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Ownership of Computer and its Usage at Home: A Case in Malaysia

Yiing Jia LOKE*
Universiti Sains Malaysia
Email: yjloke@usm.my

and

Ching Szu FOO
Email:foochingszu@yahoo.com

Abstract

The multi-functionality of computer and the increased accessibility of Internet have created a demand for computers at home which previously was concentrated in offices. Using the Heckman two-step model and by combining socio-economic factors and insights from Becker's (1965) theory on allocation of time in the household with information system theories, it is found that: i) the household allocation of resources, ii) age and gender and iii) household social environment are significant in determining computer purchase decision and its extent of usage in households. Responses collected from 500 computer users are used in the study.

Unlike most household technologies, the results also suggest that despite the multi-functionality of computer, it is perceived as a technology that facilitates the consumption process more than the production process.

Keywords: household computer ownership, household technology, household allocation of time
JEL Categories: D12, D13, O33

* Corresponding author.

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Introduction

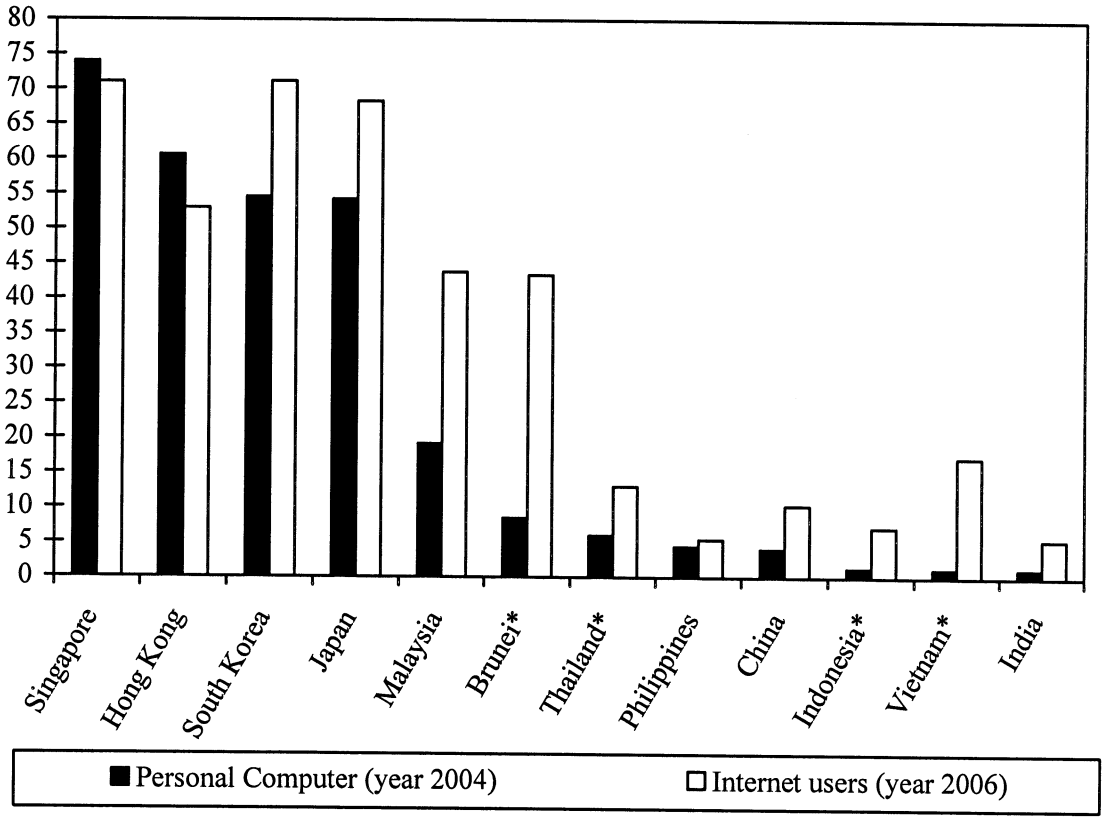
Early studies on the diffusion of computer and its usage have largely focused on its use at the work place (*see*, Davis, 1989; Davis and et al., 1989; Adams and et al., 1992). However, the widespread use of computer for work and the increased accessibility of Internet have transformed work culture, making it possible for many to work remotely from home. Besides using computer for work related activities, the multi-functionality of a computer enables user to derive pleasure from its entertainment features. Thus, these factors have created a demand for computers at home, which, previously was concentrated in offices. Consequently, this may alter the allocation of time and activities in the households.

Prior to the presence of computers at home, technology have long penetrated into households in the forms of household appliances (washing machines, microwave ovens, blenders and etc.), entertainment oriented products (television, stereo and etc.) and transportation and communication devices (automobiles, telephones and etc.). These various forms of household technologies are viewed as facilitator of the production and consumption processes in a household with different levels of efficiency (Venkatesh, 1998). An example of a household technology that contributes to the production process would be a microwave oven that helps in the meal preparation while television is related to consumption activities in a household. In the past two decades, households have gradually become more dependent on technology. This is obvious, as generally, an average income household has a washing machine, a refrigerator, a telephone and a television. However, according to Venkatesh (1995), most household technologies are geared towards the production process than the consumption process. So, what role does a computer play in a household?

