THE IMPACT OF MOBILE PHONES ON HOUSEHOLD WELFARE IN INDONESIA: EVIDENCE AND IMPLICATIONS

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This study seeks to answer to what extent information and communication technology (ICT) can increase household welfare. It is focused on ICT in the form of telecommunication technologies, i.e., mobile phones. Using two different mobile phone variables and three different household welfare measures from Indonesian national survey data, all regressions confirm that mobile phone ownership had a positive and significant impact on per capita household consumption during the period of 2006 – 2008. The impact ranged from 5.6% to 15.3% in the increases of per capita total consumption, depending on the regression model chosen, implying that households use mobile phones as a tool of finding resources and information linked to economic activities. Moreover, the mobile phone impact was also higher for those households classified as poor and for households in the rural areas. Interestingly, however, the impact of mobile phone on per capita total consumption is greater for non-poor than poor rural households. This finding indicates that the mobile phone is used as a supplement means or as a production factor to improve the economic performance of the non-poor rural group.

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PREFACE

I am deeply indebted to my thesis committee, Dr. Muge Finkel, Dr. Annemie Maertens, Dr. Martin Staniland, and Dr. Sera Linardi for the invaluable guidance, numerous insights, and critical comments they provided throughout my research process, and during the writing of my thesis and my proposal and thesis defenses. I would also like to extend my appreciation to Dr. Luke Condra, who offered me valuable advice and attended my thesis defense. My sincere gratitude also goes to the members of the GSPIA community for their immense help and hospitality during my study in Pittsburgh: Dean John T.S. Keeler, Dr. William N. Dunn, Dr. Louise K. Comfort, Dr. Barbara Porter, Kelly McDevitt, Michael Rizzi, Renee Kidney, Julia Korade, Skip Bradburn, Mary Ann Gebet, Shannon Brenner, Diane Kline, Grace Schetley, and Susan Sawyers.

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1.0 INTRODUCTION

1.1 BACKGROUND

Information and communication technology (ICT) are technologies capturing, processing, storing, displaying, and communicating information through electronic means (Heeks, 1999; OECD, 2001; ITU, 2009), and these technologies are expected to serve the purpose of development by providing efficient ways of information gathering, processing, and dissemination at marginal cost (Song, 2003; ADB, 2003; Adebayo & Adesope, 2007). Due to the rapid innovation in ICT sectors, ICT has been considered a tool to achieve economic performance and to meet development goals of both developed and developing countries.

ICT has contributed to increases in companies' productivity by making business easier to conduct for the clients, suppliers, and the distributors. For example, the OECD (2001) reports that the ICT value added represents from 5% to 14% of the total business sector value added in several OECD member countries in 1999. Furthermore, there is growing recognition of the role ICT plays in economic growth. According to a study conducted by the Centre for Economic Research in the UK (Waverman, Meschi, & Fuss, 2001), for instance, a developing country with an average of 10 mobile phones per 100 in the population between 1996 and 2003 had a per capita GDP growth more than 0.59% higher than an identical country with fewer phones.

In addition to contributing to economic growth, the access to and use of ICTs can improve household welfare through various channels of socio-economic development (Song, 2003). In her study, Song found the channels include accelerating economic efficiency,

productivity and diversification gains to create positive effects on price and market, providing access to better social services, such as health and education, enhancing the integration/participation of the poor or poor livelihoods, and addressing barriers to poverty reduction such as natural disasters. She further stated that ICT can provide access to more/better information and save costs and time, which Flor (2001) asserted can generate income. In addition, ICT can provide opportunities to reduce transaction costs, increase market coverage, and improve competitiveness, even across borders (World Bank, 2003).

However, few studies have quantitatively established causality between ICT and household welfare. In fact, many studies have expressed skepticism regarding the benefits of ICT even on economic development in general (Torero & Braun, 2006). On the macro level, for example, some studies reveal that socio-economic development contributes to a greater use of ICT rather than the reverse. Specifically, the access to and use of ICT at household level may be determined by various factors of households such as income, education, types of economic activities, etc. (Trung, Tungm, Duc, Duc, & Hung, 2007). The authors of such studies also argue that access to ICT depends on income, education, and resources and that the so-called "digital divide"[1] is part of a much broader development divide (May, 2010). Moreover, few studies of ICT related projects which have carried out systematic impact assessments offer results which are not conclusive about the relationship of ICT to poverty reduction (Batchelor & Sugden, 2003; Slater & Tacchi, 2004; May, 2010). Thus, the question of to what extent ICT have impact on household welfare remains largely unanswered.

[1] Digital divide refers to the gap or imbalance that exists between those who have access to Information and Communications Technology and also to the unequal access to resources. The digital divide can exist between those living in rural areas and those living in urban areas, between the educated and uneducated, between economic classes, and on a global scale, between more and less industrially developed nations (ICT4D, 2008).

This study seeks to answer the above question. It will focus on ICT in the form of telecommunication technologies, i.e., mobile phones, for the following reasons. First, the mobile phone has been one of the most successful ICT (Braund, Frauscher, Schwittay, & Petkoski, 2006) and the most widespread ICT across the world today, including in developing countries, is the mobile phone (Furuholt & Matotay, 2011). Second, telecommunication technologies are viewed as precursors of other advanced ICT services (Chowdhury, 2002). Third, some studies have concluded that access to mobile phones has a fairly strong impact on people welfare. For illustration, a study by Aker (2010) reveals that mobile phones have the potential to benefit consumer and producer welfare and perhaps broaden economic development. One example she provides to support this assertion is that mobile phones reduce grain price dispersion across markets by a minimum of 6.4% and reduce intra-annual price variation by 10%.

Further, there has been explosive growth globally in mobile phone access and use, with private—and in some cases, nonprofit—operations supplying access to poor people by way of very low-margin, high-volume business models (Spence & Smith, 2010). In Indonesia, the area of this study, during the period 2005 – 2009, the number of landline telephone subscribers decreased an average of 0.67% per year; while in contrast, the number of mobile phone subscribers has increased to 34% (MCI, 2010a). In terms of number of users, the mobile teledensity[2] in Indonesia has increased dramatically, from fewer than 3 million people in 2000 to more than 150 million people in 2009 (World Bank, 2011; ITU, 2011). This is a dramatic change, yet no study has explored the potential effects of mobile phones on household welfare in the country. More importantly, no study has been conducted in the nation-wide context, and the

[2] Teledensity is a term commonly used to describe the number of telephone lines per 100 population (ITU, 2010).

impact of mobile phones at the micro-level remains under-researched due to data limitations. Therefore, this study aims to fill this gap.

1.2 RESEARCH QUESTIONS AND HYPOTHESES

This study will demonstrate empirically the relationship between mobile phones and household welfare[3] in Indonesia. Specifically, this study addresses the following questions. Does the use of mobile phones increase household income? Is the impact of mobile phone usage different for poor and non-poor households? Does the use of mobile phones have a different impact on income generation for households living in rural and urban areas? How do mobile phones affect poor rural households compared to other poor and non-poor in rural and urban areas? Such questions are important for a country like Indonesia, which has experienced a rapid increase in the mobile phone industry and given the present government's commitment to reducing poverty.

Consequently, I expect the results from this study to provide evidence to test the following hypotheses:

1. *Mobile phone use has a positive impact on household total consumption.*

   By owning a mobile phone, households are expected to increase their income, which will lead to higher consumption of goods and services. Information is critical for the efficient functioning of markets (Jensen, 2007), and as a means of information gathering, the mobile phone increases rapid access to information and enables interactive communication flow

[3] Similar to study conducted by Song (2003), household welfare in study is defined as household income. The concept of household income refers to regular receipts such as wages and salaries, income from self employment, interest and dividends from invested funds, pensions or other benefits from social insurance and other current transfers receivable (The Canberra Group, 2001). In this study, household expenditure/consumption is used as a proxy for household income.

unhindered by space, volume, medium or time. As a result, mobile phones allow consumers to seek the lowest price of goods and services. At the same time, with the increased access to information, mobile phones also facilitate enterprises to increase productivity by acquiring production inputs faster and from more suppliers, cutting the role of "middleman", reducing inter-market price dispersion, simplifying and reducing transaction costs, and at the same time to expand the existing markets. For specific illustration, farmers can get immediate information on weather, crop prices, and other production inputs, such as fertilizer and pesticide, from other farmers in other regions. In other words, my hypothesis is that mobile phones are used by households in order to seek information to improve the performance of their economic activities.

2. *The impact of mobile phone use is greater for poor households than non-poor households.*

The lack of affordable access to necessary information and relevant knowledge among the poor people has been a concern of development economists. Jensen (2007) argues that access to information has the ability to empower poor communities, enhance the skills of those who live in these communities, and link various institutions involved in poverty reduction. For instance, poor households can use a mobile phone to gain access to information on health, financial, and government services, and on production, storage and marketing of farm and non-farm products, which can result in improvement in their productivity and income (Trung et al., 2007). One of the demonstrated channels through which mobile phones improve the welfare of the poor people is improved market efficiency and spatial integration (Jensen, 2007; Labonne & Chase, 2009; Aker, 2010). The recent variety of pricing of mobile phone models offers affordability and choice for poor customers so that they can have access to

information. As a result, mobile phone ownership is expected to have a greater impact on poor households than non-poor households.

