth survey = 1, Other surveys = 0.
Ninth	Ninth survey = 1, Other surveys = 0.
Tenth	Tenth survey = 1, Other surveys = 0.

Table 3. Descriptive statistics of variables from the eighth to the tenth survey

	Eighth survey		Ninth survey		Tenth survey		All three surveys	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Eudora	0.19	0.39	0.20	0.40	0.22	0.42	0.20	0.40
Messenger	0.18	0.39	0.30	0.47	0.24	0.42	0.24	0.43
MS Email	0.10	0.30	0.19	0.40	0.28	0.45	0.17	0.37
Accessibility	0.10	0.30	0.11	0.31	0.12	0.33	0.11	0.31
Recommend	0.08	0.27	0.10	0.30	0.10	0.31	0.09	0.29
Marketing	0.04	0.19	0.04	0.20	0.04	0.20	0.04	0.20
Reputation	0.09	0.29	0.13	0.33	0.17	0.38	0.12	0.33
Experience	0.12	0.33	0.17	0.37	0.24	0.43	0.16	0.36
Feature	0.23	0.42	0.30	0.46	0.42	0.49	0.29	0.45
Free	0.14	0.35	0.20	0.40	0.20	0.40	0.17	0.38
Integration	0.63	0.48	0.58	0.49	0.52	0.50	0.59	0.49
N	7,694		7,670		2,710		18,074	

choices facing each consumer, but since Eudora, Messenger, and Microsoft's email clients have captured most of the market during the specified period, my focus will be on these three products. I consider Exchange, Outlook, and Outlook Express as the same product because I want to distinguish between Microsoft's and other vendors' products. In the category of x^b , there are seven different stated reasons for choosing a particular email client by an individual which are 1) can be used at school and/or workplace or called "accessibility"

variable, 2) recommendations by friends and online discussions or called "recommend" variable, 3) marketing promotions through trade magazines, trade shows, and Web sites or called "marketing" variable, 4) vendor's reputation, 5) prior experience, 6) email client characteristics i.e. features and ease of use, 7) free availability, and 8) integration with other program(s).

To be more explicit about testing the existence of network externalities in the email client market, the dependent variable is replaced by "switching to a particular email client"

dummies. Assuming that every user has full information regarding the market share of each client, if network externalities and spillovers exist in the email client software, an individual will decide to switch to another software with a larger or the largest installed base if he/she is not currently using the market leader. Figure 3 below shows the trend of switching to leaders.

With the same right hand side variables from the above equation, $Y_i = 1$ means switching to Eudora (or Messenger, or Microsoft's email clients), and $Y_i = 0$ otherwise. Note that this analysis includes only users who actually switched their email clients in the past year. Those who never switched are excluded.

Results and Discussion

The binary logit model predicting email client choice is presented in Table 4 to 6. For users who preferred a quality product (based on its features and ease of use), they were more likely to select Eudora over other clients. The perception of high quality product was created for Eudora. Those who had prior experiences with Eudora tended to be loyal users compared

to other email clients. Significant "accessibility" variable implies that network externalities existed in Eudora. During 1997, Eudora was the market leader and its client could be widely installed at workplaces and schools. When others were using Eudora in workplaces or schools, users also preferred to use or learn how to use Eudora. For those who selected a particular email client based on recommendations from friends, Eudora was more likely to be their choice. Spillovers existed in Eudora as "recommend" variable is significant. However, although the "recommend" variable is significant during 1997 and early 1998, it becomes insignificant in late 1998. The "accessibility" variable is significant only during 1997, and insignificant afterward. It is possible that other email clients took over the leading position in 1998, so network externalities and spillovers in Eudora diminished.

For Netscape's Messenger, Table 5 shows that users were drawn to Messenger mainly because of its features and prior experience with the product. Similar to the results from Eudora, marketing promotions through magazines, trade shows, and web sites were not very effective