In recent years, Venkatesh et al., (2000), Venkatesh and Brown (2001), Cummings and Kraut (2002), Ono and Zavodny (2004), Venkatesh and Shih (2006) are among the few who have

examined the adoption and usage of computers in homes. Extending from these analyses, Ono (2005) and Venkatesh and Shih (2006) compare the digital divides among households of various countries. As all these studies are done in countries such as the USA, Sweden, India, Japan, South Korea and Singapore where personal computer (PC) ownership is above 50% of the total population in 2004, these studies have gone beyond the analysis on computer ownership and have instead emphasize on the diffusion and type of computer usage in the households.

Figure 1: Personal Computer and Internet users per 100 persons in selected countries in Asia.



* Due to unavailability of data for internet penetration for year 2006, the data from the year 2005 is used.

Source: http://millenniumindicators.un.org/unsd/mdg/Data.aspx and data for Singapore is taken from http://www.ida.gov.sg

Figure 1, compares the computer[1] and internet penetration rates per 100 people for selected countries in Asia for the year 2004 and 2006 respectively. Apart from Singapore, Hong Kong, South Korea and Japan, there are many other countries in Asia which are still lagging behind in terms of ICT(information, communication and technology) developments (*see*, Figure 1). Hence, the existing studies on computer usage in households, which were mainly conducted in advanced ICT developed countries may not apply to the countries which are still trying to increase their computer and Internet penetration rates.

As the gap between Malaysia's computer and Internet penetration rate and the less ICT developed countries is closer, the Malaysian experience would bode better with these countries than the advanced ICT countries' experience. Hence, in the effort to develop a knowledge society, the government from the less developed ICT countries in South East Asia such as Philippines, Indonesia and Thailand may be able to draw lessons from the analysis on computer ownership in Malaysia. Further, the analysis on the usage of computer in Malaysian homes may be able to give a better description on the role of computer in a less developed ICT country's household.

In 2006, it is found that 28.2% of the total household in Malaysia has access to personal computer (*see*, MCMC, 2007). The government has undertaken many initiatives to increase the country's computer penetration rate[2]. In the 9th Malaysia Plan (2006-2010), the government aims to increase computer penetration rate to 40% by the end of the 2010. The existing "One Home One Computer" campaign will be intensified to target first time buyers and low-income earners to ensure higher adoption rate.

[1] From 2005 onwards, computer penetration rate ceased to be one of the ICT indicators in the Millennium Development Goals. Instead, internet penetration rates are used. Hence, no data is available for 2005 onwards.
[2] For example, in the year 2003, the government launched the "One home one computer" campaign where EPF (Employee Provident Fund – a pension fund) contributors are allowed to withdraw money to purchase a personal computer. Further, tax rebates up to RM3000 is allowed for purchase of personal computers.

Existing studies on computer ownership and its usage at home draw extensively from the Information System theories[3] and economic insights are often overlooked particularly the relationship between the dynamics of the household structure on computer ownership and usage at home . In this paper, socio-economic dimensions and economic insights from Becker's (1965) theory on allocation of time in the household are added into the analysis on computer ownership and the time spent on computer at home. Further, unlike Ono (2005) who used two logistic regressions models to study the ownership and usage of computers in Japan, Korea and Singapore, the decision to own a computer in this paper, is differentiated from hours spent on computer a week by using the Heckman two-step procedure (Heckman, 1979) which is a theoretically less restrictive two stage decision model. Lastly, this paper only takes into account the purchase decision made by computer users as it is of the interest of the study to understand the factors that determine computer users to own a computer at home instead of using it at their workplace, cyber cafes or other places.

Model Development

The selection of variables that determine computer ownership at homes and hours spent on computer a week at homes are drawn from past studies by Venkatesh, V. and Shih, (2005), Ono (2005), Ono and Zavodny (2004), Shih and Venkatesh, A., (2004), Ono and Madeline (2003), Papadakis (2001), Venkatesh, V. and Brown (2001), Venkatesh, A. et al. (2000) and Venkatesh, A. (1985). The variables can be broadly divided into four categories: a) Socio-economic and demographic, b) Household social environment, c) Utilitarian outcomes and d) Personal dimension.

A. Socio-economic and demographic variables

Age, gender, income and education constitute the socio-demographic and economic variables that are used in this paper to investigate the effects of these variables on computer ownership and the

[3] This includes theories such as technology acceptance model, diffusion of innovations and unified theory of acceptance and use of technology.

hours spent on computer a week at home. Cutler et al. (2003), Comber et al. (1997), Pope-Davis and Twing (1991) and Loyd and Gressard (1984) are among those who have specifically investigated the significance of age differences on computer ownership, usage and attitudes. While Cutler et al. (2003), Comber et al. (1997) and Pope-Davis and Twing (1991), found that age differences matter in terms of computer usage and attitudes, the earlier studies such as by Loyd and Gressard (1984) did not find a clear age trend in computer attitudes. On the other hand, Ono and Madeline (2003) found that home computer ownership is heavily concentrated in households with "prime age" head of households.

