Diffusions of Mobile Cellular Phones in East, Southeast, and South Asia

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Abstract--**This paper will examine the patterns of diffusion of mobile phones of 25 countries in the East, Southeast, and South Asia (ESS Asia) for the period between 1995 and 2010. We will first examine the growth patterns in the number of mobile phones in the world and in the ESS Asia. We will then examine mobile and fixed phone uses per 100 inhabitants. Comparisons of the total number of mobile phone uses between countries are not as useful because of the differences in their population sizes. We will examine how mobile phones per 100 inhabitants fared relative to their fixed phone per 100 housefolds at several different points in time. We will then examine how the rankings of the countries with respect to mobile phone per 100 changed at different points in time and explore their implications. Finally, we will carry out the usual multivariate statistical analysis to identify the economics and cultural variable that may influence the behavior of mobile phone uses. .**

I. INTRODUCTION

In 2013, there were about 6.8 billion mobile phone subscribers in the world[1]. With an estimated population of 7.1 billion in the world for 2013, we can state that the number of mobile phone in use in 2013 were about 96 percent of the world population. International Telecommunication Union (ITU hereafter) which publishes statistical data on the use of mobile phones for countries in the world has not published mobile phone related data for individual countries in the world for 2013. However, 2012 data are now available. Our calculations show that the total number of mobile phones for 228 countries in the world in 2012 was 6.317 billion and that for 25 countries in East Asia, Southeast Asia and South Asia (ESS Asia from hereafter) was 3.177 billion. This means that ESS Asia had 50.3 percent, slightly more than half, of the world's mobile phones in 2012. We also find that, in terms of the number of mobile phones in use, six of the world's top ten countries in 2012 are in ESS Asia.

- (http://en.wikipedia.org/wiki/List_of_countries_by_number_of_mobile_phones_in_use)

Even though ESS Asia dominates in terms of mobile phone uses, we did not find any study of the mobile phone uses for the ESS region as a whole or any of East Asia, Southeast Asia, or South Asia. This is an attempt on our part to make an initial attempt.

II. LITERATURE REVIEW

Our survey of literature did not lead to any study that deal with mobile phone growth patterns for either the entire ESS Asia or any of its three regions – East Asia, Southeast Asia or South Asia. However, there are studies that deal one country or a group of countries.

Chu, Yuntsai and Kung-Chung Lie [7] describe the cause of Taiwan's unprecedented mobile phone growth and provide policy solution for countries that strive to improve their telecommunication sectors in a short time scale. The paper highlights the role of asymmetric regulation rather than pure liberalization in the creation of the deregulated telecommunication industry in Taiwan. The asymmetric regulation in Taiwan is a twofold framework: dominant carrier vs. mobile companies. They conclude that dualistic asymmetric regulation leads to higher growth for mobile competitors and raises the total mobile penetration rate.

Singh, Sanjay Kumar [18] using S-Shaped Growth curve estimated that mobile phone subscriptions per 100 for India will increase from 8.1 in 2005-2006 to 36.5 in 2010-2011 and the total number of mobile phone subscriptions will increase from 90 million in 2005-2006 to 433 million in 2010-2011. We found that both of his estimates for 2010-2011 are gross underestimates. According to ITC data, subscription per 100 for 2010 is 61.0, almost twice that of his estimate, and total number of subscriptions for 2010 is 752 million as opposed to 433 million.

Tom Wright and Yayu Yuniar [19] provides information on the growth of mobile surfing market in the third world countries such as Indonesia, Russia, and Egypt and that using mobile phones to surf the Internet is booming in emerging markets. The paper reports that using mobile phones to surf the internet is growing. It reports that the strongest growths are occurring in places with poor fixed phone communications.

Chu and Pan [6] build and test multi-generation and multi-products diffusion models of mobile cellular phones diffusions for Taiwan. They point out that varying stages of the S-shaped diffusion curves have not been analyzed by longitudinal studies. Their study is to determine whether the best model applies to an entire diffusion life spanlife span. Mobile telephone subscriber data for Taiwan during 1988–2007 are analyzed to compare the performance of three popular diffusion models and one well-known forecasting model—the Gompertz, Logistic, Bass, and time-series autoregressive moving average (ARMA) models. Their studt indicates that the Gompertz model outperforms the other models before diffusion take-off, and the Logistic model is superior after inflection and over the aggregate range of the diffusion.

