The Battle for World Wide Web Dominance: In Search of Network Externalities

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Abstract: The purpose of this study is to test for the existence of network externalities and to identify possible sources of network externalities in the 3 leading search engine and web-based email providers namely Google, Microsoft and Yahoo. A product creates direct network externalities when the utility that an agent derives from consuming the product increases with the number of other agents consuming the same product. When a market exhibits network externalities, winner takes all or winner takes most is usually the consequence. Data was collected from 449 university students in Thailand. Participants completed a 20 question survey conducted by trained administrators. The binary logit model was applied to test for the adoption and network externalities in or with respect to search engines and web-based email. The study indicates that network externalities do not exist in the selection of a search engine. Google is chosen because of two factors, its features and reputation. The results show that the only web-based email service that exhibits traits of network externalities is Hotmail, the market leader. This means that users choose Hotmail as their primary web-based email because others are also using it. Recommendation by others is not the source of network externalities for web-based email. The study provides an enhanced understanding of how firms dominate and sustain their lead in the world wide web. Furthermore, this research also helps us to understand future trends in the cyber world. A limitation of this study is that other services such as Google talk, Windows Live Messenger and Yahoo Messenger were not considered in measuring network externalities. Thus, future research could usefully include these services. Although the topic of network externalities has been studied previously, this is the first that attempts to identify the traits of network externalities in the search engine and web-based email market.

Key words: World wide web, network externalities, search engine, email, market lader, Thailand

INTRODUCTION

During the past two decades, the internet market has moved through both expansionary and contractionary phases. Although estimates suggest that internet-related companies grew by 100% $year^{-1}$ during the boom of the 1990s and with a period of explosive growth in 1996 and 1997 (Coffman and Odlyzko, 1998), not all companies survived the downturn between 1998 and 2001. Several former leaders fell behind while many startups took over the top position. Since its establishment in 1998, Google has become one of the largest Internet-based companies with revenues of $5.51 billion in the first quarter of 2009, an increase of 6% compared to the same quarter of 2008 (Google, 2009). By contrast, Yahoo posted revenues of $1.58 billion for the same period, a decline of 13%. It did not take Google many years to grow and compete with incumbents like Yahoo or even Microsoft. As for Microsoft, it made a public offer to take over Yahoo with an official bid of $44.1 billion on February 1, 2008

(Reuters, 2008). After one and a half years of negotiations, Microsoft and Yahoo finally concluded a partnership agreement on July 29, 2009. The 10 year deal allows both to maintain their search engine brands but search results on Yahoo will be labeled powered by Bing. Yahoo will be responsible for attracting advertisers. Microsoft will have the right to integrate Yahoo's search engine into its web platform while 88% of the revenue gained from searches on Yahoo's sites will be shared by Yahoo (Goldman, 2009). During the same period, Google has been working on a secret project called caffeine, a new version of its search engine which it claims to be faster and more relevant than the current one.

While internet users are expected to reach 1.9 billion unique users or 30% of the world's population by 2012 (International Data Corporation, 2008) and e-commerce is expected to be worth $13 trillion mostly from B2B transactions by 2012 (eMarket Services, 2009), the World Wide Web (WWW) is undoubtedly full of both opportunities and threats for participating firms. A recent

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study conducted by the Pew Internet Project in the United States shows that on a typical day, about 60% of users use a search engine while 49% use e-mail. These two are ranked first and second accordingly as the most popular online activities (Kincaid, 2008).

Unsurprisingly, the competition has to focus on these services, since the number of visitors draws advertisers money and advertising is a major source of firms revenues and profits.

Search engine: Archie, a pre-web search application created in 1990 has been credited as the first internet search engine. Based on the Internet File Transfer Protocol (FTP) standard, Archie used similar modern web search engine architecture such as crawling sources, building indexes and providing a search interface (Battelle, 2005). The search interface, however was not user-friendly and was only used by techies and academics. By 1992, over 200 public FTP sites had been cataloged by Archie (Wall, 2007). In 1993, Veronica was created with the improvement of allowing searchers to connect directly to the document for which they were searching (Battelle, 2005).

Also in 1993, Matthew Gray a researcher at the Massachusetts Institute of Technology created the WWW wanderer which was a pioneer of the early web-based search engines. The WWW wanderer was the first to use robots to index sites and provide users with a search interface that allowed them to search the index (Battelle, 2005). The Wanderer eventually gave way to other powerful search engines that emerged in the 1990s such as Excite which was released to the public in mid 1993. Created by two Ph.D. candidates from Stanford University, David Filo and Jerry Yang, Yahoo was launched in 1994.