3. *The impact of mobile phone use is greater for households in rural areas than for those in urban areas.*

   According to Bhavnani, Chiu, Janakiram, and Silarszky (2008) the value of mobile phone services and the associated benefits is higher in rural areas. Obviously, there is a gap between urban and rural areas in terms of infrastructure and technologies, especially ICT. Barrantes (2010) points out that in rural areas, people usually lack fixed telephony and public phones compared to those who live in urban areas. Particularly for many small businesses in rural areas, mobile phones are the only source of communication and literally essential to their businesses (Samuel, Shah, & Hadingham, 2005). Therefore, since rural households have more limited options for communication than urban households, the ownership of mobile phone service is expected to help rural households gain affordable access to relevant information and knowledge services which can increase their income and livelihoods.

4. *In rural areas, the impact of mobile phones is smaller among the poor than among the non-poor households.*

   Considering the second and third hypotheses above, it is expected that the impact of mobile phones is higher for both the poor households and those who live in rural areas. However, when the two categories are combined together, the magnitude of mobile phones' impact may differ between the poor and non-poor groups. Mainly for rural households, owning a mobile phone is a necessary condition, not a sufficient condition. While all mobile phone users are expected to enjoy a positive increase in their total consumption, it is highly possible that the non-poor group gains more than its poor counterparts because the non-poor rural

households start out with more means and sources of income to support their livelihood. In this sense, a mobile phone is one of those resources which can assist and supplement the non-poor rural households to achieve a higher consumption level, but it should be interplayed with other factors.

1.3 OUTLINE OF THE STUDY

The remainder of this study is organized as follows: Chapter two reviews the previous literatures. Chapter three presents and discusses the concept of household economic model used as theoretical framework in this study. Chapter four outlines the ICT policies and the development of the mobile phone industry in Indonesia. Chapter five describes the data which is used and the methodology. The empirical results are presented and interpreted in Chapter six. Finally, in Chapter seven, I present conclusion, deliberate implications and identify validity of this study, and propose directions for the future research.

2.0 LITERATURE REVIEW

Few empirical studies have explored mobile phone ownership and its economic impact. Particularly in developing countries, according to Jagun, Heeks, and Whalley (2008), micro-level analysis of telecommunication's impact has been less extensive. One of the pioneer studies in this field is conducted by Bayes (2001). He examined the effects of village pay phones (VPPs) from two angles, i.e. owners and buyers of mobile phone services. The VPPs was launched by Grameen Bank (GB) of Bangladesh in which GB leased mobile phones to its members. Using the selected random sample of phone owners, consisting of 50 persons in 50 different villages, which constituted about 60% of all VPP owners, he found that the VPP owners earned an average net profit of 277 Tk. per week. The profits accruing from phone services constituted from about one-fifth to one-fourth of their total income. Moreover, based on the sample of users of VPP services consisting of 400 individuals, which accounted for 27% of all VPP users, Bayes found that the buyers experienced a surplus of 165 Tk. per user per week. In other words, the surplus created amounted to 11% of the household income. In sum, the VPP turns mobile phones into production goods, especially through lowering transaction costs and expanding access to vital information input for the population.

Current research primarily, however, focuses on the short- to medium-term effect of mobile phones on search costs, market agents' behavior, and price dispersion (Aker & Mbiti, 2010). For example, using a panel data set of 300 sardine fishing units between 1997 and 2001

to examine the effect of mobile phones on the fisheries sector in Kerala, India, Jensen (2007) found that the expansion of mobile phone coverage led to a significant reduction in the dispersion of fish prices across markets as well as a decline in waste. He shows that this led to important welfare improvements for both the fishermen and the consumers; the fishermen's profits increased by 8%, consumer prices declined by 4%, and consumer surplus increased by 6%. With improved access to information via mobile phones, the fishermen became better able to take advantage of spatial arbitrage opportunities, thereby improving allocative efficiency.

Furthermore, using a panel data set of 395 traders and 205 farmers between 2005 and 2007 in Niger, Aker (2008) found that mobile phones reduced grain price dispersion across markets by a minimum of 6.4% and reduced intra-annual price variation by 10%. Prior to the introduction of mobile phones, search costs were prohibitively high, hence mobile phones reduce price dispersion and lower transaction costs. Mobile phones increased traders' welfare, primarily by increasing their sales prices, as they were able to take advantage of spatial arbitrage opportunities. Hence, she concluded that the introduction of mobile phones can be associated with increased trader and consumer welfare. Specifically, the net effect of the sales prices was an increase in average daily profits, equivalent to a 29% increase per year. In Aker's study, however, the effects of mobile phones upon farmers' welfare were not measured.

To address the lack of measurement in Aker's study, Muto and Yamano (2009) conducted a similar study to estimate the impact of mobile phones on agricultural markets in Uganda, focusing on farmers' market participation rather than market efficiency. Using a panel dataset of 856 farm households between 2003 and 2005 in 94 communities, they found that mobile phone coverage was associated with a 10% increase in farmers' probability of market participation for bananas, although not maize; this suggests that mobile phones are more useful

for perishable crops. Moreover, the effect of mobile phone coverage was greater for farmers located in communities farther away from district centers. While the authors do not empirically explore the specific mechanisms behind their results, they suggest that improved access to price information reduced marketing costs and increased farm-gate prices, thereby increasing productive efficiency.

Further, Donner (2007) conducted a study of the use of mobile phones by microentrepreneurs in Kigali, Rwanda. This study examines actual calling behavior by analyzing recent calls and text messages made and received on users' mobile phones. Based on sample of 277 respondents, Donner found that microentrepreneurs use their mobile phones to increase the frequency of their contact with friends, family, and existing business contacts and to facilitate new contacts with business partners, suppliers, and customers. Specifically, he demonstrated changes to microentrepreneurs' social and economic networks, facilitated by mobile phone ownership and use, in which 20% of all the call partners were new to respondents' networks and, of the 80% whose relationships predated the mobile. In addition, the study also reveals that the proportion of new entrants, who were concentrated in business calls, was highest, a predicted 38%, among the business-related call partners of those who own only a mobile phone.

An interesting study done by Labonne and Chase (2009) reveals that there is a positive impact of access to information on poor farmers' consumption in the Philippines. The study combines spatially coded data on mobile phone coverage with household panel data on farmers from some of the poorest areas of the Philippines. The regression results indicate that over the 2003 – 2006 period studied, farmers purchasing a mobile phone experienced a higher growth rate in per capita consumption, ranging from 11 % to 17 %. The findings of this study suggest that information technologies can contribute to poverty reduction in developing countries.

3.0 THE CONCEPT OF HOUSEHOLD ECONOMIC MODEL

Building upon agricultural household modeling (AHM) by Singh, Squire, and Strauss (1986) and others, the objective of this theoretical framework is to provide a brief overview of household economics. In most developing countries, as pointed out by Singh et al. (1986), agriculture remains a principal source of income for the majority of the population, an important earner of foreign exchange, and a central concern of government policymakers. Approximately 70% of the labor force in the developing countries in the 1980s and about three quarters in the least developed countries in the 1990s were employed in the agricultural sector (Bardhan & Udry, 1999). Likewise, since the 1970s, Indonesia has been a predominantly agrarian economy, with agriculture contributing the largest share to gross domestic product (GDP), employment, and export earnings (ADB, 2006). According to data from the Indonesian Central Statistical Agency [BPS] (2010), agriculture has remained the largest sector in the country in terms of employment, with 42.83 million people, or almost 40% for the population, making up the agriculture labor force in 2010. Originally envisioned as a tool for price policy analysis, Taylor (2002) suggests that the AHM has been used in a design of research ranging from technology adoption and migration to deforestation and biodiversity.

Most households in the agricultural sector produce crops partly for sale and partly for personal consumption. They also purchase some of their production inputs (such as fertilizer) and provide some (household labor, for example) from their own resources. As a result,

households make simultaneous decisions about production (the level of output, the demand for production factors, and the choice of technology) and consumption (labor supply and commodity demand). The model of the household that is jointly engaged in production and consumption is called commonly the AHM. Although the model is derived from the behavior of agriculture households, the AHM can be applied as well to households that operate enterprises such as small-scale trading or petty manufacturing (Bardhan & Udry, 1999), or to all but agribusiness-operated commercial farms, which consume a very small share, if any, of their own output and supply few, if any, of their own inputs (Taylor, 2002).

Singh et al. (1986) formulate the AHM by assuming a simple agricultural household that produces one crop, for example rice, has a fixed amount of land, and uses one variable input, i.e. family labor. In the production activities, the household consumes some of the rice, and sells some in order to buy a nonagricultural commodity. Furthermore, Singh et al. (1986) assume that the household can sell rice at a fixed price and buy labor at a fixed wage. The household cannot consume more rice or more leisure (that is, reduce its labor supply or use more hired laborers) than is allowed by its total income.