Auero, de Silva, and Kang [1] analyzes patterns of expenditure on mobile phone services at the bottom of the pyramid (BoP) of six Asian countries – Bangladesh, Pakistan, India, Sri Lanka, the Philippines, and Thailand. The purpose of the study is to examine whether mobile phones services in these countries display characteristics of a luxury good or those of necessity. They first examine the

expenditure patterns of mobile phones among the five income groups within the BoP. Then, they estimate the income elasticity of mobile phone services using Engel curve. They conclude that mobile phones are necessity at the BoP.

Akiyoshi, Mito and Hiroshi One [2] point out that, in Japan, mobile phones become increasingly popular medium of accessing the Internet and email, especially those who do have affordable access to computers. The lower startup cost and easier overall access of mobile phone relative to personal computer suggest that the mobile phones may be a possible alternative to for overcoming unequal access information and communication technology in Japan. Using micro data of 2001, the authors compare and contrast the determinants of mobile versus computer based Internet in Japan. Their findings show that mobile Internet access, as compared to computer access, is determined less by demographics, socioeconomic status, and technological readiness suggesting that the barrier is the case of computers.

De Silva and Ratnadiwakara [9] examines influence of various social factors that influence mobile phone adoptions at the bottom of the pyramid (BoP) in Bangladesh, Pakistan, India, Sri Lanka, Philippines and Thailand. They argue that,based on existing theoretical framework, adoption is modeled by fitting logit model to a six country dataset. They find evidences of social influence on mobile phone adoption and go on to argue for using mobile phone services for poverty at the BoP and similar other countries.

Yeow, Paul H.P and Yen Yuen and Regina Connolly [20] examines the factors that influence consumer satisfaction with mobile telephone use in Malaysia. The study observed that people in Asia and particularly in Malaysia peer chatting and family coordination increase the overall mobile satisfaction while health concerns and public disturbance decreases it.

Carol Ko [13] discuss the development of mobile applications in Macau and the importance of managing data privacy and shortage of information technology. The paper lists several challenges that Macau's industries need to consider. Among them are tracking booking behavior of customers through segmentation, knowing what devices customers use to access retail services, and expanding value added services of mobile applications for 3G subscribers.

Jeffrey Robin and Assa Doron [17] tracts many different facets of Mobile Phone communication in South Asia, particularly relating to economy, politics, and social practices. The paper points out that of 900 million mobile phones users in 2012, 96 percent of them on cell phone, and majority of them are poor. At the same time, mobile phones provoke bitter struggle among India's biggest business houses and branches of government. The essay attempts to gain insight into the most important aspect of mobile phone: the sheet variety of activities on which it imparts.

Asif Khan and Muhammad [12] This is an empirical study of service quality of mobile phones for Pakistan. The study found that the adaptive SERVICEQUAL with additional dimensions is a valid instrument to measure service quality in the mobile phone services. However, inclusions of additional dimensions would make it more comprehensive for telecommunication services. The dimensions of network quality, convenience, and reliability are important aspect that needs managerial attention to attract and retain customers.

Wai-Chi Chu [5] provides a preliminary examination of the uses of information and communication technology – limited to mobile phone and Internet use – in contemporary China. The paper shows how Chinese cultural traits and speed of evolution in China have combined to bring unique cyber experience.

Chan, Shirley; Douglas Voget, and Louis Ma [4] about an ethnographic study of the culture in Hong Kong that the cultural characteristics of fast pace, deal making, and cense of urgency explain why Hong Kong people are receptive toward such interruption and have the habit of participating in both physical and mobile space at the same time.

Ann, Peng Hwa, Shyam Tekwani and Guozhen Wang [3] The paper describes the attempts made by the King of Nepal to shoot down the uses of mobile phones in order to improve security against insurgents in 2005. Prepaid mobile phone services were forced to stayed off for 88 days. The insurgents had to develop their own parallel communication network. The net impacts were hurting the economy, alienating the public, perhaps eventual downfall of the King.

Chan, Shirley; Douglas Voget, and Louis Ma [4] made an ethnographical study on the culture in Hong Kong that the cultural characteristics of fast pace, deal making, and sense of urgency explains why Hong Kong people are receptive toward such interruption and have the habit of participating in both physical and mobile spaces at the same time.

Chu, Web-Lin and three others [8] compares the performance of three conventional models for Taiwan, namely Gomprez, Logistic, and Bass to identify the most appropriate model, and to distinguish the forces driving the diffusion rate. Their results indicates that the most appropriate model is the Logistic model. Economic conditions, technogical innovations and number of other operations are insignificant factors. Their study also shows that mobile telephones is substitute for fixed line telephones in Taiwan.