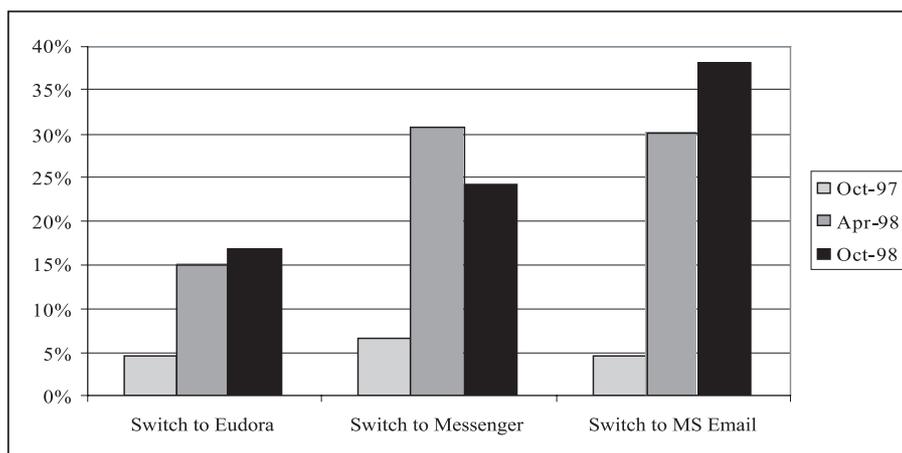


Figure 3. Percentage of users' switching to the following email clients based on the GVV's eighth, ninth, and tenth survey

Note: Switching in this figure means switching from any other email clients to a particular email client

in encouraging adoption. An interesting result was the positive and significant “integration” variable. The fact that Netscape bundled its email client with its suite could encourage consumers’ adoption of its Messenger. Network externalities and spillovers did not exist in Messenger since both “accessibility” and “recommend” variables do not have expected positive sign.

Microsoft’s email clients provide opposite results compared to Eudora and Messenger. Users’ adoption did not depend on products’ features or prior experience. Reputation is more important although this variable is insignificant later surveys. Microsoft’s products did not exhibit spillovers during 1997 and 1998 when it was gaining the share, but showed a sign of network externalities in 1997. However, it appeared that Microsoft’s bundling strategy was effective. A user who preferred the integration of an email client and other programs, was more

likely to use its products. Users who preferred free email client tended to choose Microsoft over others. Additionally, marketing promotions were another factor which influenced the use of Microsoft’s products.

To focus more on the role of network externalities and spillovers, switching to (rather than selecting) a particular email client is the dependent variable. The results are presented in Table 7. Users switched to all three email clients because of the products’ characteristics, and switched to Eudora and Messenger because of prior experiences. For Netscape’s Messenger, bundling was the only strategy that motivated users’ switching to its product, while free and bundling strategies were very effective in encouraging users to switch from existing email clients to Microsoft’s products. Microsoft’s email clients started to exhibit network externalities through accessibility at schools or workplaces, and this was another

Table 4. Binary logit model predicting adoption of Eudora

Variable	Eighth survey	Ninth survey	Tenth survey	All surveys
Accessibility	0.329* (3.627)	0.047 (0.530)	-0.130 (-0.917)	0.132* (2.278)
Recommend	0.485* (4.947)	0.429* (4.731)	0.272 (1.849)	0.432* (7.161)
Marketing	0.071 (0.513)	0.012 (0.082)	0.223 (1.012)	0.089 (0.986)
Reputation	0.148 (1.384)	0.180 (1.891)	-0.047 (-0.334)	0.112 (1.771)
Experience	0.456* (4.770)	0.453* (5.403)	0.730* (6.066)	0.514* (9.259)
Feature	0.651* (9.095)	0.075 (1.107)	0.244* (2.401)	0.334* (7.578)
Free	-0.072 (-0.870)	-0.550* (-6.800)	-0.491* (-3.875)	-0.356* (-6.796)
Integration	-0.583* (-8.906)	-0.470* (-7.438)	-0.706* (-6.946)	-0.567* (-13.741)
Eighth				-0.020 (-0.357)
Ninth				-0.039 (-0.691)

Note: N = 7,694 for the eighth survey, N = 7,670 for the ninth survey, N = 2,710 for the tenth survey, and N = 18,074 for all surveys. Numbers in parentheses are t-statistics. *P-value < 0.05.

Table 5. Binary logit model predicting adoption of Messenger

Variable	Eighth survey	Ninth survey	Tenth survey	All surveys
Accessibility	-0.352* (-3.165)	-0.360* (-4.082)	-0.382* (-2.502)	-0.353* (-5.609)
Recommend	-0.072 (-0.587)	-0.347* (-3.557)	-0.139 (-0.851)	-0.222* (-3.202)
Marketing	-1.237* (-5.581)	-0.921* (-5.631)	-1.308* (-3.976)	-1.069* (-8.773)
Reputation	0.211 (1.799)	0.113 (1.251)	0.288* (2.034)	0.181* (2.825)
Experience	0.682* (6.623)	0.522* (6.634)	0.319* (2.526)	0.536* (9.556)
Feature	0.346* (4.396)	0.144* (2.253)	-0.016 (-0.155)	0.183* (4.181)
Free	0.014 (0.154)	0.037 (0.536)	0.289* (2.492)	0.073 (1.487)
Integration	0.378* (5.406)	0.461* (8.078)	0.309* (3.149)	0.411* (10.192)
Eighth				-0.258* (-4.653)
Ninth				0.363* (6.874)