Because income contributes positively to total household utility or satisfaction, the household will attempt to achieve the largest profit possible from its fixed quantity of land. This implies that the household will want to hire labor until the marginal revenue product of labor equals the market wage and so achieve maximum profits. In order to approximate the profit-maximizing solution, households therefore require information on prices, which in this case includes the price of rice and the wage rate, and information on the technological relationships between inputs and outputs. These pieces of information are important for the households to balance wages and marginal revenue from their product. Therefore, the importance of such

information, and technology linking inputs and outputs, coupled with the context of Indonesia as an agricultural and developing country, lead to the AHM as the appropriate theoretical framework for this study.

The basic idea of the AHM is that the household's objective is to maximize utility subject to constraints. Accordingly, based on the above explanation and this idea, Singh et al. (1986) propose that for any production cycle, the household is assumed to maximize a utility function:

$$U = U(X_a, X_m, X_l) \tag{2-1}$$

where the commodities are an agricultural (X_a), a market purchased good (X_m), and leisure (X_l). For the household, leisure is achieved by reducing its labor supply and using more hired laborers. Utility is maximized subject to a cash income constraint:

$$p_m X_m = p_a(Q - X_a) - w(L - F) \tag{2-2}$$

where p_m and p_a are the prices of the market-purchased commodity and the staple, respectively, Q is the household's production of the staple (so that Q - X, is the staple's marketed surplus), w is the market wage, L is total labor input, and F is family labor input (so that L - F, if positive, is hired labor and, if negative, off-farm labor supply).

Besides a cash income constraint, the household also faces a time constraint-it cannot allocate more time to leisure, on-farm production, or off-farm employment than the total time available to the household:

$$X_l + F = T \tag{2-3}$$

where T is the total stock of household time. Moreover, the household also faces a production constraint or production technology that depicts the relation between inputs and output:

$$Q = Q(L, A) \tag{2-4}$$

where A is the household's fixed quantity of land.

The above three constraints on household behavior can be collapsed into a single constraint. Substituting the production constraint into the cash income constraint for Q and substituting the time constraint into the cash income constraint for F yields a single constraint of the form

$$p_m X_m + p_m X_a + wX_l = \pi + wT \tag{2-5}$$

where $\pi = p_a Q(L, A) - wL$ and is a measure of farm profits. In this equation, the left-hand side shows total household "expenditure" on three items-the market-purchased commodity, the household's "purchase" of its own output, and the household's "purchase" of its own time in the form of leisure. The right-hand side represents a concept of full income in which the value of the stock of time (wT) owned by the household is explicitly recorded. Equations (2-1) and (2-5) are the base AHM postulated by Singh et al. (1986) and are used as the core of all the studies of agricultural households reported in their book.

4.0 ICT POLICIES AND THE MOBILE PHONE INDUSTRY IN INDONESIA

4.1 ICT POLICIES

Indonesia has adopted ICT as a tool for governance and development. Its national ICT vision, is "to bring into reality a modern information society, prosperous and highly competitive, with strong support by ICT," is reflected in the several policies that serve as the country's ICT framework. Of the numerous policies issued by the government in support of this vision, the first initiative was the Telecommunication Act No. 36/1999 along with the Blueprint of Government Policy on the Telecommunication Development Strategy. The Act and the Blue Print give directions for telecommunication sector reform, which covers the importance of making new policy on restructuring and liberalizing the telecommunication industry.

The government then issued Presidential Decree No. 50/2000, which included establishing the National Coordinating Team of ICT. The main task of the team is to coordinate the development and the utilization of ICT in all sectors from government agencies in Indonesia. Furthermore, in April 2001, Presidential Instruction No. 6/2001 was issued, containing a five-year National ICT Plan of Action for Indonesia. This was followed by the formation of an ICT Coordinating Team by virtue of Presidential Decree No. 9/2003 and the issuing of Presidential Instruction No. 3/2003 concerning National Policy on e-Government Development. The government has also planned the year of 2015 to be the year of Indonesia Information Society,

where ICT will be an effective tool in the implementation of government, and in the business and public sectors and also the social stratum communication or ICT for all (MCI, 2010a).

In addition to the above policies, the government has established some government bodies to deal with ICT issues. In 1999, the government established the Ministry of Communication and Information (MCI). The ministry is responsible for national policy formulation, policy implementation, and technical policies in the field of communication and informatics, including the post, telecommunications, broadcasting, information technology and communications, multimedia services and the dissemination of information. Moreover, the MCI, in collaboration with the private sector, develops several programs in efforts to optimally develop ICT for increasing governance and the quality of government services. Besides MCI, the government also established the State Ministry of Research and Technology, which handles coordination of research on expanding the ICT infrastructure through telecommunications and internet application development, digital broadcasting, development of energy-saving and low-cost computers, and open source applications. The Indonesian National ICT Council was established in 2006 to accelerate Information and Communication Technology (ICT) growth through policies that would synchronize the ICT programs of all government departments, ministries, and agencies.

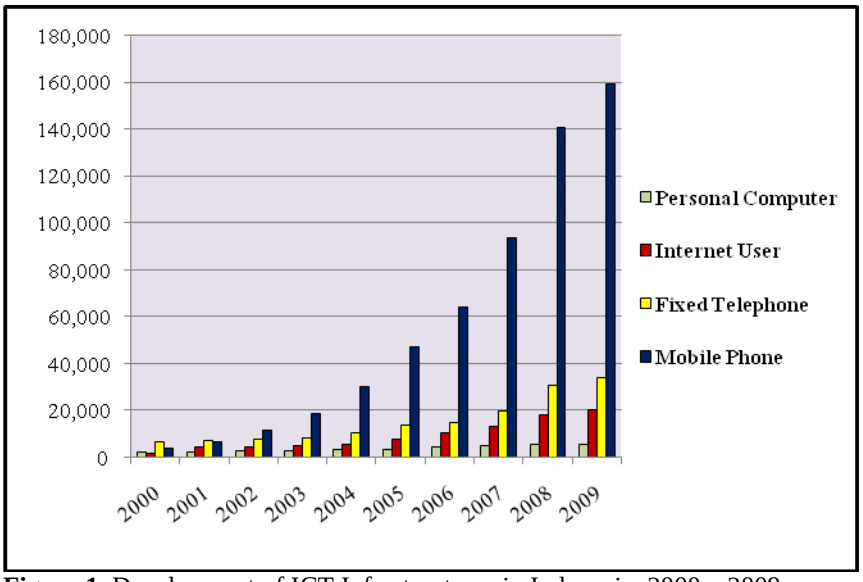


Figure 1. Development of ICT Infrastructures in Indonesia, 2000 – 2009

Source: World Bank (2011); ITU (2011)

Indonesia has had phenomenal expansion in ICT infrastructure in recent times. Table 1 shows that among the four ICT tools, the development of mobile phone in Indonesia is the greatest compared to personal computer (PC)[4], fixed telephone[5] and internet users[6]. The growth rate of mobile phone subscription in Indonesia between 2000 and 2009 is almost 8 times that of the world and 5 times that of other Asian-Pacific countries. During the same period, as shown in Figure 1 above, mobile phone subscriptions dramatically increased, particularly since 2005, while the increase in internet subscribers and users has slowed since 2008.

[4] Personal Computer (PC) is all low-, medium-range and high-end portable and non-portable personal computer systems, designed to be operated by a single user at a time for both business and residential use (ITU, 2010).

[5] Internet users are people with access to the world-wide network via home or work internet-enabled computers, internet cafes or mobile phones (ITU, 2010).

[6] Fixed telephone lines connect a subscriber's terminal equipment to the public switched telephone network. Integrated services, digital network channels and fixed wireless subscribers are included (World Bank, 2011; ITU, 2010).

Table 1. Development in ICT Infrastructures: Comparison of Indonesia, the Asian Pacific Region, and the World

	Indicators	2000 (1000 people)	2009 (1000 people)	Growth Rate (%)
World				
	Personal Computer	464,266.4	1,197,331.3	157.9
	Internet User	399,440.0	1,817,661.3	355.1
	Fixed Telephone	975,182.7	1,198,937.8	22.9
	Mobile Phone	738,722.4	4,677,404.7	533.2
Asia Pacific				
	Personal Computer	105,257.3	341,341.0	224.3
	Internet User	109,117.0	739,741.0	577.9
	Fixed Telephone	318,117.6	532,377.0	67.4
	Mobile Phone	230,071.6	2,179,519.1	847.3
Indonesia				
	Personal Computer	2,100.0	5,700.0	171.4
	Internet User	1,900.0	20,000.0	952.6
	Fixed Telephone	6,662.6	33,957.9	409.7
	Mobile Phone	3,669.3	159,247.6	4240.0

Note: All figures are in 1000 people, 2000 – 2009
Source: World Bank (2011); ITU (2011); Euromonitor International (2011)

Moreover, Table 2 below reveals that mobile phone subscriptions in Indonesia were significantly higher in number than all of the Southeast Asian countries combined. As of 2010, mobile phone users numbered about 175 million, an increase of about 10% over the previous year. However, in the same year, the number of personal computer owners in Indonesia was relatively few compared to that in other ASEAN member countries. The only countries to lag behind Indonesia's PC user base rank were Singapore, Myanmar, Laos, Cambodia, and Brunei.