Ono and Zavodny (2004), Losh(2003), Papadakis (2001), Hammett (1997), Whitley, (1997) and Comber et al., (1997) are amongst some who have found significant gender gaps in computer ownership and usage. These findings seem to lend support to the gender stereotype that males have greater interest in technology and are more comfortable in using technological gadgets.

Unlike some of the technological household appliances and gadgets such as the washing machine and television which are considered almost as a necessary item in a modern household, computer does not fall into such category. As a result, the decision to purchase a computer can add further pressure on the household's budget. Hence, studies such as Chin and Fairlie (2004), Ono and Madeline (2004), Dutton et al. (1983) and McQuarrie and Langmeyer (1987) found that computer owners are predominantly affluent. While income is expected to affect computer ownership, it is not expected to affect its usage at home. Hence, the income variable is not included in the model on the hours spent using the computer at home.

The operation of typical household technological products usually do not go beyond "switching off and on" the products, while to fully utilize the functions of computer, a user requires more skill than pressing the "off and on" buttons (Venkatesh, 1985). Further, as computer is operated using computer language such as Java, C++ and etc. or written language such as English, French and etc., a certain level of literacy is required. As such, education level

will have an effect on the receptiveness of an individual towards acquiring computer skill and appreciating computer technology. Dickerson and Gentry (1983) and McQuarrie and Langmeyer (1987) are amongst those who found that computer owners have higher education level than non-computer owners.

B. Household Social Environment

In Shih and Venkatesh (2004)'s "Use-Diffusion" model in the context of home technology use, household social environment is one of the components in the model. This component is incorporated in this study on the adoption and use of computer at home. The household social environment in terms of ownership of computer consists of three variables: i) the number of computer users in the household, ii) the level of computer knowledge of the household and iii) the number of technological products owned by the household. In short, the household social variables give a description on the technological sophistication of the household and household's prior experience with technology. This would affect the viability of owning a computer at home. In other words, the household social variables will affect the user's transaction utility (Thaler, 1985) of purchasing computer for home use.

The effect of household social variables on the hours spent using computer at home consists of four variables: i) the number of children at home, ii) the waking time spent at home, iii) the competition to use the computer and iv) the type of household social communication network. The number of children and waking hours spent at home will affect the allocation of time in the household and household activities. This indirectly will affect the number of hours a week a computer user gets to use the computer at home. The competition to use the computer is captured by a competition index that takes into account the number of computer users and number of computers in the household. If a computer is shared among a few users, this can reduce the hours that a computer user gets to spend on the computer a week at home. The intuition to these variables follows from the theory on allocation of time in household as postulated by Becker (1965). Further, as communication is central to usage behaviour (see,

Blonski, 1999; Wasserman and Faust, 1994), the frequency to which the household depends on computer as a communication tool can affect the time spent on computer.

C. Attitudinal Beliefs

The computer user's expectation and perception on computer can also play a role in the computer purchase decision and the amount of time spent on computer at home. Attitudinal beliefs are frequently incorporated in the studies on technology adoption-usage *(see*, Venkatesh and Brown, 2004; Venkatesh and Brown, 2001; Adams et al., 1992 and Davis, et al., 1989). The attitudinal beliefs components are: i) Utilitarian outcomes and ii) social outcomes.

Utilitarian outcomes in this paper are defined as the extent to which computer enhances the effectiveness of household activities and main computer activity conducted by the user. The latter indirectly, measures the greatest utility that a user derives from his use of computer. In this study, the variables that represent utilitarian outcomes in the computer ownership model are consist of: i)Efficient – the user's perception on whether computer will bring about efficiency in the household, ii) the user's main computer activity – whether it is mainly use for work related activities, online activities or for games and entertainment related activities. The main computer activity conducted by the user is the only variable to capture the role of utilitarian outcomes on the hours a week a computer user spends on the computer at home.

Social outcomes are defined as the extent to which the user believes his purchase decision will change the perception of others on his social status. In this paper, the social outcomes are captured by: i) perception of user that computer ownership reflects a higher social status and ii) perception of user that computer ownership reflects that he is technology savvy. For example, Haddon (1988) developed the idea that technologies acquired are used as a symbol of scientific and technological progress. Further, Habib and Cornford (2001) is in the opinion that as long as there are not many households that own a computer at home, computer ownership will still be seen as a symbol of higher social status.

D. Personal Dimension

Computer user's income and his personal opinion on whether the price of computer is value for money may have different effects on user's purchase decision. While level of income may directly constrain the user's budget, the relationship between the price worthiness of computer and user's budget is less direct. In other words, an item may not be affordable to an individual but the item may be considered as being priced reasonably according to its value. Hence, the user's personal opinion on the price worthiness of a computer is included in the purchase decision.

An aspect of personal dimension, which is considered in the model on the hours spent on the computer at home, is the level of the user's computer knowledge. Complex technology can frustrate the user and it may have an effect on the amount of time that a user spends on the product (Mick and Fournier, 1998 and Mukherjee and Hoyer, 2000). These studies argue that if it is too difficult for the user to fully utilize the product, this may cause frustrations, which would result in the product being used less frequently than originally intended.

Methodology: Model and Data

A. Model

As the hours spent on computer a week at home is only observed if there is a computer at home, this causes bias in sample selection. Therefore, a Heckman's two-step procedure is used (Heckman, 1979) to take the sample selectivity bias into account.