The Internet boom of the 1990s also saw the growth of search engines. Lycos was also introduced in 1994 by Dr. Michael Mauldin from Carnegie Mellon University. Lycos used the technology of indexing the web through spiderlike crawlers but with more sophisticated mathematical algorithms. Lycos was the first to use links to web sites on the basis of relevance, the underlying concept used by Google (Battelle, 2005). AltaVista was introduced to the market in 1995 and by 1996, it became the most-loved brand and arguably the best brand on the internet.

Such was its success that on its first day, AltaVista generated 300,000 hits and within its first year of operation, >4 billion queries had been served. America Online (AOL) also joined the race for supremacy in the search market in 1995 (Battelle, 2005). Google and Live Search, the two current super powers of searching were
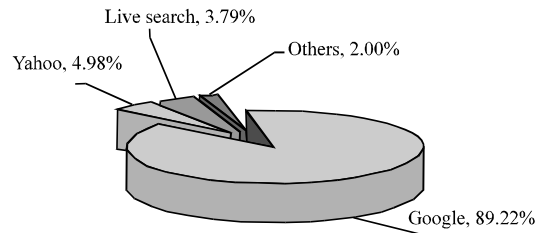

Fig. 1: Global market shares of search engines

born in 1998. With an initial investment of $1 million, Google was created by two Stanford University graduate students, Larry Page and Sergey Brin (Google, 2009). Although the network of MSN Internet services debuted in the United States in 1995, the search capabilities through its website was offered in the United States and in 22 different countries in 1998.

The trends in search technologies and search engines have changed over different periods in time. Specifically in 1997, AltaVista was regarded as the king of search engines as it served >25 million queries a day and was on track to generating $50 million in sponsorship revenue. It was in a three-way heat with Yahoo and AOL as the dominant search engine on the Internet. In 1999, for a short period, Lycos was the most popular (Battelle, 2005). Currently, Google leads the global market share at 89.22% followed by Yahoo at 4.98% and Live Search at 3.79% as shown in Fig. 1.

Web-based email: Email existed even before the introduction of the Advanced Research Project Agency Network (ARPANet) or the Internet. Ray Tomlinson has been credited as the inventor of modern day email systems when in 1972, he chose the @ symbol on the keyboard to denote the sending of messages from one computer to another. Eudora, developed by Steve Dorner in 1988 has been described as the first really good commercial email system. The email market next saw the introduction of an email system known as Pegasus (Peter, 2004).

Hotmail was founded by Jack Smith and Sabeer Bhatia in 1995 and was launched commercially on July 4, 1996. Hotmail was acquired by Microsoft in January 1998 in a reported deal worth nearly $400 million. Microsoft claimed that Hotmail had the ability to allow users to access their inbox from anywhere in the world. In December 1998, Microsoft announced that Hotmail was being used by 30 million users with the number increasing to 100 million in May 2001 (Computer Hope, 2009). Yahoo mail was launched by Yahoo Inc. in October 1997. Yahoo
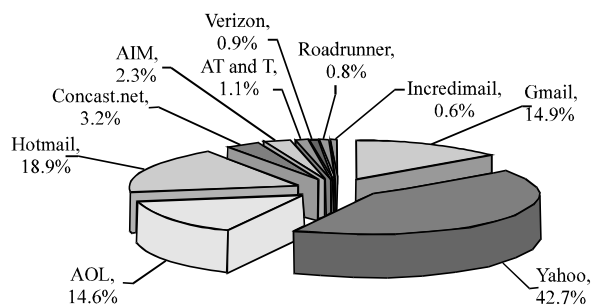
Fig. 2: Global market shares for web-based email

Fig. 3: Market share for search engines in Thailand (TrueHits, 2009)

mail also a free email service was created based on the RocketMail technology of Four11. The same day on which Yahoo announced its launch of Yahoo mail, it also announced the takeover of Four11, the creators of Rocket mail (Yahoo, 1997).

Google eventually entered the market by launching Gmail on April 1, 2004 (Graham, 2008). Gmail's differentiation was the free webmail service with the largest amount of storage capacity of 1 gigabyte. Currently, Yahoo leads the way with the global market share for web-based email at 42.7% followed by Hotmail at 18.9% and Gmail at 14.9% as shown in Fig. 2.