Table 2. Comparison: ICT Infrastructures in ASEAN Member Countries

Country	Personal Computer	Internet User	Fixed Telephone	Mobile Phone
Brunei	51.8	335.3	80.5	435.4
Cambodia	68.8	84.9	59.7	7,494.4
Indonesia	6,119.8	28,406.6	36,424.6	174,932.8
Laos	201.5	364.2	140.5	3,753.8
Malaysia	9,238.6	16,518.0	4,988.7	32,387.4
Myanmar	657.3	132.5	566.0	601.5
Philippines	10,068.1	9,458.0	7,412.2	100,021.1
Singapore	3,950.8	3,466.5	1,945.5	7,216.0
Thailand	7,851.6	19,824.2	7,245.1	72,084.3
Vietnam	11,512.9	25,495.5	19,088.2	104,413.4

Note: All figures are in 1000 people, 2010
Source: World Bank (2011); ITU (2011); Euromonitor International (2011)

4.2 MOBILE PHONE INDUSTRY

The mobile phone industry in Indonesia has grown rapidly over the past decade. According to MCI (2010b), by the end of 2001, the country had only around 13.25 million phone lines (fixed and mobile), equivalent to 6.77% of the population. However, by 2005 mobile penetration increased significantly at 20%, and five years later, in 2010, more than half of the population had mobile phones, while the number of landlines declined by 10%. More specifically, by early 2008, the total mobile subscriber base in the country had passed 90 million, up from 12 million just six years earlier, and it was expected that the milestone of 120 million mobile subscribers would have been reached by the end of 2008 (Business Wire, 2008). Moreover, according to ITU (2010), Indonesia's mobile market has continued to expand at around 50% per annum and its penetration rate, as of September 2009, was 56.8%.

Additionally, the mobile phone industry in the country is also marked by a great number of telecommunication providers. According to data from MCI (2010b), the three biggest mobile

phone companies in Indonesia cover over 90% of the country's population. However, for mobile network providers, there was no increase in number in 2010 after a very significant increase of 13.3% in 2009. As shown in Table 3, in terms of market sharing, Telkomsel dominates with 50% of the market share, followed by Indosat with 24% and XL with 15%, respectively. Some of the smaller companies include Telkom Flexi (6%), Mobile8 (3%) and Bakrie Telecom (2%). The presence of these smaller GSM operators has contributed to a competitive environment and helped keep prices low for the majority of the Indonesian people. Most importantly, the lower rates offered by the different providers, coupled with the emergence of cheaper handsets, means that more Indonesians can afford mobile phones.

Table 3. Mobile Phone Companies and Their Coverage

Operator	Technology	Subscribers (in millions)
Telkomsel	GSM, GPRS, EDGE UMTS, HSDPA	74 (May 2009)
Indosat	CDMA GSM, GPRS, EDGE UMTS, HSDPA	33.3 (May 2009)
Excelcomindo	GSM, GPRS UMTS, HSDPA	24.9 (May 2009)
Telkom	CDMA	12.7 (December 2008)
Bakrie Telecom	CDMA	8.03 (May 2009)
3	GSM, GPRS UMTS	6.4 (Q2 2009)
Natrindo	GSM, GPRS, EDGE UMTS	3.9 (Q1 2009)
Mobile-8	CDMA, EV-DO Rev A	2.2 (Q1 2009)
Smart Telecom	CDMA, EV-DO Rev A	2.05 (Q1 2009)
Sampoerna Telekom	CDMA	0.784 (March 2008)

Source: MCI (2010b)

The country has some particularly big challenges to confront in building the necessary telecommunications infrastructure to cover its complex geography. This makes Indonesia low ranking compared to other countries in the Asian Pacific region in terms of telecommunication

infrastructures, although if we consider the attractiveness indicator,[7] Indonesia is in the 23rd position (ITU, 2009). Despite the growing market of the mobile phone industry, the digital divide is sharp not only between Indonesia and its peers but within Indonesia itself. In the eastern areas of the country, for example Maluku, Papua, and Nusa Tenggara, only 0.02 percent of the population has fixed telephones. More than half of Indonesia's 70,000 villages (or about 43,000 villages) do not have access to any public telephones (Samarajiva & Zainudeen, 2008). As a result, the availability of pre-paid mobile phone cards is expected to offer various coverage and networks in those provinces so that the mobile phone technology can offer much-needed basic telecommunication services to previously underserved communities.

[7] The attractiveness indicator is one of the many indicators foreign investors usually use for deciding whether or not to invest in the telecommunication sector in a particular country. The indicator is calculated using the ratio between the penetration of telephone lines and the GDP per capita, which reflects the availability of telephone lines compared to the affordability of the country. In general, the smaller the number, the most attractive the country is to investment (ITU, 2009).

5.0 RESEARCH METHODOLOGY

5.1 DATA

For my analysis, I use data from the National Socioeconomic Survey (Susenas) collected by the Indonesian National Statistics Agency (BPS). The survey is cross-sectional in design and was administered at the household level. The robustness of any empirical analysis depends on the quality of the data available and this study is no exception. Therefore, this study focuses on the years 2006 to 2008 for two important reasons. First, though the section "ICT" was initially included in the Susenas in 2005, the data available for the 2005 Susenas was not complete for all provinces in Indonesia. Second, at the time of writing, although data from Susenas on mobile phone ownership for the whole country only was available through 2009, the 2009 Susenas had a different version of questionnaire than previous years. Therefore, to avoid any inconsistency, only observations from 2006 – 2008 are included in the economic estimates.

5.2 ESTIMATION METHOD

Recall that equation (2-5) of the AHM model estimates profit π of the household in producing and consuming a commodity i as follows:

$$\pi_i = p_m X_m + p_m X_a + wX_l - wT \quad (5\text{-}1)$$

where the right-hand side is the amount of all purchased inputs devoted to producing and consuming a commodity, with p_m representing the prices of the market-purchased commodity and X_m, X_a, and X_l being an agricultural input, a market purchased good, and leisure, respectively. Now if the household maximizes profit, and time allocated for leisure (wX_l) and the stock of time (wT) are not constraints for the household to run the small-scale economic activities, mainly due to the fact that they provide their family labor, the household will use all the profit for consumption. This implies that household consumption depends directly on the production constraints, i.e. production inputs owned by the household and purchased from market. Therefore, equation (5-1) can be transformed as:

$$\pi_i = p_m (X_m + X_a) \quad (5\text{-}2)$$

The mobile phone can be one of the production inputs because Singh et al. (1986) stated that in order to approximate the profit-maximizing solution, households require information on prices and the technological relationships between inputs and outputs. In this regard, mobile phone can affect the production process by improving access to information and so allowing functioning markets to work better (Jansen, 2007), by reducing search costs and inter-market price dispersion (Aker, 2010) or by affecting "directly productive" uses, such as communicating with clients, suppliers or producers' associations and agricultural profits (Barrantes, 2010).

Based on the above function, I estimate the impact of mobile phone usage on household per capita consumption, controlling other factors influenced to household consumption. If *i* represents household and *t* represents time, the basic empirical model for this study is given as:

$$C_{it} = \alpha_{it} + \beta_1 MOB_{it} + \beta_2 CV_{it} + \mu_i + \varepsilon_{it} \qquad t = 1, 2, \ldots, T \tag{5-3}$$

where C_{it} is a measure of total household consumption of family i at year t. MOB is a variable equal to one if household i at year t owns a mobile phone and zero otherwise. CV is a vector of control variables that vary across households and time. The μ_i represents unobservable variables, time-invariant heterogeneity across households arising from differences in location. The α, β_1, and β_2 are coefficients to be estimated.