There are two stages to the model. In the first stage, a probit regression is conducted to estimate the probability that a given household owns a computer. The individual's decision is modeled as a dichotomous choice problem. The selection equation is expressed as follows:

$$L_i^* = \gamma' z_i + \mu_i \qquad (1)$$

where, $\mu_i \sim N(0, \sigma_u)$ and z_i is the vector of variables that affects L_i^*. L_i^* is not observable, but it can be observed if individual owns a computer or not at home in the way that:

$$L_i = 1 \text{ if } L_i^* > 0 \quad \text{and} \quad L_i = 0 \text{ if } L_i^* \leq 0$$

where, Li =1 if the individual owns a computer at home and L_i =0 if the individual does not own a computer at home. The first stage regression helps to determine whether an observation makes it into the sample, causing the sample to be non-random. To avoid bias, the estimation in second stage of regression must take into account the phenomenon of sample selection.

Hence, from (1), the inverse Mills ratio for each individual is obtained and then used as an instrument in the second stage regression on the length of computer usage at home. The inverse Mills ratio, λ_i, for every individual can be computed as:

$$\lambda_i = \frac{\phi(\alpha_u)}{\Phi(\alpha_u)} \qquad (2)$$

where, $\alpha_u = \frac{\gamma' z_i}{\sigma_\mu}$, ϕ and Φ are respectively, the normal density function and the normal distribution function.

Let W_i to represent the length of computer usage at home (hours a week), assuming that:

$$W_i = \beta' x_i + \varepsilon_i \qquad (3)$$

where, x_i is the vector of variables that determine hours of computer usage at home in a week and $\varepsilon_i \sim N(0, \sigma_\varepsilon)$. W_i is observed only when L_i =1, when the individual owns a computer at home, then

$$E(W_i | L_i = 1) = E(W_i | L_i^* > 0, x_i) = E(W_i | \mu_i > -\gamma' z_i)$$

$$= \beta' x_i + \beta_\lambda \lambda_i(\alpha_\mu) \qquad (4)$$

In the second stage, ordinary least square (OLS) is used to regress the observed W_i values in the x_i and the λ_i to obtain estimated values for parameters β' and β_λ. Table 1 defines the explanatory variables and gives the sample statistics.

B. Data

The data used in this study were collected from a survey, which was conducted, from January 2006 to March 2006 across the Penang Island in Malaysia. A total of 500 responses from computer users were randomly collected. The respondent must be a computer user aged 21 years old and above. The sample structure in terms of gender and age follows the Malaysian Population Census of 2000 closely. Penang island is chosen as the percentage of household that have access to PC (29.9%) in Penang is the closest to the country's average of 28.2% in 2004 (MCMC, 2007).

Of the 500 computer users interviewed, 81.8% (409) of them owned a computer at home. In a glance, it is found that the mean income, number of IT products at home and the number of computer users in the household are slightly lower for non-computer owners than for computer owners while the mean age for non-computer owners is slightly higher compared to the mean age of computer owners. Further, it is found that among the computer owners, the mean hours spent on using computer at home is 8.25 hours a week.

Table 1 gives the description of the variables selected and the sample statistics.

Table 1: Definition of Explanatory Variables and Sample Statistics

Explanatory Variables	Definition	Entire Sample (n=500)		Computer Owners (n_1=409)		Non-computer owners (n_2=91)	
		Mean	S.D	Mean	S.D	Mean	S.D
Socio-economic and demographic							
Age	The age of the respondent in years.	34.41	11.81	33.20	11.00	39.86	13.72
Gender	1 if Male; 0 if Female.	0.52	0.50	0.56	0.50	0.32	0.47
Education	1 if the respondent has a tertiary education; 0 if otherwise.	0.66	0.47	0.75	0.43	0.23	0.42
Income	The respondent's monthly income in Ringgit Malaysia.	3455	2633	3740	2673	2176	2011
Household social environment							
IT products	Number of IT products that the respondent possesses [4]	2.99	1.12	3.22	1.04	1.92	0.75
Household knowledge 1	1 if the highest level of computer knowledge in the household is at the advanced level; 0 if otherwise.	0.16	0.36	0.18	0.39	0.03	0.18
Household knowledge 2	1 if the highest level of computer knowledge in the household is at the intermediate level, 0 if otherwise. (*Omitted variable refers to the highest level of computer knowledge in the household is at the elementary level*)	0.68	0.46	0.77	0.42	0.31	0.46
Number of users	Number of people in the household who knows how to use computer including the respondent.	3.01	1.33	3.33	1.21	1.59	0.77
Waking hours	Waking hours spent at home	6.66	3.1	6.46	2.84	7.57	4.23
Children	Number of children in the household.	0.92	1.24	0.92	1.20	0.93	1.38
Competition index[5] (PH)	Degree of competition on computer usage. $PH = \frac{\text{Number of PCs at home}}{\text{Number of users at home}} + C$ where, C=1 if the respondent does not own a computer at home, C=0 if the respondent owns a computer at home.	0.53	0.28	0.422	0.2	1	0

[4] The eight IT products listed in the questionnaire are: i) Electronic organizer or handheld computer (PDA), ii) Facsimile machine, iii) Voice mail or answering machine, iv) Video or game console, v) DVD, DVIX or laser disk player, vi) Cable TV, vii) Video camera, viii) Digital camera (Venkatesh and Shih, 2006).