Xia, Jun [14] discuss China's current prevailing 2.5 G mobile phone uses, not compeling need to move into 3G and yet needing to be adopt 4G and beyond. To this end, China is confronted with challenges in re-examining its industrial policy as well as technological strategies. The study offers heuristic analysis and innsights based on archiaval document reviews and personal interviews.

Libredo, Filix and Others [15] explore the possibility of using cell phones and short messaging services (SMS) for formal and non formal education in Phillipines and Monglia and point out that their experiements yielded positive reactions from students and trainees.

Noor, Mohd Nazri; Jayashree Sreenivasan and Hishamud Ismail [16] applied Structural Equation Modeling (SEM) to evaluate Malaysian consumer attidute toward moblile advertising and their purchasing intentions. The results of

SEM demonstrated significant relationship between the consumer's attitude toward mobile advertising, subjective norms, and perceived perceived behavioral control and their intention to purchase products and services.

III. DATA

Two data series play critical role in this study. They are telephone and cell phone subscription data. Data on Telephone Lines Subscribers per 100 and Cellular Telephone Subscriptions per 100 inhabitants, both of which are provided by International Telecommunication Union (ITU). The data series that we have actually used for this study are from World Telecommunication/ICT Indicators Database, 15th Edition, 2011. All charts in this paper where cell phones per 100 inhabitants, fixed phones per 100, or both have been presented are based on data found in this database.

According to the technical notes of ITU, Telephone Lines refers to telephone lines connecting customer equipment such as telephone sets or facsimiles to the Public Switch Telephone Network (PSTN) and have dedicated ports on a telephone exchange. The data also include public payphones where some countries include ISDN and ASDL channels. Mobile cellular phones refer to cellular technologies that provide access to the PSTN. These include analogue and digital cellular systems including IMT-2000 (Third Generation, 3G). Both postpaid and prepaid subscriptions are included. Prepaid subscriptions are those where accounts have been used within a reasonable period of time (e.g. 3 months). Inactive subscriptions, prepaid cards where a call has not been made or received within the last 3 months, are excluded. Mobile cellular telephone subscriptions per 100 inhabitants are calculated by dividing the number of mobile cellular telephone subscriptions by the total population and then multiplying by 100. Subscriptions should be distinguished from users. Subscription*s* are taken by entities such as businesses and individuals and may be prepaid or postpaid.

ITU provides statistical data on the number of personal computers (PC) in countries. The ITU publication does not explain how this data was obtained and how reliable is the data itself. According to an UN document, only a few countries publish reliable data on personal computers (PC). Because of the difficulties in getting data on the actual numbers of computers, most estimates are based on the shipment data taking into account the probable numbers of computers based on the estimated life of the computers.

There are three sources for GDP-PPP (GDP adjusted for purchasing power parity per capita) for 2012. They are World Economic Outlook Database of IMF that contains GDP-PPP for 187 countries, GDP-PPP & Population of World Bank July 2012 that contains GDP-PPP for 180 countries, and GDP-per capita (PPP) of the World Fact Book, Central Intelligence Agency April 2012 which contains GDP-PPP of 195 countries. We used GDP-PPP of IMF. We should point out that Wikipedia uses IMF's GDP-PPP in its country reports. We should also point out that ITU publishes data on GDP but not adjusted for price.

The figures from the report represent a mixture of data collected by the CIA World Fact Book national self-reported data. Where data was unavailable older figures were used. For highly developed/high income countries where literacy statistics were not collected, a rate of 99% was assumed.

Data on Literacy Rates were obtained from Wikipedia on December 1, 2013. Wikipedia obtained this data from United Nations Development Program Report 2009, which was based on April 2007 report of UNESCO Institute of Statistics relating to adult literacy rates of the countries in the world. In collecting literacy data, many countries estimate the number of literate people based on self-reported data. Some use educational attainment data as a proxy, but measures of school attendance or grade completion may differ. It is recommended that because both definitions and data collection methods vary across countries, literacy estimates should be used with caution.