However, a problem exists with this equation due to a suspected correlation between MOB and μ_i. This would mean that the error term ε becomes related to MOB so that β estimated with the Ordinary Least Squares (OLS) regression model would be biased. Using a fixed effects estimator on the panel data can resolve this problem. The fixed effects estimator has the ability to control for unobservable variables. Therefore, under a strict exogeneity assumption for the control variables, the regression model is unbiased, meaning the error term ε should be uncorrelated with each explanatory variable across all time periods (Wooldridge, 2009). Now, for each household i, if I average equation (5-3) over time, the equation can be written as:

$$\overline{C_i} = \overline{\alpha_i} + \beta_1 \overline{MOB_i} + \beta_2 \overline{CV_i} + \overline{\mu_i} + \overline{\varepsilon_i} \tag{5-4}$$

Because μ_i is fixed over time, it appears in both equation (5-3) and (5-4). If I subtract (5-4) from (5-3) for each t, the new equation is constructed as:

$$C_{it} - \overline{C_i} = \alpha_{it} - \overline{\alpha_i} + \beta_1 (MOB_{it} - \overline{MOB_i}) + \beta_2 (CV_{it} - \overline{CV_i}) + \mu_{it} - \overline{\mu_i} + \varepsilon_{it} - \overline{\varepsilon_i} \tag{5-5}$$

$$\Delta C_{it} = \Delta\alpha_{it} + \Delta\beta_1 MOB_{it} + \Delta\beta_2 CV_{it} + \Delta\varepsilon_{it} \qquad t = 1, 2, \ldots, T \tag{5-6}$$

From the equation (5-6), the unobserved effect has disappeared, as $\mu_i = 0$ and time-constant unobserved heterogeneity is no longer a problem. For this reason, I apply the empirical

estimation method using the fixed effect panel data model for equation (5-6). Accordingly, this model permits regressors to be endogenous, provided that they are correlated only with a time-invariant component of the error. Prior to this regression, to distinguish between fixed and random effects, the Hausman test will be performed with the null hypothesis being that random effects are consistent and efficient and the alternative being that random effects are inconsistent (Cameron & Trivedi, 2009).

5.3 PANEL CONSTRUCTION

With the information available from the Susenas, I construct a panel dataset which contains information on the household level. The predictor variable is mobile phone ownership for each household, while the outcome variable of interest is household consumption. According to The Canberra Group (2001) there are difficulties in collecting data on both income and expenditure/consumption in household surveys. Income is a sensitive issue for many respondents and non-response or misreporting of some income components may be significant. Moreover, the manual of Susenas (BPS, 2002) says that it collects information on household expenditure/consumption rather than income. Hence, per capita total consumption[8], is used as the basic measure of household income in this study. Nevertheless, the danger of using consumption as a proxy for household income is that mobile phone can increase consumerism, which can increase consumption without increasing income.

[8] Per capita total consumption is total household consumption divided by the number of household members. The total consumption measure includes food and nonfood goods and services, whether purchased, home-produced, or received as a gift or payment in kind.

The traditional parameterization of the income distribution is log normal, while the distribution of consumption is also close to log normal, and is in fact closer to log normal than income (Battistin, Blundell, & Lewbel, 2009). This is true, as shown in Appendix A, the distribution of the per capita total consumption is positively skewed, where the mass of the data distribution is concentrated on the left of the figure. It is because of the data has relatively few high values. As a consequence of this distribution, I take the normal logarithm in order to make it normal, as we can see in Appendix B. The normal distribution of the per capita consumption also satisfies the assumption of an OLS model.

In addition, I consider several control variables. First is the household's ownership status of their occupied residential buildings and any business loans they have from the government or private entities, which variables both reflect physical capital of the household. Government subsidies in the form of cheap rice, measured by the quantity times the price of the rice, are also considered as a control variable. Furthermore, I also observe variables associated with human capital stock. The variables included in this category are: household size, indicated by the number of household members; age of household head, sex of household head, employment status, a dummy for the household head having been an outpatient in the previous month and an inpatient in the previous year, which reflects his/her ability to perform in economic activities, particularly in order to earn income; and accumulated human capital, based on the educational level of the household head. Further, the panel data also includes two dummy variables that capture whether the household can be categorized as poor or non-poor and whether the household is located in an urban or rural area. The two dummy variables are chosen in order to see the different impact of mobile phone usage in both groups and both areas. The variables and their descriptions are presented in Table 4 below.

Table 4. Variable Names and Descriptions

Variable	Description
Hhid	Household identification number
Year	Year of observations
Total consumption	Normal logarithm per capita total consumption
Mobile phone	A dummy for owning mobile phone 1=Yes 0=No
Number of mobile phones	Number of mobile phones owned in the household
Own home	A dummy of ownership status of occupied residential building 1=privately owned 0=not privately owned
Received work loan	A dummy for receiving work loan 1=Yes 0=No
Quantity of cheap rice	Quantity (kilograms) of cheap rice bought by household
Price of cheap rice	Price of cheap rice bought by household
Receive cheap rice	A dummy for ..Government subsidies in form of cheap rice (quantity times price of the rice)
Insurance	A dummy of health insurance held by household 1=Yes 0=No
Household size	Household size
Head age	Age of household head
Head Sex	A dummy for household head's sex 1=Male 0=Female
Job status	A dummy for employment status of household head 1=Business owner 0=Worker
Outpatient	A dummy for household head who has been an outpatient in the last 1 month 1=Yes 0=No
Inpatient	A dummy for household head who has been an inpatient in the last 1 year 1=Yes 0=No
Education diploma	A dummy of highest education diploma held by household head 1=above compulsory education 0=up to compulsory education (no diploma to junior high school)
Poor	Household categorized as poor 1=Yes 0=No
Rural	Area classification 1=Rural 0=Urban

Table 5 provides summary statistics. As the most basic use of statistics, the table is used to describe distributions, particularly the measures of central tendency (Acock, 2008). The table summarizes unbalanced panel data which is merged from two different panel data sets.[9] For the purpose of this study, I only include the data which has the same level of analysis. I also exclude any observation where the outcome is recorded as not matched. Consequently, after merging there are 700,605 observations which are matched.

[9] The first panel data contains basic variables at the household level with 725,759 observations; meanwhile the second panel data comprises all variables categorized as human capital stock at the individual level with total observations of 706,718.

Table 5. Summary Statistics

Variable	Obs (in thousands)	Mean	Std. Dev.	Min	Max
Hhid	700	238869.6	137741.3	1	481289
Year	700	2007	0.82	2006	2008
Total consumption	700	12.36	0.56	2.14	17.22
Mobile phone	700	0.35	0.48	0	1
Number of mobile phones	700	0.56	0.98	0	25
House ownership	700	0.81	0.39	0	1
Received work loan	700	0.06	0.24	0	1
Quantity of cheap rice	700	7.99	13.26	0	1300
Price of cheap rice	700	747.93	830.59	0	9600
Receive cheap rice	700	11361.49	19863.86	0	4900000
Insurance	700	0.32	0.47	0	1
Household size	700	4.01	2.04	0	604
Head age	700	46.43	13.96	10	98
Head Sex	700	0.87	0.34	0	1
Job status	700	0.68	0.47	0	1
Outpatient	700	0.16	0.37	0	1
Inpatient	700	0.02	0.14	0	1
Education diploma	700	0.24	0.43	0	1
Poor	700	0.5	0.5	0	1
Area classification	700	0.67	0.47	0	1

Note: all consumption variables are the natural log of per capita measures.

6.0 EMPIRICAL RESULTS AND INTERPRETATION

This section presents regression results in light of the framework for analysis and underlying hypotheses described above. In order to determine between fixed or random effects, the Hausman test was performed for the baseline model with the null hypothesis being that random effects would be consistent and efficient and the alternative being that random effects would be inconsistent. The test results, as shown in Table 6, confirm that the Prob>chi^2 is 0.00 (below 0.05) so that I fail to reject the null hypothesis, and therefore, I have to use a fixed effects (FE) model. The essential advantage of this model is that it can eliminate any concern that variation in mobile phone ownership is driven by some unobserved time-invariant factor that also causes changes in household consumption.

Table 6. Hausman Test Results

	Coefficients			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Mob	.1158671	.3252055	-.2093384	.00209
B	= consistent under Ho and Ha; obtained from xtreg			
B	= inconsistent under Ha, efficient under Ho; obtained from xtreg			
Test:	Ho: difference in coefficients not systematic			
chi2(1)	= (b-B)'[(V_b-V_B)^(-1)](b-B)			
	= 10032.29			
Prob>chi^2	= 0.0000			

6.1 IMPACT ON TOTAL CONSUMPTION

The regression results, presented in Table 7, confirm my expectations, indicating that mobile phone ownership has a positive and significant impact on per capita household total consumption. It is important to note that because the per capita total consumption is in natural logarithm form, I needed to convert it into exponential form. Another consideration is that all regressions in this study compare households who have and do not have a mobile phone. Therefore, in the baseline model (M1), when I exclude human capital variables, it shows that if the household owns a mobile phone, its per capita total consumption is 1.11 higher than the households which do not. This coefficient means that per capita total consumption of the mobile phone user is estimated to have increased by about 11.1% during the period 2006 – 2008. Model 1 also indicates the variables house ownership, credit access, and government subsidy are significant at 5 percent or better level.

For Model 2, where I include both basic and human capital variables, the impact of mobile phone usage on per capita total consumption is higher than in Model 1, i.e. 12.2%, holding other variables constant. This means that the human capital stock and the characteristics of the household have an important impact on its total consumption. For instance, a higher education attainment level and age of the household head imply a stronger ability to be productive and generate more income. In summary, those variables strengthen the impact of mobile phone usage on the household income, particularly because of the fact that factors such as, literacy, being healthy, being young, and so forth are conducive to ICT absorption.