[5] If $PH \geq 1$, there exist no competition in the usage of computer. In the case of home computer owners, it indicates that the respondent has full monopoly over the usage of computer. For non-computer owners, as there is no competition in the usage of computer, the competition index does not mean anything. On the contrary, if PH <1, certain degree of competition for computer usage exist. The lower the PH, the higher the degree of competition for computer usage. Hence, a positive relationship between hours spend on computer per week and competition index (PH) is expected.

Communication 2	1 if the respondent never communicates with family and friends using computer, 0 if otherwise. (*Omitted variable refers to a respondent that occasionally communicates with friends and family using computer*)	0.21	0.018	0.11	0.015	0.66	0.05
Attitudinal beliefs							
Efficient	1 if the respondent agrees that compute will bring about efficiency for the household; 0 if otherwise.	0.69	0.021	0.77	0.021	0.35	0.05
Social Status	1 if the respondent feels that computer ownership reflects higher social status; 0 if otherwise.	0.47	0.022	0.51	0.025	0.55	0.05
IT status	1 if the respondent feels that computer ownership reflects that the individual is up to date with technology; 0 if otherwise.	0.78	0.019	0.83	0.019	0.28	0.05
Work	1 if the respondent uses the computer mainly for work related activities; 0 if otherwise.	0.72	0.02	0.71	0.02	0.75	0.46
Online	1 if the respondent uses the computer mainly for online activities; 0 if otherwise (*Omitted variable refers to the respondent that uses the computer mainly for games and entertainment activities*)	0.24	0.019	0.25	0.021	0.16	0.04
Personal dimension							
Value	1 if the respondent thinks that the price of computer is value for money, 0 if otherwise.	0.59	0.022	0.67	0.023	0.20	0.04
Personal computer knowledge 1	1 if the respondent grades his level of computer knowledge as advanced; 0 if otherwise.	0.22	0.019	0.27	0.022	0.02	0.02
Personal computer knowledge 2	1 if the respondent grades his level of computer knowledge as intermediate, 0 if otherwise. (*Omitted variable refers to the respondent that grades his level of computer knowledge as elementary*)	0.46	0.022	0.51	0.025	0.23	0.04
Hours a week	Hours a week spent on using computer at home	6.75	0.28	8.25	0.30	0	0

Estimation Results

Table 2 summarizes the estimation results for computer ownership (column 1), the hours spent on computer at home a week (column 2), marginal effects on the probability of computer ownership (column 3), marginal effects on the conditional expected hours of computer usage a week (column 4) and the marginal effects on the unconditional expected hours of computer usage a week (column 5).

A. Socio-economic and demographic variables

Of the four variables (age, gender, education and income) that represent the socio-economic and demographic variables in the ownership equation (column 1), only age and level of education are found to be significant in affecting computer user's purchase decision.

The negative relationship found between age and computer ownership complies with the studies by Cutler et al. (2003), Comber et al. (1997) and Pope-Davis and Twing (1991). Further, the results on the relationship between education and computer ownership is consistent with Dickerson and Gentry (1983), MacQuarrie and Langemeyer (1987), whereby computer owners are more educated than non-computer owners. This lends support to Venkatesh's (1985) perception that utilization of computer requires specific skills, which higher educated individuals would find it easier to acquire and younger individuals may be more receptive to learning such skills.

The results in Table 2 column 3, show that a computer user who is a year younger will increase the probability of computer ownership by 0.1% while for a computer user with a tertiary education will increase the probability of computer ownership by 2.7% compared to a computer user without a tertiary education, holding other factors constant.

Age is also found to have negative significant effect on the hours spent a week on computer at home. A computer user who is a year younger will spend 0.16 hours (column 4) more a week on the computer among computer owners and 0.17 hours (column 5) more a week for the total sample.

On the other hand, while gender is found to be not significant in determining the probability of computer ownership at home, it is found to have a positive and significant effect on the respondent's time spent on computer at home. A male computer user will increase the hours spent on computer at home a week by 3.78 hours (column 4) among computer owners and 3.60 hours (column 5) a week for the overall total sample. Perhaps this is because; female computer users may be too pre-occupied with other household chores that prevent them from spending longer hours on the computer.

The non-significance of income towards computer user's purchase decision may suggest that the computers in Malaysia are affordable to the public majority. This is perhaps due to the various financial assistance that are provided by the government and the related government agencies in the forms of computer loan, tax rebate and the computer fairs which are held several times a year.

B. Household Social Environment

All the three variables (number of users, household's level of computer knowledge and number of IT products that a household possess) are found to have positive significant effect on computer user's purchase decision.

For every additional computer user in the household and every additional IT products possessed by the household, the probability of computer ownership will increase by 4.2% and 2.4% respectively. The significance of the number of computer users in the household towards computer ownership in this paper is consistent with Shih and Venkatesh's (2004) findings. More computer users will make computer purchase a viable decision as the computer can be utilized by different members of the household. The result on the significance of IT products towards computer ownership supports the views of Rogers (1995) and Vitalari et al. (1985) who found that the adoption of a given technology may increase with the adoption of other technologies in the household. Further, it is found that a household with intermediate level of computer knowledge will increase the probability of computer ownership by 6.5% compared to a household

with just an elementary level of computer knowledge. However, there is no statistical difference between a household with an advance level of computer knowledge and a household with just an elementary level of computer knowledge.