Internet market in Thailand: There are currently approximately 13.4 million internet users in Thailand or 20.5% of the total population. The three most common activities performed online by Thai users are searching for information (31.4%), sending and receiving email (23.0%), and playing online games (10.3%) (NECTEC, 2008). Thailand's search engine market share is different from the global trends. As of July 2009, the market is dominated by Google with a 97.65% market share followed by Sanook, a Thai web portal with a 1.18% market share followed by Live Search at 0.69% as shown in Fig. 3. Sansarn, Siamguru and Sanook are Thailand's versions of search sites but their popularity has decreased over the past few years. In 2003 at their peak, Siamguru and Sansarn held 1.92 and 3.96% market shares, respectively (TrueHits, 2009).

The current trend towards alliances and mergers has an important business implication. The question is not whether there is a relationship between WWW dominance and potential profits but rather how to achieve and sustain the dominance. The success of a given search engine and web-based email could be the result of various factors such as the firms strategies or features. For example, Microsoft's strategy is to embed its search capabilities into its browser, Internet Explorer and to integrate its chat program, Windows Live Messenger into its web-based email service, Hotmail. This strategy is also
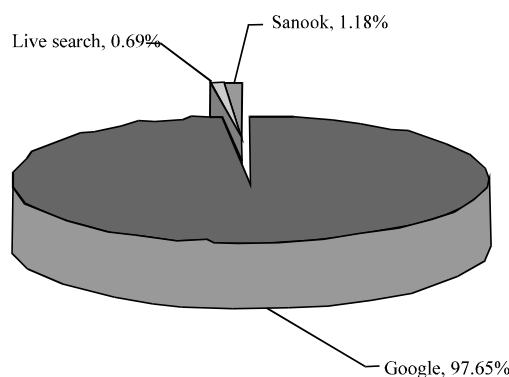
shared by Google and its Gmail and Google talk integration and Yahoo with Yahoo mail and Yahoo Messenger. In terms of features, Google's claim is its highly relevant search results and retrieval speed. Network externalities could also explain the firm's sustained success.

Network externalities: The topic of network externalities has been studied for almost two decades but has received more attention recently because many high-technology products seem to exhibit some form of network externality. A product creates direct network externalities when the utility that an agent derives from consuming the product increases with the number of other agents consuming the same product. When a market exhibits network externalities, winner takes all or winner takes most is usually the consequence. The following considerations explain why search engines and web based email may exhibit network externalities.

Firstly, the influence of friends could be a source of network externalities (Goolsbee and Klenow, 1999). An Internet novice may choose a particular search engine or web-based email because his/her friend is an experienced user and has a useful level of knowledge about the particular search engine or web-based email. As a result, this friend provides a recommendation and/or assistance. A similar concept was proposed by Berndt *et al.* (1999) specifically with respect to the recommendation of antiulcer drugs by other patients.

Secondly, friends or colleagues could influence the adoption decision through Word of Mouth (WOM). This distribution of product information relies on social influence which is used synonymously with the term viral marketing and WOM (Ermecke *et al.*, 2009). WOM can be defined as informal, person-to-person communication between a perceived non-commercial communicator and a receiver regarding a brand, a product, an organization or

a service (Harrison-Walker, 2001). Consequently, a person may not be accepted or belong in the same group if the person does not use the same service as his/her friends.

Thirdly, conventional wisdom states that once a consumer adopts a product, he/she is reluctant to switch to another competing product thus creating a lock-in effect (Dube *et al.*, 2009). This is especially true for web-based email. Once a user adopts a particular web-based email, there is a high switching cost especially the time and effort required to register for the new web-based email and inform others of the change in email address.

Fourthly, the most popular search engine and web-based email is likely to be readily available or allow easier access to at schools, universities, libraries and workplaces similar to the default browser (Cusumano and Yoffie, 1998). This could be the case because schools, universities and workplaces set the particular search engine or web-based email as the default page, once the browser has been activated.

Fifthly, the search engine and the web-based email that is the market leader could be perceived by users as having a superior image or reputation. The features may or may not be superior but it is the perception that matters. This perception draws users to adopt a certain product. Katz and Shapiro (1985) refer to this as the bandwagon effect.

Previous empirical studies conducted on network externalities can be characterized as follows according to the sources of network externalities: network size, compatibility and the influence of others. The study of network size focuses on the relationship between the adoption decision of current users and the size. McAndrews and Kauffman (1993) studied banks decisions to join Automated Teller Machine (ATM) networks.

Saloner and Shepard (1995) concluded that bank adoption rates of ATMs depend on the number of bank branches. Gowrisankaran and Stavins (1999) focused on bank adoption of Automated Clearinghouse (ACH) electronic systems. Iimi (2005) studied consumer adoption decisions of cellular phone carriers in Japan and recently, Weber (2006) investigated brokerage firm adoption of the International Securities Exchange (ISE) trading platform.