Table 7. Regressions Results for Total Consumption

Variables	Total Consumption			
	M1	M2	M3	M4
Mobile phone	0.1053***	0.1151***		0.1091***
	(0.00)	(0.00)		(0.00)
Number of mobile phones			0.0388***	0.004*
			(0.00)	(0.00)
House ownership	0.0004	0.0579***	0.0547***	0.0574***
	(0.00)	(0.00)	(0.00)	(0.00)
Received work loan	-0.0150**	0.0039	0.0117*	0.0037
	(0.00)	(0.00)	(0.00)	(0.00)
Government rice subsidy	-0.0000***	-0.0000***	-0.0000***	-0.0000***
	(0.00)	(0.00)	(0.00)	(0.00)
Insurance	0.0294***	0.0088***	0.0066**	0.0085***
	(0.00)	(0.00)	(0.00)	(0.00)
Household size		-0.0847***	-0.0853***	-0.0849***
		(0.00)	(0.00)	(0.00)
Head age		0.0011***	0.0010***	0.0011***
		(0.00)	(0.00)	(0.00)
Head sex		0.0201***	0.0216***	0.0202***
		(0.00)	(0.00)	(0.00)
Job status		0.0244***	0.0242***	0.0246***
		(0.00)	(0.00)	(0.00)
Outpatient		0.0012	0.0032	0.0012
		(0.00)	(0.00)	(0.00)
Inpatient		0.0411***	0.0421***	0.0410***
		(-0.01)	(-0.01)	(-0.01)
Education diploma		0.1743***	0.1818***	0.1736***
		(0.00)	(0.00)	(0.00)
Constant	12.3434***	12.5074***	12.5347***	12.5092***
	(0.00)	(-0.01)	(-0.01)	(-0.01)
R-sqr: within	0.018	0.127	0.123	0.127
between	0.096	0.195	0.181	0.195
overall	0.088	0.184	0.173	0.185
Number of Observations	700544	700544	700544	700544

*Note: all consumption variables are the natural log of per capita measures. Robust standard error in parentheses. Significance are denoted by asterisks with * p<0.1; ** p<0.05; *** p<0.01.*

Further, with Model 3 and 4, I estimate the impact of having more than one mobile phone in the household on per capita total consumption. The coefficient of number of mobile phones in Model 3 is much lower that of the previous two models, but still statistically different from zero at the 1 percent significance level. The coefficient represents a 3.9% increase in household consumption for each phone owned by the household. Unpredictably, Model 4 suggests that the additional mobile phone in the household does not necessarily have a higher impact on the

household consumption. In other words, the first owned mobile phone is what made a big difference on household consumption, but any additional mobile phones make little difference. In Model 4, however, at least one household member, especially the household head, owning mobile phone can advance per capita total consumption by some 11.5% compared to the household who does not have a mobile phone.

Model 4 also shows that some control variables confirm my expectations. House ownership, insurance, and household's head size, age, sex, and education diploma are significant at a 1 percent level. Obviously, the coefficient of house ownership is positive and statistically significant at the 1 percent significance level, meaning that having a privately owned house can increase per capita total consumption by 5.91% if other variables are held constant. Likewise, having health insurance and receiving a work loan from private financial institutions, cooperative/foundation, or government projects have a positive and significant impact on per capita total consumption, although the impact's levels are quite small, i.e. 0.85% and 0.37% respectively. One type of government subsidy is in the form of cheap rice which only poor households are eligible to buy. Unexpectedly, the subsidy policy has a negative impact to per capita total consumption, but the coefficient is zero, i.e. -0.00%. The main explanation for this is that households that receive the subsidy are desperately poor, and hence consume less than other households. Moreover, if households are large in size, their total consumption is projected to decrease by 8.14% and this decrease is statistically significant at a 1% level.

In addition, the expected signs for the human capital variables were also verified. For the variable head age, if the household is older, the total consumption is estimated to have increased by 0.11%. A related variable, head sex, is significant and positive in the total consumption, i.e. 2.04%, meaning that being a male has a higher effect on the household's consumption because a

male household head can earn more money than the female ones. Moreover, if the household head is a business owner, per capita total consumption is calculated to have increased by 2.49% compared to counterparts whose occupation is worker. As expected, education diploma has a strong positive impact on per capita total consumption, i.e. 8.96%, and is statistically significant at the 1 percent significance level. This indicates that a household head having an education beyond the compulsory level[10] will have more opportunities to have more economic resources and increase their welfare so that they can also increase the total consumption of their family.

While the other human capital variables conform to their expected sign, outpatient and inpatient have a positive impact rather than the expected negative impact. For the outpatient variable, although the coefficient is not statistically significant, if the household head has been an outpatient in the last 1 month, his/her family's per capita total consumption is estimated to increase by a very small percentage, i.e. 0.12%. Similarly, inpatient is statistically significant at the 1 percent significance level and has a positive impact on per capita total consumption, i.e. 4.15%. The impact of these two variables is positive because of the fact that the outcome variable used in this study is household's total consumption, not income, being an outpatient and inpatient increase the consumption because they must spend more money on medical treatment and medicine.

[10] In Indonesia, according to the Law No. 2/1989, the Government Regulation No. 28/1990, and the National Education System Law No. 20/2003, compulsory education consists of six years of elementary school and three years of junior high school (Unesco, 2010).

6.2 IMPACT ON POOR AND NON-POOR HOUSEHOLDS

Table 8 shows the regression results for the contribution of a mobile phone to the household total consumption of the poor and non-poor groups. From the regression, the impact of mobile phone use is somewhat greater for the poor than for the non-poor households. Being a mobile phone user increases total consumption by 9.5% among the poor, which is slightly higher than the non-poor households' increase of 9.4%. The two models support my hypothesis that mobile phone ownership has a greater impact on poor than on non-poor households. From Table 8, we can also see that Model 5 and 6 explain the importance of household human capital variables for the household consumption, where consistently the household's head, sex, job status, and education diploma are positive and significant for both the poor and non-poor households. Additionally, the government rice subsidy does not change household consumption for the poor households. However, if the household was non-poor, receiving the subsidy contributes negatively to household consumption, implying that some problems might have occurred in those households, such as diseases, crop failure, and so forth.

Table 8. Regressions Results for Poor and Non-poor Households

Variables	Total Consumption	
	Poor Households	Non-poor Households
	M5	M6
Mobile phone	0.0907***	0.0897***
	(0.00)	(0.00)
House ownership	0.0322***	0.0827***
	(-0.01)	(0.00)
Received work loan	0.0492***	-0.0339***
	(-0.01)	(-0.01)
Government rice subsidy	0.0000***	-0.1996**
	(0.00)	(-0.07)
Insurance	-0.0428***	0.0643***
	(0.00)	(0.00)
Household size	-0.1102***	-0.0979***
	(0.00)	(0.00)
Head age	0.0000	0.0016***
	(0.00)	(0.00)
Head sex	0.0390***	0.0417***
	(0.00)	(-0.01)
Job status	0.0299***	0.0366***
	(0.00)	(0.00)
Outpatient	0.0271***	-0.0223***
	(0.00)	(-0.01)
Inpatient	0.0396***	0.0237*
	(-0.01)	(-0.01)
Education diploma	0.0859***	0.1512***
	(-0.01)	(0.00)
Constant	12.5068***	12.6258***
	(-0.01)	(-0.01)
R-sqr: within	0.183	0.102
between	0.161	0.109
overall	0.163	0.112
Number of Observations	350083	228953

*Note: all consumption variables are the natural log of per capita measures. Robust standard error in parentheses. Significance are denoted by asterisks with * p<0.1; ** p<0.05; *** p<0.01.*

6.3 IMPACT ON RURAL AND URBAN HOUSEHOLDS

The results obtained for Models 7 and 8 are presented in Table 9. These results reveal the contribution of mobile phone usage to household total consumption in rural and in urban households. After the regression, the households living in rural areas show a higher coefficient than those living in urban areas, implying a higher effect on household consumption in rural

areas than urban. For the rural households, the ownership of a mobile phone in the household is associated with an increase of 15.3% of per capita total consumption over rural households which do not own one. However, for the urban households, ownership of a mobile phone is only associated with an increase of 8.3% over urban households which do not have mobile phone.

Other interesting figures in the two models are the coefficients of insurance, head sex, and outpatient. In Model 7, health insurance being owned by the household has a negative effect on per capita total consumption for people living in rural areas. Even though households were covered by health insurance, their consumption was estimated to have decreased by 1.75%, implying that although the insurance is provided free of charge by the government, the insurance is not helpful for rural people, partly because of lack of health facilities and medical doctors in rural areas so that people cannot receive optimum benefits of the insurance when they have health problems. In Model 8, all other variables are significant at the 1 and 5 percent significance levels, except household head sex, indicating that whether the head of family is male or female does not have influence on per capita total consumption of households living in urban areas, while being a male head of household in rural areas has a positive and significant impact on household income. Nonetheless, the coefficient of the variable in Model 8 is not statistically significant at any level.