In terms of the hours spent on computer at home, it is found that the number of children, the number of waking hours, the availability of computer for use and the household's type of social communication network are all significant. The numbers of children and the number of waking hours have effects on the allocation of time in the household. An individual who is a parent to more children will have to divide his time between his children and other household activities. More children imply greater demand for time from the parents. As a result, for every additional child that an individual has, it will decrease his conditional and unconditional hours spent on computer a week by 0.49 hours and 0.48 hours respectively. Further, the length of waking hours spent at home determines the individual's allocation of time between various household activities. Hence, for every additional waking hour that an individual spends at home, it will increase the time he gets to spend on the computer by 0.55 hours a week. The number of children and amount of waking hours at home affects the trade off that an individual has to consider between spending his time on the computer and indulging himself in other household activities.

In a home where there are more users than the number of computers, competition to use computer will arise. In other words, availability of computer for usage becomes an issue. The degree of competition for computer usage (degree of availability of computer) is captured by the competition index, (PH). Higher competition index indicates lower degree of competition to use computer (higher availability). Thus, for every additional 0.1 increase in the competition index, the hours spent on computer increases by 0.58 hours a week among computer owners and increases by 0.57 hours a week for the total sample.

It is found that there only exist significant differences between a computer user who always communicates with family and friends using computer with one who does that

occasionally. Holding other factors constant, the result suggests that a computer user who always communicates with family and friends using computer spends 1.87 hours more than one who only does so occasionally.

C. Attitudinal Beliefs

The significance of utilitarian outcomes on computer ownership is found to exist only for the case where, if the computer user believes that computer brings about efficiency to the household, the probability of owning a computer at home increases by 3.1%. The perceptions that computer ownership reflects a higher social status or technology savvyness of the computer owner do not appear to have significant effect on the computer user's decision to purchase a computer for home usage. The findings suggest that computers have become part and parcel of modern living to the extent that majority is expected to be computer literate and to be able to afford a computer. As a result, computer ownership does not imply technology savvyness or higher social status. The latter seems to be consistent with the non-significance of income towards computer ownership.

It is found that there exist significant differences between a computer user that uses the computer for work related activities and a computer user that uses the computer for games and entertainment related activities in terms of the hours spent on the computer a week. The findings show that a computer user that uses the computer for game and entertainment related activities spends 3.17 hours longer a week and 1.32 hours longer a week than a computer user that uses computer for work related activities among computer owners and for the total sample respectively. However, there is no significant difference in the hours spent on computer between a computer user that uses the computer for online related activities and a computer user that uses the computer for games and entertainment related activities. Both online and games and entertainment related activities appear to be regarded as leisure activities conducted on the computer. Following from Venkatesh and Brown (2001) and Hirschman et al. (1982), the finding here appears to show that the utility derived from the entertainment provided by the computer is greater than the other activities provided by the computer. Indirectly, this suggest that while

computers were designed initially for work related activities, the usage of computer at home is viewed as a leisure related technology instead of a work related tool.

Table 2: Estimation results on computer ownership and hours of computer usage in a week and the marginal effects on the probability of computer ownership, conditional expected hours of usage and unconditional expected hours of usage[6]

Variables	Ownership equation		Usage equation (hours in a week)		$\frac{\partial \Pr(L_i^* > 0)}{\partial Z}$	$\frac{\partial E(W_i > 0)}{\partial X}$	$\frac{\partial E(W_i)}{\partial X}$
	γ (1)	z-stats	β (2)	z-stats	(3)	(4)	(5)
Socio-economic and demographic							
Age	-0.031***	-2.19	-0.015***	-4.75	-0.001	-0.163	-0.171
Gender	0.030	-1.16	3.864***	7.39	-0.127	3.779	3.602
Education	0.513*	1.80			0.027		
Income	0.001	1.55			0.000006		
Household social environment							
IT products	0.563***	3.29			0.024		
Household knowledge 1	0.734	1.52			0.019		
Household knowledge 2	0.972***	3.32			0.065		
Number of users	0.989***	6.68			0.042		
Waking hours			0.554***	6.39		0.554	0.545
Children			-0.491*	-1.75		-0.491	-0.483
Competition Index (PH)			5.756***	4.37		5.756	5.660
Communication 1			1.866***	3.43		1.866	1.834
Communication 2			0.632	0.71		0.632	0.621
Attitudinal beliefs							
Efficient	0.569**	2.27			0.031		
Social Status	0.326	1.26			0.014		
IT status	0.438	1.51			0.024		
Work	-0.867	-1.56	-2.984*	-2.25	-0.027	-3.171	-1.321
Online	-0.533	-0.97	-0.902	-0.68	-0.031	-1.095	-3.365
Personal dimension							
Value	0.545*	1.90			0.026		
PC knowledge 1			2.456***	2.80		2.456	2.414
PC knowledge 2			1.957***	2.84		1.957	1.924
Constant	-3.448***	-3.99	6.009***	3.32			
Inverse Mills ratio (λ)			-3.038	-2.61			

* **denotes significance at 1%; ** denotes significance at 5%; * denotes significance at 10%.