Compatibility exists when a purchase decision in favor of a network good depends on whether the product is compatible with other existing products. Examples of relevant research include Greenstein (1993) who studied federal agency acquisition of mainframe computer systems from vendors in the 1970s. Gandal (1994, 1995)

concluded that consumers Willingness To Pay (WTP) depends on the compatibility of the spreadsheet and database management software while consumers WTP depends on the compatibility of the spreadsheet software as also studied by Brynjolfsson and Kemerer (1996).

The influence of others exists when an individual's adoption decision depends on influence by family, neighbors, friends or experts. Berndt *et al.* (1999) concluded that an individual's WTP for antiulcer drugs is affected by other patients and physicians influence on the drug's acceptability while the diffusion of home computers based on the spillover effects in the local area was studied by Goolsbee and Klenow (1999).

Instead of focusing on observable variables such as price and quantity, other researchers have studied consumer motives in purchasing or adopting a product. These studies on the existence of network externalities rely on consumer survey data. Capello (1994) compared the effects of network externalities on the Special Telecommunications Action for Regional Development (STAR) program in Southern Italy and in the more highly developed Northern Italy. The STAR program was initiated with the objective of developing advanced telecommunication technologies in less developed regions of the European Community. A sample of 70 small and medium-sized firms from different sectors were interviewed, half of them from Southern Italy and half from Northern Italy. Other examples include Mahler and Rogers (1999) who studied the adoption decisions by banks of 12 telecommunication services based on survey data from 392 German banks and Chiaravutthi (2006) who studied how network externalities and firms' strategies affect consumers' adoption choices between Microsoft's Internet Explorer and Netscape's Navigator.

MATERIALS AND METHODS

Survey data can be used to test network effects more directly by studying the reasons given for adoption. For this study, a questionnaire was designed in order to gather exploratory data on user adoption of search engines and web-based emails and to test for the existence of network externalities. The questionnaire was pre-tested and adjusted which led to the final version used in this study. The questionnaire was divided into three parts of which the first asked the respondents questions about their choice of primary search engine and reasons for selecting it. The second part asked questions about the choice of primary web-based email and the reasons for their particular choice. Demographic data was collected in the third part of the questionnaire. The data

Table 1: Variables and explanations for search engines

Variables	Explanation
P_Google	Selected Google as the primary search engine = 1, others = 0
P_Live	Selected live search as the primary search engine = 1, others = 0
P_Yahoo	Selected Yahoo as the primary search engine = 1, others = 0
SwitchGoogle	Switched to Google as the primary search engine
(P) Others_SE	Using the (primary) search engine because others are using it
(P) Recommend_SE	Using the (primary) search engine because of recommendations by 1) friends and 2) Internet experts
(P) Feature_SE	Using the (primary) search engine because of characteristics that include 1) ease of use 2) relevant search results 3) fast retrieval of results and 4) size of search database
(P) Thai_SE	Using the (primary) search engine because it is available in Thai language
(P) Link_SE	Using the (primary) search engine because it is linked from 1) the browser and 2) already using search engine's related pages/services
(P) Ad_SE	Using the (primary) search engine because 1) saw in advertisement and 2) linked from other websites
(P) Reputation_SE	Using the (primary) search engine because of its reputation
Default_SE	Default search engine used
Often	The frequency of using the Internet. Once in a while = 1, every month = 2, every 2 weeks = 3, every week = 4, twice a week = 5, 3-6 times a week = 6, everyday = 7
Education	Using the search engine for educational purposes = 1, other reasons = 0
Hour	Hours per week on the Internet. 0-1 h = 1, 2-4 h = 2, 5-6 h = 3, 7-9 h = 4, 10-20 h = 5, 21-40 h = 6, over 40 h = 7
Usage	The length of usage in years. 0-1 year = 1, 2-3 years = 2, 4-6 years = 3, 7-10 years = 4, over 10 years = 5
IE	Using Internet Explorer as the default browser = 1, others = 0
Male	Male = 1, Female = 0
Age	Age of the user. 18-20 = 1, 21-23 = 2, above 23 = 3
High speed	Using high speed Internet to access the Internet = 1, others = 0
Bangkok	Currently living in Bangkok = 1, others = 0
TU	Student at TU = 1, MUIC = 0