Table 9. Regression Results for Rural and Urban Households

Variables	Total Consumption	
	Rural Area	Urban Area
	M7	M8
Mobile phone	0.1421***	0.0798***
	(0.00)	(0.00)
House ownership	0.0175***	0.0814***
	(0.00)	(0.00)
Received work loan	0.0608***	-0.0560***
	(-0.01)	(-0.01)
Government rice subsidy	-0.0000***	-0.0000***
	(0.00)	(0.00)
Insurance	-0.0176***	0.0397***
	(0.00)	(0.00)
Household size	-0.1103***	-0.0680***
	(0.00)	(0.00)
Head age	0.0009***	0.0009***
	(0.00)	(0.00)
Head sex	0.0555***	0.0012
	(0.00)	(-0.01)
Job status	0.0097***	0.0436***
	(0.00)	(0.00)
Outpatient	0.0232***	-0.0269***
	(0.00)	(-0.01)
Inpatient	0.0447***	0.0383**
	(-0.01)	(-0.01)
Education diploma	0.1576***	0.1740***
	(0.00)	(0.00)
Constant	12.5405***	12.6327***
	(-0.01)	(-0.01)
R-sqr: within	0.203	0.099
between	0.188	0.159
overall	0.196	0.138
Number of Observations	471590	228954

*Note: all consumption variables are the natural log of per capita measures. Robust standard error in parentheses. Significance are denoted by asterisks with * p<0.1; ** p<0.05; *** p<0.01.*

6.4 IMPACT ON POOR RURAL HOUSEHOLDS AND OTHER GROUPS

Looking at Models 9 to 12, as shown in Table 10, mobile phones have a positive and statistically significant 1 percent impact on per capita total consumption. Surprisingly, among the four groups, i.e. poor rural, poor urban, non-poor rural, and non-poor urban, Model 10 reveals that ownership of a mobile phone has the highest impact on per capita total consumption for non-

poor households living in rural areas. This model shows an increase in total consumption of 14.21% over the same households without a mobile phone user. Mobile phone ownership shows a lower significant impact of 11.18% for the poor households living in rural areas, as presented in Model 9. Furthermore, in line with the third hypothesis, the impact of mobile phones on per capita total consumption is much lower for urban households than rural ones. As revealed in both Model 11 and 12, mobile phones have a significant positive impact on per capita total consumption for poor urban and non-poor urban groups, i.e. 5.6% and 5.8%, respectively. These results signify that people living in urban areas do not lack information and are more likely to use the mobile phone for personal reasons than their rural counterparts, so they are less affected by the impacts of mobile phone.

Particularly for Model 9 and 10, the above mentioned results confirm my hypothesis that although both groups experience a positive increase in their total consumption, the non-poor rural group enjoys a greater increase than their poor rural counterparts. The probable explanation is that the non-poor rural households have more means and sources of income to support their livelihood. For a more detailed explanation is that generally, the rural people in Indonesia can be placed into two categories: small business owners or producers and workers. This categorization reflects their differing current productive strategies, access to assets, and engagement with local economic processes. As mentioned earlier, agriculture remains a principal source of income for the majority of the country's population, especially for those rural households. Therefore, the job status of the rural households is farmers, farming traders or workers in the agriculture sector. Regarding their job status, the non-poor rural households are those who own land, as physical capital, and have access to financial capital to run their business, either by themselves and family

members, or with assistance from unpaid and paid workers. Meanwhile, the poor rural people are farming related workers because they do not have their own land or access to financial capital.

Table 10. Regression Results for Poor Rural Households and Other Groups

Variables	Total Consumption			
	Poor Rural	Non-poor Rural	Poor Urban	Non-poor Urban
	M9	M10	M11	M12
Mobile phone	0.1060***	0.1329***	0.0547***	0.0564***
	(0.00)	(0.00)	(-0.01)	(-0.01)
House ownership	0.0214***	0.0115	0.0523***	0.1116***
	(-0.01)	(-0.01)	(-0.01)	(-0.01)
Received work loan	0.0599***	0.0423***	0.0227	-0.0859***
	(-0.01)	(-0.01)	(-0.01)	(-0.01)
Government subsidy	0.0000***	0.0000***	-0.0000***	-0.2048*
	(0.00)	(0.00)	(0.00)	(-0.08)
Insurance	-0.0493***	0.0406***	-0.0233**	0.0740***
	(0.00)	(-0.01)	(-0.01)	(-0.01)
Household size	-0.1107***	-0.1068***	-0.1091***	-0.0933***
	(0.00)	(0.00)	(0.00)	(0.00)
Head age	0.0002	0.0014***	-0.0006*	0.0015***
	(0.00)	(0.00)	(0.00)	(0.00)
Head sex	0.0437***	0.0518***	0.0289**	0.0378***
	(-0.01)	(-0.01)	(-0.01)	(-0.01)
Job status	0.0219***	0.0133*	0.0484***	0.0518***
	(0.00)	(-0.01)	(-0.01)	(-0.01)
Outpatient	0.0315***	0.0103	0.0132	-0.0452***
	(0.00)	(-0.01)	(-0.01)	(-0.01)
Inpatient	0.0462***	0.0267	0.0237	0.0259
	(-0.01)	(-0.02)	(-0.02)	(-0.02)
Education diploma	0.1041***	0.1341***	0.0547***	0.1554***
	(-0.01)	(-0.01)	(-0.01)	(-0.01)
Constant	12.4823***	12.6070***	12.6230***	12.7574***
	(-0.01)	(-0.01)	(-0.02)	(-0.01)
R-sqr: within	0.197	0.184	0.184	0.082
between	0.178	0.175	0.175	0.056
overall	0.179	0.179	0.179	0.065
Number of Observations	274136	197454	75947	153007

*Note: all consumption variables are the natural log of per capita measures. Robust standard error in parentheses. Significance are denoted by asterisks with * p<0.1; ** p<0.05; *** p<0.01.*

In addition, for the non-poor rural group, the higher impact of mobile phone on its per capita consumption is related to the fact that a mobile phone is likely used as a production factor to improve their performance in economic activities. In this regard, non-poor rural households have more resources compared to the poor ones, so that they can take advantage of the

opportunities that their mobile phone gives them. Therefore, mobile phones can help them to start a new business and reduces costs of the existing business by helping them to secure better commodity markets and prices, increase sales, transfer of money, reduce transportation costs, bypass the middleman, and maximize the outcomes of business journeys. The mobile phone usage also increases the non-poor's productivity by allowing timely communication of business-related information with other producers in other regions and movement of their products to other places where they can make a better sale. As a result, the non-poor rural group can increase its business income and profits thereby achieve a higher consumption level.

However, for the poor rural group, due to the fact that most of the group members are workers who do not have physical and financial capital, a mobile phone can help them not solely to improve the performance of their economic activities. Rather mobile phone improves the group's livelihoods through some possible mechanisms. First, mobile phones can expand and strengthen social networks. By using a mobile phone, poor rural households not only receive support when they are in emergency conditions, but also give assistance to troubled relatives and neighbors. Second, as poor rural people are workers, mobile phones enable them to search for jobs. For illustration, the porter who spent his days hanging around outside of farming and constructions sites and hoping to be hired to carry crops and construction materials can now go only where the jobs are available or when they receive a call from their partners.

7.0 CONCLUSION AND IMPLICATIONS

7.1 CONCLUSION

This study examines the impact of mobile phones on household welfare in Indonesia based on national survey data. Using two different mobile phone variables and three different household welfare measures, all regressions confirm that mobile phone ownership had a positive and significant impact on per capita total consumption during the period 2006 – 2008. The impact ranged from 5.6% to 15.3% in the increase of per capita total consumption, depending on the regression model chosen. This result indicates that households use mobile phones to improve their economic performance, particularly as a means of finding resources and information linked to economic benefits.

The impact of mobile phone usage was higher for the poor households and households living in the rural areas. If a poor household owned a mobile phone, the per capita total consumption was estimated to have increased by 9.5% during the years 2006 to 2008, an increase slightly greater than that of the non-poor households, which is 9.4%. Moreover, a comparison between urban and rural areas reveals that mobile phone ownership had a much higher impact on rural households, with a 15.3% increase in rural household consumption compared to an 8.3% increase in that of urban households. Indeed, this evidence refutes some assumptions that the rural poor are not able or not willing to pay for mobile telecommunication

services and that the constraints of rural areas, such as low population density, lack of education and electricity, low awareness, low disposable income, and poor health and living conditions, would prevent mobile phone adoption, as pointed out by Bhavnani et al. (2008). In fact, the mobile phone usage is shown to have the potential to reduce poverty and improve incomes of rural households and their livelihoods.

However, if the variables poor and rural are considered together, the impact of mobile phone on per capita total consumption is higher for non-poor rural households. The magnitude of the impact is an increase in total consumption of 14.21% if the non-poor rural household is a user of a mobile phone which compared to the 11.18% increase of the poor living in the same areas. This finding indicates that the non-poor rural group enjoys more benefits than poor rural counterparts from mobile phone usage, mostly because they have more means and sources of income to support their livelihood, where the mobile phone is used as a supplement means or as a production factor to improve the performance of their business.