Note: N = 7,694 for the eighth survey, N = 7,670 for the ninth survey, N = 2,710 for the tenth survey, and N = 18,074 for all surveys. Numbers in parentheses are t-statistics. *P-value < 0.05.

Table 6. Binary logit model predicting adoption of Microsoft's email clients

Variable	Eighth survey	Ninth survey	Tenth survey	All surveys
Accessibility	0.402* (3.092)	0.088 (0.917)	-0.072 (-0.505)	0.146* (2.138)
Recommend	-0.758* (-3.668)	-0.593* (-4.907)	-0.576* (-3.337)	-0.608* (-6.829)
Marketing	0.081 (0.356)	0.347* (2.398)	0.604* (2.777)	0.348* (3.306)
Reputation	0.331* (2.009)	0.182 (1.720)	0.015 (0.100)	0.177* (2.300)
Experience	-0.038 (-0.246)	-0.170 (-1.749)	-0.550* (-4.021)	-0.249* (-3.515)
Feature	0.118 (1.081)	0.088 (1.236)	-0.145 (-1.451)	0.036 (0.709)
Free	0.074 (0.600)	0.332* (4.319)	0.351* (3.032)	0.289* (5.117)
Integration	0.723* (7.481)	0.489* (7.428)	0.762* (7.945)	0.617* (13.055)
Eighth				-1.365* (-23.147)
Ninth				-0.537* (-10.200)

Note: N = 7,694 for the eighth survey, N = 7,670 for the ninth survey, N = 2,710 for the tenth survey, and N = 18,074 for all surveys. Numbers in parentheses are t-statistics. *P-value < 0.05.

reason for switching to its email clients. Spillovers also played an important role in users' switching decisions. During 1997 and 1998, users switched to Eudora because of spillovers (the "recommend" variable has expected positive sign). However, it should be noted that although marketing, bundling, or free strategies may encourage trials among users, permanent adoption of an email client requires other supporting factors such as the product's quality. Unfortunately, the data from the survey does not cover the permanent adoption decision.

Conclusion

In 1997, Eudora's competitive advantages were derived from its high quality product which was perceived by users, loyalty which was created from users' prior experience, network externalities and spillovers which were driven by high market share. Sources of network externalities and spillovers are outside accessibility and others' recommendations, respectively. These

advantages became less significant when Netscape employed bundling with its suite, and when Microsoft employed bundling with its operating system and free strategies. Any firm's strategy would be meaningless if consumers do not actually value it. The above results which are based on consumers' viewpoints show that bundling and free strategies were effective, at least in encouraging a trial. The fact was that market share of Microsoft's email clients rose sharply during 1997 and 1998. We may be able to conclude that network externalities and spillovers exist in the market leader's product, however externalities and spillovers can be absorbed by firms' strategies which reduce users' switching costs.

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Table 7. Binary logit model predicting switching to a particular email client

Variable	Eudora	Messenger	MS email
Accessibility	0.051 (0.473)	-0.280* (-2.717)	0.329* (3.338)
Recommend	0.640* (6.516)	-0.249* (-2.303)	-0.541* (-4.652)
Marketing	0.004 (0.024)	-1.231* (-6.259)	0.317* (2.208)
Reputation	0.072 (0.632)	0.100 (0.972)	0.084 (0.745)
Experience	0.527* (5.263)	0.645* (7.163)	-0.313* (-3.032)
Feature	0.297* (3.780)	0.335* (4.930)	0.158* (2.233)
Free	-0.501* (-5.199)	-0.081 (-1.022)	0.326* (4.113)
Integration	-0.621* (-8.150)	0.374* (5.804)	0.607* (9.001)
Eighth	-1.235* (-11.838)	-1.480* (-16.329)	-2.666* (-29.928)
Ninth	-0.012 (-0.116)	0.393* (4.466)	-0.404* (-5.033)

Note: N = 11,325 for all models. Numbers in parentheses are t-statistics. *P-value < 0.05.

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