Table 2: Variables and explanations for web-based email*

Variables	Explanation
P_Hotmail	Selected Hotmail as the primary web-based email = 1, others = 0
P_Gmail	Selected Gmail as the primary web-based email = 1, others = 0
P_Yahoo	Selected Yahoo Mail as the primary web-based email = 1, others = 0
(P) Others_EM	Using the (primary) web-based email because others are using it
(P) Recommend_EM	Using the (primary) web-based email because of recommendations by 1) friends and 2) Internet experts
(P) Feature_EM	Using the (primary) web-based email because of characteristics that include 1) fast retrieval of email 2) large storage capacity and 3) effective virus detection for file attachments
(P) Thai_EM	Using the (primary) web-based email because it is available in Thai language
(P) Ad_EM	Using the (primary) web-based email because 1) saw from advertisement and 2) linked from other websites
(P) Reputation_EM	Using the (primary) web-based email because of its reputation
(P) Chat_EM	Using the (primary) web-based email because it has a built-in chat program
PRelated_EM	Using the primary web based emails related pages/services
Default_EM	Default web-based email used
Search_EM	Using services provided by the search engine
SwitchHotmail	Switched to Hotmail as the primary web-based email

*The demographic variables used in Table 2 are the same as those shown in Table 1

was collected during May and June of 2009. Four faculty members were trained to administer the questionnaire to 449 students at Mahidol University (MU) and Thammasat University (TU). These are two leading universities in Thailand and both have a good reputation. The sample used in the study was mostly convenience sampling for which students were approached randomly.

There is no way of knowing whether the respondents represent the overall population but the survey is expected to yield meaningful insights and a useful initial perspective of whether network externalities exist in the selection of primary search engines and web-based emails. Some questionnaires were not completed by respondents, resulting in 384 and 385 samples for search engines and web-based email, respectively. Acronyms and their explanations for search engines are shown in Table 1 while Table 2 shows the acronyms and

explanations of web-based email selection. The descriptive statistics for the variables are shown in Table 3 and 4. The results of the survey show that 95.7% of the sample selected Google as their primary search engine. This number is very close to the 97.65% market share for Google in Thailand while Google leads the global market share at 89.22%.

Although, the Thai market share has Sanook as second at 1.18%, none of the users in this survey selects Sanook as their primary search engine. The results also show that 11.7% of users have switched to Google as their primary search engine. Unlike the global market share of web-based email, about 93% of the sample selected Hotmail as their primary web based email followed by Gmail at 5.2% and Yahoo mail at 1.4%, respectively. Interestingly, 8.8% of the respondents have switched to Hotmail as their primary web-based email.

Table 3: Descriptive statistics of variables for search engines

Variables	Mean	SD
P_Google	0.957	0.023
P_Live	0.203	0.149
P_Yahoo	0.007	0.082
SwitchGoogle	0.117	0.322
Pothers_SE	0.135	0.342
PRecommend_SE	0.114	0.318
PFeature_SE	0.964	0.187
PThai_SE	0.246	0.431
PLink_SE	0.137	0.345
PAd_SE	0.127	0.333
PReputation_SE	0.402	0.491
Default_SE	0.018	0.134
Often	6.413	1.022
Education	0.869	0.338
Hour	4.625	1.714
Usage	3.962	0.774
IE	0.826	0.380
Male	0.422	0.504
Age	1.454	0.574
High speed	0.964	0.199
Bangkok	0.804	0.398
TU	0.323	0.468

* Descriptive statistics are presented for primary choice only

Table 4: Descriptive statistics of variables for web-based email

Variables	Mean	SD
P_Hotmail	0.930	0.255
P_Gmail	0.052	0.222
P_Yahoo	0.014	0.116
POthers_EM	0.697	0.460
PRecommend_EM	0.326	0.470
PFeature_EM	0.565	0.496
PThai_EM	0.052	0.222
PAd_EM	0.060	0.237
PReputation_EM	0.223	0.417
PChat_EM	0.536	0.499
PRelated_EM	0.031	0.174
Default_EM	0.054	0.227
Search_EM	0.036	0.187
Switch Hotmail	0.088	0.284

*Descriptive statistics are presented for primary choice only

Research questions and model specification: The following research questions are proposed, since there are reasons to believe that there are indeed network externalities in the search engine and web-based email market.

RQ1: Whether or not there are network externalities with respect to the market leader in the search engine and web-based email market. Sources of network externalities will also be explored.

RQ2: What factors persuade users to adopt a particular search engine and web-based email and what are the reasons that users switch from an existing search engine and web-based email to the current one?

There could be many reasons why users adopt a certain search engine and web-based email. It could be because of specific technical such as ease and simplicity of usage, fast accessibility, relevant results, size of the search database, large storage capacity for emails and effective virus detection for file attachments. Reputation could also play an important role in attracting users.