As one of the few studies that closely examines the impact of mobile phone ownership on household welfare in Indonesia, this study contributes to the growing literature of mobile phone and ICT in general, and their impacts on economic development, especially at the national level, contrasting with most of the current empirical studies in this field, which are case specific to a certain area. Nevertheless, this study does not empirically capture the mechanism through which the mobile phone has an impact on household welfare. Given the unprecedented growth of the mobile phone industry and the number of subscribers in Indonesia, and the fact that there is no empirical study which explores the potential effects of mobile phones on its users, this research is expected to open up the field for further research.

7.2 IMPLICATIONS

This research has two main implications. First, by revealing that mobile phone ownership has a strong impact on rural households, this study questions the commonly held belief that private investment in ICT is more valuable in urban areas than in rural areas. It is likely that the reason that many Indonesian rural people do not have a mobile phone is more related to people's information needs and types of information available via mobile phone services rather than to the cost or skills required to use a mobile phone. Moreover, the high costs associated with the expansion of mobile phones networks in rural areas is also related to the lack of electricity, which people cannot charge batteries and power mobile telecommunications base stations. However, there is an emerging trend in the development of mobile phone-based applications in that they go beyond basic voice calls and text messaging to include data transfer, mobile web, and video and audio recording and sharing. If these services are available and provide information useful for their livelihoods, the rural people are willing to pay for it. Accordingly, a practical implication of this study is that it would be beneficial for mobile phone companies and applications providers in Indonesia to expand mobile phone coverage and provide services which satisfy the information needs of the rural people. For the provision of electricity, there is also small scale alternative energy solution, such as wind, solar and thermal, for powering base stations and mobile phone batteries, which can provide a feasible way to expand mobile services to rural populations and isolated areas in Indonesia.

Second, this study also demonstrates that mobile phones and ICT in general, have the potential to be used as a means in reducing poverty. ICT is not an area that has been well-integrated into the national poverty reduction strategies in Indonesia. More importantly, most of the beneficiaries of the ICT development in the country have been those with resources and

skills, leaving out the majority of the poor. With the unique characteristics of the poor populations, the present government's policy on lowering the national poverty rate, and the potential of mobile phones to act as a direct source of livelihood for poor people, therefore, different approaches involving the intervention of the Indonesian government are needed. Possible policies could include the public sector taking a role in: (a) including ICT as a tool for poverty reduction; (b) facilitating the poor gaining affordable access to information by persuading the mobile phone companies to reduce costs and increase mobile phone distribution as widely as possible; (c) developing locally relevant content and design for both product and social technologies which meet the needs of the poor.

7.3 VALIDITY AND FUTURE RESEARCH

Although my study's findings suggest that mobile phone ownership has a positive and significant impact on household welfare in Indonesia, indeed, interpreting the results should also be done with care. In terms of internal validity, which has to do with the accuracy of the results, my study has used national survey data conducted by a national statistical agency. As a result, the samples of the survey are selected randomly. However, my results did not identify the impact of mobile phones on food and non-food consumption over poor and non-poor groups and households living in rural and urban areas. Distinguishing these two kind of consumptions are important because an increase in non-food consumption means individuals are engaged in productive economic activities which seem to be one of important determinants for them to become an active seeker of information (Song, 2003). The non-food consumption is also generally found to be increasing function of real income, and thus can be considered a valid welfare indicator and can be used as

a proxy for household welfare (Huppi & Ravallion, 1991). Furthermore, in terms of external validity, which has to do with the generalizability of the findings to the population, I only capture the impact of mobile phones in the Indonesian context and had no intention to generalize the findings into a larger population. Therefore, this study has no threat to external validity.

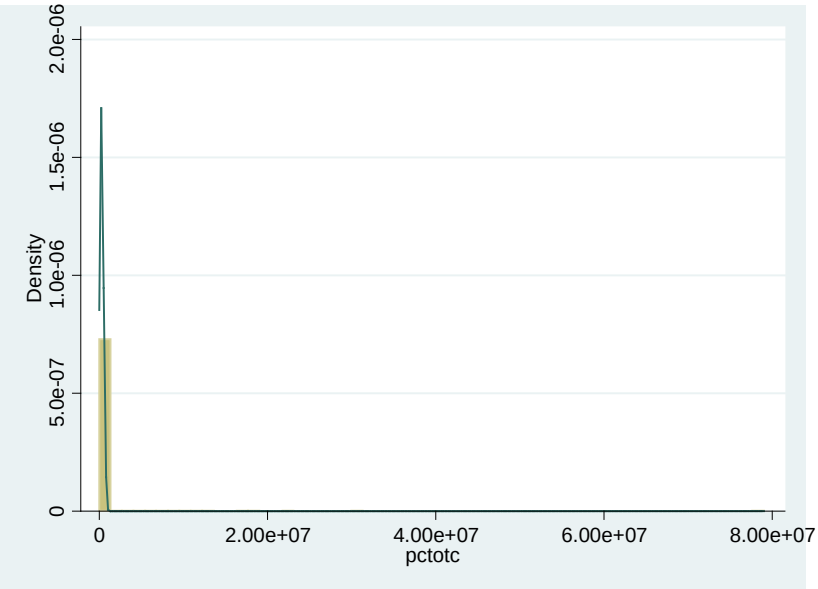
Given the above mentioned validity and the fact that this study's results provide preliminary evidence that mobile phone ownership has potential impacts on economic development, especially in Indonesia, however, my results are a first step in understanding how mobile phone ownership impacts household welfare, and hence imply three directions for future research. The first research direction is motivated by the fact that ICT includes a wide range of essential tools for sharing information, such as fixed telephones, computers, and internet. Provided the availability of such data in Susenas, it would be interesting to estimate and compare which of the ICT instruments has the highest impact on household welfare in Indonesia. Most importantly, with the same models and variables used in regression, this research should distinguish the impact of mobile phones on food and non-food consumption over poor and non-poor groups as well as households living in urban and rural areas.

The second research direction would be to identify the appropriate mobile phone applications and services for different groups of users. The mobile phone handset has different features and functions which can be used in diverse ways. Exploring who uses what mobile communications services, what factors influence ownership, use, and non-use of mobile phones, and which utilities are appropriate for different users can yield a better understanding of the function of the mobile phone as a complex technology. This survey research type can further compare the utility of the mobile phone to basic connectivity, or texting to voice, or voice compared to newer features such as mobile-Internet, m-commerce, or m-banking.

The third research direction is related to exploring the empirical mechanisms through which the impact of mobile phone usage materializes. I was not able to present those mechanisms in this study because of limited data, time, and resources. Identifying the mechanisms is the most significant direction future research can take in order to classify and maximize the economic benefits for the mobile phone users, especially those are categorized as being at the Bottom of Pyramid (BoP), the largest, but the poorest sector of the population. Mohammad Yunus (2008) predicts that "the future of poverty, as I see it, will be decided by the technological devices and services that are designed a priori for poor people." Therefore, involving poor people in the BoP, both in urban and rural areas in Indonesia, in experimental research of the ICT-related technologies, is an area of study important to pursue.

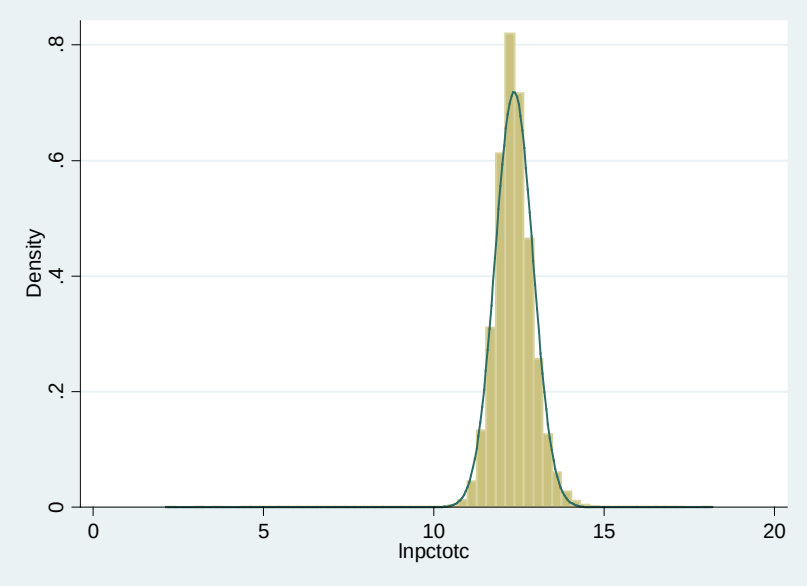
APPENDIX A

DATA DISTRIBUTION OF PER CAPITA TOTAL CONSUMPTION



APPENDIX B

DATA DISTRIBUTION OF NATURAL LOGARITHM OF PER CAPITA TOTAL CONSUMPTION



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