[6] Hoffmann and Kassouf, (2005) detail the methodology to calculate marginal effects in Heckman models.

D. Personal Dimension

The result showed that user's positive belief towards the price worthiness of computer will have significant positive effect on the probability of computer ownership. It is found that user's who think that the price of computer is value for money will increase the probability of purchasing a computer by 2.6% compared to a user who thinks otherwise.

On the other hand, it is found that the level of computer user's knowledge significantly affects the hours a week he spends on the computer. Among the computer owners, a computer user who has advanced or intermediate computer knowledge will spend 2.45 hours or 1.96 hours a week longer respectively than a computer user who has only elementary level of computer knowledge. This also implies that computer user who has higher level of computer knowledge is able to derive greater pleasure in using the computer and hence, spend longer hours on the computer compared to one who may struggle to operate the computer due to his lower level of computer knowledge. This finding lends support to Shih and Venkatesh (2004), Mick and Fournier (1998) and Mukherjee and Hoyer (2000) studies.

CONCLUSION

The objective of this paper is to investigate the various factors that play a role in determining computer ownership and the time spending using computer at home. Besides identifying the motivating factors, the findings of the paper are able to shed some insights to the role of computer in the household of a developing ICT country.

It is clear that computer is distinctly different from other household technology. Level of education, computer literacy and level of education are significant motivating factors for computer ownership. As the operation of the computer and the utilization of computer require a certain level of literacy and specific computer skill, high literacy rate is an essential factor in enhancing computer penetration.

As the price of computer is relatively higher than any other household technological products, it increases the need for a potential buyer to maximize his transaction utility. In the case of computer ownership, a buyer's transaction utility is maximized if he is assured that a computer at home can be fully utilized and its function maximized. Thus, the increase in the number of computer users in the household and the level of computer knowledge of his household members will ensure that the decision to purchase a computer for home use is purposeful.

Although the average cost of a computer is almost equivalent to the monthly income of an average income household[7]; income does not appear to be a significant factor in determining computer ownership at home. Perhaps the government's computer financing campaigns were successful in easing the cost burden of purchasing a computer. In other words, strong financial support is helpful in increasing computer penetration.

In a household framework, the time spent on computer depends on the dynamics of a household social environment. The time spent on computer involves a decision between work and leisure in the household. Further, the significance of gender, time spent at home, number of children and the main activities conducted on the computer at home indirectly help to define the role of computer in a household.

The constraints for a female member of a household to indulge in computer usage highlight the priority of other household chores over computer usage. This is especially true, where female still plays an active role in household activities that are particularly associated to the production process in a household. The finding indicates that spending time on the computer is viewed more as a leisure activity than a work (production) activity within a household. Further, as the usage of computer decreases with the number of children in the household, it implies that household activities involved in the management of children takes precedence over

[7] According to Economic Planning Unit (2006), the average income of household in rural is RM1,875 and urban is RM3,956 in the year 2005. The exchange rate between USD and RM is USD 1 = RM3.20.

the time spent on the computer. In addition, the hours spent on computer is found to increase when computer is used mainly for entertainment related activities compared to work related activities. Despite the multi-functionality of a computer that allows users to use it for both production (work) and consumption (entertainment) processes, the findings above suggest that the usage of computer in the Malaysian household is perceived as a technology that enhances the consumption process more than the production process. In other words, the presence of computer in the Malaysian home is simply viewed as another household gadget that provides pleasure and leisure more than increases the performance expectancy of household activities.

Hence, the use of computer for entertainment and games related activities would not augur well with the government's objective in developing knowledge based society. To achieve this objective, it is important that computer is used more innovatively and facilitates more in the production process of the household than the consumption process.

REFERENCES

Adams, D.A., Nelson, R.R., and Todd, P.A., 1992, Perceived Usefulness, Ease of Use and Usage of Information Technology: A Replication. *MIS Quarterly* **16,** pp. 227-247.

Becker, G., 1965, A Theory of the Allocation of Time. *Economic Journal* **75**, pp. 493-517.

Blonski, M., 1999, Social Learning with Case-Based Decisions. *Journal of Economic Behaviour and Organization* **38**, pp. 59-78.

Chin, M. and Fairlie, R., 2004, The Determinants of Global Digital Divide: A Cross-Country Analysis of Computer and Internet Penetration. Economic Growth Center, Yale University.

Comber, C., Colley, A., Hargreaves, D. and Dorn, L., 1997, The Effects of Age, Gender and Computer Experience Upon Computer Attitutes. *Education Research* **39**, pp. 123-133.

Cummings, J. N., and Kraut, R., 2002, Domesticating computers and the Internet. *Information Society* **18**, pp. 221-232.

Cutler, S.J., Hendriks, J., and Guyer, A., 2003, Age Differences in Home Computer Availability and Use. *Journal of Gerontology Series B: Psychological Science and Social Science Online* **58**, pp. 271-280.

Davis, F., 1989, Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology. *MIS Quarterly* **13**, pp.319-340.