With network externalities, an increase in the number of users represents a higher value for a network good. As stated earlier, there are several reasons why search engines and web-based email may exhibit such externalities. The value of a search engine or a web-based email increases if users can also use these services at schools, universities or workplaces which means that external accessibility can be a source of network externalities. The influence of friends, the word of mouth effect and recommendations by friends, colleagues or family members could also be another source. Since the network industry usually results in a situation of winner takes all or winner takes most firms in the network industry compete intensely for market leadership. As a result if the market leader's position shifts from one product to another network externalities are expected to shift accordingly.

Consumers maximize satisfaction subject to resource limitations when they decide to adopt or use a particular product or service. Benefits derived from product attributes or even network externalities, determine the satisfaction obtained from adoption. Based on the objective of maximizing utility, an individual makes his/her search engine and web-based email decision (called Y_i) and the following binary logit model is thus proposed:

$$\text{Probability } (Y_i = j) = \beta_j x_{ij}^{\ b} + y_j x_{ij}^{\ d} + u_{ij} \qquad (1)$$

for each respondent i who selects a particular primary search engine or web-based email choice j. $x_{ij}^{\ b}$ represents reasons for individual differences in selecting a search engine and web-based email. $x_{ij}^{\ d}$ include individual differences in basic demographics and Internet usage. There are many search engine and web-based email services that consumers can choose to adopt. However, this study focuses only on those with the top three market shares for search engines namely Google, Live Search and Yahoo and for web-based email, Yahoo mail, Hotmail and Gmail since they control most of the market. In the category of $x_{ij}^{\ b}$, there are seven different stated reasons for choosing a particular search engine which are using the search engine because others are using it, recommendations by friends or internet experts, features which include ease of use, relevant search results, fast retrieval of results and size of search database, availability in Thai language, linkage from the browser, advertisements or linkage from other websites and reputation of the search engine. The first and second reasons capture network externality effects. Similar

reasons apply to the selection of web-based email with one addition being that users are already using other services related to the web-based email. The additional reason arises because web-based email mostly has other integrated programs that attract users such as the various chat programs.

x_{ij}^d are divided into basic demographics and internet usage variables. Basic demographics include age, gender, city of residency and university enrolled at. Internet usage is measured in terms of knowledge of the internet proxied by hour(s) of usage per week, year(s) of internet experience and frequency of use. Other variables in this category include the purpose of searching, the speed of the internet service and the particular browser connected to the internet.

In order to be more precise in testing the existence of network externalities in the search engine and web-based email market, the dependent variable can be replaced by switching to a particular search engine or web-based email dummy. The assumption is that users have full information about the market share of these services. Therefore, if there are network effects, an individual will switch to the service with a dominant market share provided that he or she is not currently using the market leader. Equation 2 is adjusted from Eq. 1 with the same right hand variables. In Eq. 2, $Y_i = 1$ means switching to Google and $Y_i = 0$ means the converse. The same equation was used for the switch to Hotmail where $Y_i = 1$ means switching to Hotmail and $Y_i = 0$ means otherwise. The test includes only those who actually switched their search engine or web-based email services. Those who originally adopted a particular service and never switched the primary service are excluded. The binary logit model for capturing the switching effect is shown in Eq. 2:

$$\text{Probability } (Y_i = 1) = \beta x_i^{\,b} + y x_i^{\,d} + u_i \qquad (2)$$

RESULTS AND DISCUSSION

The results of Eq. 1 are shown in Table 5. The outcome of the binary logit model shows that network externalities do not exist in the selection of search engine. The variable POthers_SE is not significant which means that Google's existing users do not take others choices into consideration. The PRecommend-SE variable is also not statistically significant, implying that Google users are not influenced by friends, colleagues or even family members. As a result, WOM recommendations are not a source of network externalities for search engines.

The two major reasons that Google is chosen are its features and reputation. It is fair to assume that Google has better features such as the speed of retrieving

Table 5: Binary logit model for selecting Google as the primary search engine

Variables	PGoogle	PGoogle
POthers_SE	0.398	0.382
	(0.455)	(0.462)
PRecommend_SE	-0.839	-0.734
	(-1.091)	(-1.026)
PFeature_SE	2.177***	1.718***
	(2.716)	(2.320)
PThai_SE	0.032	0.224
	(0.047)	(0.336)
PLink_SE	0.913	0.814
	(0.811)	(0.766)
PAd_SE	-0.360	-0.243
	(-0.423)	(-0.307)
PReputation_SE	1.723***	1.584***
	(2.175)	(2.066)
Often	0.033	-
	(0.127)	
Education	0.715	-
	(0.940)	
Hour	0.057	-
	(0.375)	
Usage	0.204	-
	(0.611)	
IE	-0.134	-
	(-0.173)	
Male	-0.451	-
	(-0.786)	
Age	-0.187	-
	(-0.322)	
High speed	2.408***	-
	(2.470)	
Bangkok	-0.219	-
	(0.300)	
TU	-0.144	-
	(0.207)	

N = 384. Numbers in parentheses are t-statistics. *** p<0.05. ** p< 0.10 * p<0.15

information as evident by the time displayed (usually in seconds) compared to the search results for other search engines. Reputation could be established through various means such as superiority of the service quality itself, advertising, public relations or other marketing campaigns. As for the demographic and internet usage characteristics, only the use of high speed Internet is statistically significant. It seems that those who have access to broadband services are more likely to use Google as their primary search engine. This variable can in fact be a good proxy for distinguishing between heavy and light users. Gender, age and city of residence are not determinant factors in this model.

There are no network externalities associated with Google, the clear market leader. The reason that Google is dominant in the search engine market is because it provides better features than its competitors and has a better reputation among users. Table 6 shows the results of Eq. 2 which is an attempt to identify the reasons why search engine users switch to Google as their primary service. Although, no variable is significant at the 0.10 significant level, the Recommend_SE has p = 0.139.

Table 6: Binary logit model for switching to Google

Variables	SwitchGoogle
Default_SE	39.709
	(0.000)
Others_SE	-0.762
	(-0.560)
Recommend_SE	2.010*
	(1.478)
Link_SE	41.551
	(0.000)
Ad_SE	40.243
	(0.000)
Reputation_SE	-1.904
	(-0.197)
Thai_SE	-0.293
	(-0.197)

N = 56; Numbers in parentheses are t-statistics. ***$p<0.05$. ** $p<0.10$ *$p<0.15$

This implies that Yahoo and Live Search users were influenced by their friends or colleagues in making the switching decision. Google is clearly benefiting from the WOM effect.

The above results shed some light on the sequence of adopting and switching to Google or as to why Google is currently the market leader. Google was launched with superior features, probably in terms of its simplicity, relevancy and speed of search results. A strong reputation then developed.

These are the two most important reasons affecting user adoption decisions. In addition, those who were relying on Yahoo or Live Search, switched to Google because of social influences.

The results of the binary logit model shown in Table 7 show that the only web-based email that exhibits traits of direct network externalities is Hotmail because POthers_EM is statistically significant. This means that users choose Hotmail as the primary web-based email because others are also using it. Recommendation by others is not a source of network externalities for web-based email.

The fact that Hotmail has a built-in chat program is also another reason why users choose the service. The case is strengthened by the results shown in Table 8, which shows that the reason users switch from Yahoo mail or Gmail to Hotmail is because it has a built-in chat service. Though the model does not test the existence of network externalities in the chat service, it can reasonably be assumed that the users wish to use the same chat service as their friends or family.

Therefore, when a person is currently chatting in Windows Live Messenger, he or she is more likely to adopt Hotmail as well. As for the internet usage characteristic, only the use of high speed internet is able to explain the use of Hotmail. Browsers play no role in the selection process for the search engine or web-based email. Interestingly, even though Internet Explorer is the

Table 7: Binary logit model for selecting Hotmail, Gmail and Yahoo as the primary web-based email

Variables	PHotmail	PHotmail	PGmail	PYahoo
POthers_EM	1.224**	0.943*	-0.464	-1.271
	(1.894)	(1.593)	(-0.584)	(-1.091)
PRecommend_EM	0.463	0.542	-1.157	-0.845
	(0.592)	(0.767)	(-1.006)	(-0.603)
PFeature_EM	-0.576	-0.549	1.116	1.335
	(-0.834)	(-0.853)	(1.203)	(0.909)
PThai_EM	40.454	40.653	-35.303	-0.072
	(0.000)	(0.000)	(0.000)	(-0.039)
PAd_EM	-0.286	-0.802	-36.233	3.790***
	(-0.234)	(-0.069)	(0.000)	(2.514)
PReputation_EM	-0.841	-0.587	1.250*	1.819
	(-1.200)	(-0.897)	(1.517)	(1.307)
PChat_EM	1.090**	0.913*	-0.163	-35.120
	(1.699)	(1.507)	(-0.216)	(0.000)
PRelated_EM	-2.634***	-2.247***	3.497**	-32.148
	(-2.988)	(-2.798)	(3.471)	(0.000)
Hour	-0.234	-	-	-
	(-1.223)			
Usage	-0.452	-	-	-
	(-1.015)			
IE	0.881	-	-	-
	(1.240)			
Male	-0.033	-	-	-
	(-0.051)			
Age	-0.042	-	-	-
	(-0.074)			
High speed	2.528***	-	-	-
	(2.017)			
Bangkok	-0.352	-	-	-
	(-0.399)			
TU	0.366	-	-	-
	(0.437)			