Davis, F., Bagozzi, R., and Warshaw, R. (1989), "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models." *Management Science* **35**: 982-1003.

Dickerson, M. and Gentry, J., 1983, Characteristics of Adopters and Non-Adopters of Home Computers. *Journal of Consumer Research* **10**, pp.225-235.

Dutton, W., Rogers, E., and Jun, S., 1987, The Diffusion and Impacts of Information Technology in Household. *Oxford Surveys in Information Technology* **4**, pp. 133-193.

Economics Planning Unit, 2006, *Ninth Malaysia Plan: 2006-2010*, Malaysia.

Habib, L. and Conford, I., 2001, Computer in the Home: Domestic Technology and the Process of Domestication. In Proceedings of the 9th European Conference on Information Systesm (ECIS), Bled, Slovenia, June 27-29. http://home.hio.no/~laurence/bled2001.pdf (accessed February 23, 2008)

Haddon, L. and Skinner, D., 1991, The Enigma of the Micro: Lessons from the British Home Computer Boom. *Social Science Computer Review*. **9**, pp. 435-439.

Heckman, J., 1979, Sample Selection Bias as a Specification Error. *Econometrica,* **47**, pp.153-161.

Hirschman, E. and Holbrook, M., 1982, Hedonic Consumption: Emerging Concepts, Methods and Propositions. *Journal of Marketing,* **46**, pp. 92-101.

Hoffmann, R., and Kassouf, A., 2005, Deriving Conditional and Unconditional Marginal Effects in Log Earnings Equations Estimated by Heckman's Procedure. *Applied Economics,* **37**, pp. 1303-1311.

Losh, S., 2003, Gender and Education Digital Chasms in Computer and Internet Access and Use Over Time: 1983-2000. *IT and Society* , **1,** pp. 73-86.

Loyd, B.H. and Gressard, C., 1984, The Effects of Sex, Age and Computer Experience on Computer Attitudes. *AEDS Journal,* **18**, pp. 67-77.

Malaysian Communication and Multimedia Commission (MCMC), 2007, *Communications and Multimedia: Selected Facts and Figures: Quarter 4, 2007*, Cyberjaya, Malaysia.

McQuarrie, E. and Langmeyer, D., 1987, Planned and Actual Spending Among Owners of Home Computers. *Journal of Economic Psychology,* **8**, pp.141-159.

Mick, D. and Fournier, S., 1998, Paradox of Technology: Consumer Cognizance, Emotions and Coping Strategies. *Journal of Consumer Research,* **25**, pp.123-143.

Mukherjee, A., and Hoyer, W., 2001, The Effect of Novel Attributes on Product Evaluation. *Journal of Consumer Research,* **28,** pp.462-472.

Ono, H., and Zavodny, M., 2004, Gender differences in information technology usage: a U.S-Japan comparison. *Sociological Perspectives,* **48**, pp. 105-133.

Ono, H., 2005, Digital Inequality in East Asia: Evidence from Japan, South Korea and Singapore. *Asian Economic Papers,* **4,** pp. 116-139.

Papadakis, M., 2001, *The Application and Implications of Information Technologies in the Home: Where Are the Data and What do They Say?*, Arlington VA.

Pope-Davis, D.B. and Twing, J.S., 1991, The Effects of Age, Gender and Experience on Measure of Attitude Regarding Computers. *Computer in Human Behaviour* , **7,** pp. 333-339.

Rogers, E., 1995. *Diffusion of Innovations.* 4th. Edition, New York: Free Press.

Venkatesh, A., Shih, C.F., and Stolzoff, N., 2000, A Longitudinal Analysis of Computing in the Home Census Data 1984-1997. In *Home Informatics and Telematics: Information, Technology and Society,* ed. Sloane, A., and van Rijn, F. pp. 205-215.

Venkatesh, V., and Brown, S., 2001, A Longitudinal Investigation of Personal Computers in Homes: Adoption Determinants and Emerging Challenges. *MIS Quarterly,* **25,** pp. 71-102.

Venkatesh, A., and Shih, C.F., 2006, An Investigation of Theories of Diffusion in the Global Context: A Comparative Study of the U.S., Sweden and India. Center for Research on Information Technology and Organizations, I.T. in the Home (CRITO), Paper 374, University of California Irvine. http://repositories.cdlib.org/crito/home/374. (accessed on February 2006).

Venkatesh, A., 1985, A Conceptualization of the Household Technology Interaction. In *Advances in Consumer Research,* ed. Hirschman, E., and Holbrook, M., **7,** pp.189-194.

Vitalari, N., Venkatesh, A., and Gronhaug, K., 1985, Computing in the Home: Shifts in the Time Allocation Patterns of Households. *Communications of the ACM,* **28**, pp. 512-522.

Thaler, R.H., 1985, Mental Accounting and Consumer Choice. *Marketing Science,* **4,** pp. 199-214.

Wasserman, S. and Faust, K., 1994, Social Network Analysis, Cambridge, U.K.: Cambridge University Press.

Whitley, B. E., 1997, Gender Differences in Computer Related Attitudes and Behaviour: A meta analysis. *Computers in Human Behaviour,* **13**, pp.1-22.