N = 385. Numbers in parentheses are t-statistics. ***$p<0.05$. ** $p<0.10$ *$p<0.15$

Table 8: Binary logit model for switching to Hotmail

Variables	SwitchHotmail
Default_EM	-2.274
	(-1.096)
Others_EM	0.320
	(0.316)
Recommend_EM	-0.380
	(-0.447)
Ad_EM	1.367
	(0.967)
Reputation_EM	-0.911
	(-0.914)
Thai_EM	0.885
	(0.455)
Chat_EM	3.217***
	(2.593)
Search_EM	45.336
	(0.000)
Feature_EM	-1.244
	(-1.315)

N = 56. Numbers in parentheses are t-statistics. ***$p<0.05$. **$p<0.10$ *$p<0.15$

market leader for browsers at 66.97% as of September 2009 (Netmarketshare, 2009), it did not influence the user choices of other Microsoft services such as Live Search or Hotmail. Gmail and Yahoo mail do not exhibit any network externalities, since neither is the leader in the web-based email market. Users select Gmail because they

are already using other services provided by Gmail and because of its reputation. The selection of Gmail is consistent with the selection of Google with reputation playing an important role. Yahoo mail is selected because users have seen advertisements for Yahoo in other websites and links to it. It is observed that the demographic variables also yields a similar result.

CONCLUSION

Search engines reveal no sign of network externalities. It can be concluded that consumers decide to adopt a particular search engine because of its features and reputation. However, the research can also be interpreted as implying that better features could lead to an increase in the number of users because the more people who use the search engine, the more advertisers will be willing to pay. The increase in pay for ads will increase the relevancy of ads that show up with search results, hence providing better search results. Consequently, better search results raise the number of users which in turn establishes the reputation of the search engine. Therefore, features and reputation could serve as indirect sources of network externalities.

At first glance, the entry barrier seems to be low, since there are no network externalities. However, success depends on how effectively new firms can provide users with better features and quality and thus establish their reputation. Since its inception, the search engine industry has seen the demise of many popular search engines such as AltaVista or even Lycos which were once considered to be the dominant search providers. Currently, Google alone controls the top position as it also has a very strong positive brand image among users. The growth model and discrete-choice model have shown that new entrants must be aware that pure first mover advantage of early entrants has declined over time (Gandal, 2001). The challenge to new entrants is to provide better technology which facilitates better search results much like what Google did to overtake Lycos, Yahoo and Live Search. To survive in the search engine market, firms must continue to innovate and improve their services because in this market, the switching cost is very low and with no obvious signs of network externalities, users are very likely to switch for better features and quality.

The web-based email market by contrast, clearly shows that there are network externalities with respect to the market leader, Hotmail, while Gmail and Yahoo mail show no signs of network externalities. The trend established over the years seems to be the linkage between services which complement each other. Although Google has also implemented this strategy with the integration of Google talk with Gmail and Yahoo has

with Yahoo Mail and Yahoo Messenger; Hotmail seems to be the best established. The results of the present study show that users are willing to switch to Hotmail because of its integrated chat program, Windows Live Messenger. It is also interesting to note that dominant as Internet Explorer is in the browser market, it plays no role in user decisions to adopt Live Search or Hotmail.

Besides integrating search, email and chat services, these firms are also providing a host of other integrated services to their users. For example, Google provides other services such as Google scholar, Google groups, and Google docs. Yahoo provides services such as the weather forecast and news which makes Yahoo more of a portal while Microsoft provides news and maps services among others. Whether or not these services are determinants in drawing users and whether or not they exhibit direct or indirect traits in terms of network externalities, is an issue for further studies. The main limitation of this study, therefore is that these services are not considered in measuring network externalities and adoption.

Although, it may be possible for new entrants to enter the market, breaking the dominance of Google and Hotmail constitutes a very substantial challenge. Currently, Google is the clear winner in the search engine market and Microsoft in the web-based email market. However for the WWW, there is no clear winner yet. Only time will tell whether the partnership between Microsoft and Yahoo will swing the balance of power in Microsoft's direction.

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