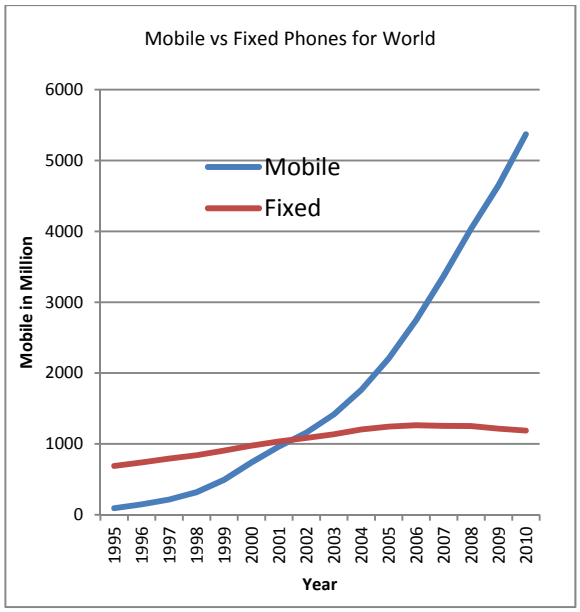
IV. MOBILE VS FIXED PHONES FOR WORLD VS EAST, SOUTH, AND SOUTHEAST ASIA

Figures 1A and Figure 1B show the total number of mobile phones and that of the fixed phones for the world and for the countries in the East, South East, and South Asia (will be referred as Asia from here after).

They show that the number of mobile phones grew exponentially for both the world and the ESS Asia while the number of fixed phones did not grow much for both the world and the ESS Asia.

The total number of fixed phones in 2010 was only1.7 times that of 1995, a compound growth rate of about 3.6 percent during this 15 years period. However, that for the total number of mobile phone phones in 2010 was 59.1 times that of 1995, a compound growth rate of 31.2 percent. Cross over between fixed phones and mobile phones occurred in 2002. For the ESS Asia, the total number of fixed phone in 2010 was 3.1 times that of 1995and 2.7 times that of 1996 whereas the total number of mobile phones in 2010 was 118.2 times that of 1995 and 57.8 times that of 1996. Cross over between fixed phones and mobile phones also occurred in 2002. The two figures above also show that, for both the world and the ESS Asia, total number of fixed phones grew until about 2006 and remain the same for the world and slightly declined for the ESS Asia.

In Figure2A and Figure 2B, lines labelled Actual are the the number of mobile phones presented in Figure 1A and Figure 1B. The lines labelled Constant depict what the Actual lines would have been if the mobile phones grew at a constant rate during the entire period 1995-2010. Note that the constant growth lines are below the Actual lines. This observations suggest that the actual growth rates for the mobile phones for the world and the ESS Asia were higher during the earlier parts of the 1995- 2010 period.



Figures1A: Number of Mobile and Fixed Phones for World

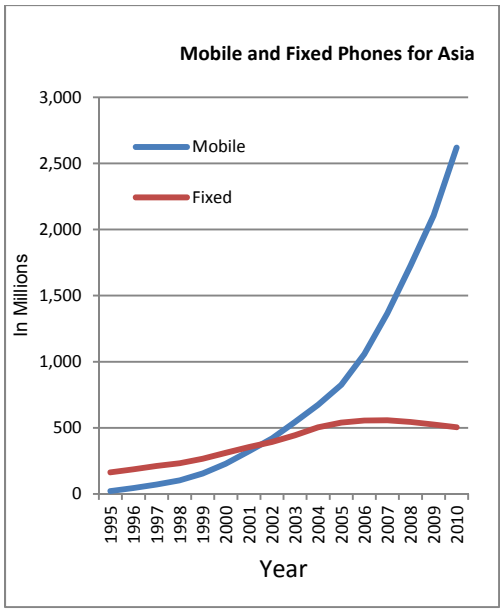


Figure 1B: Number of Mobile and Fixed Phones for ESS Asia

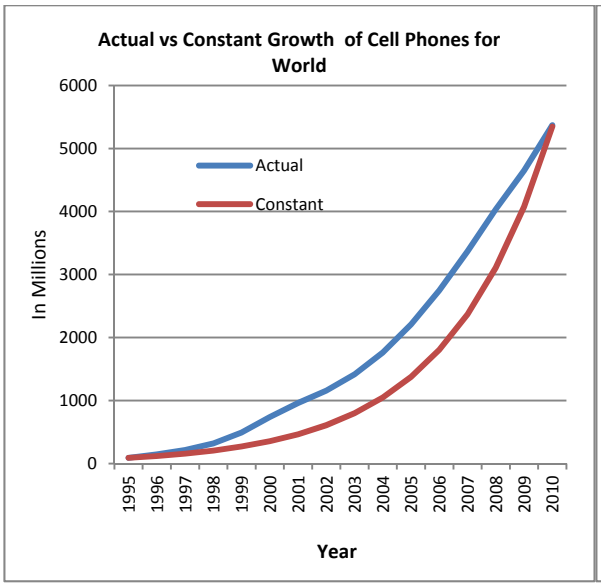


Figure 2A. Mobile Phones Subscriptions of World

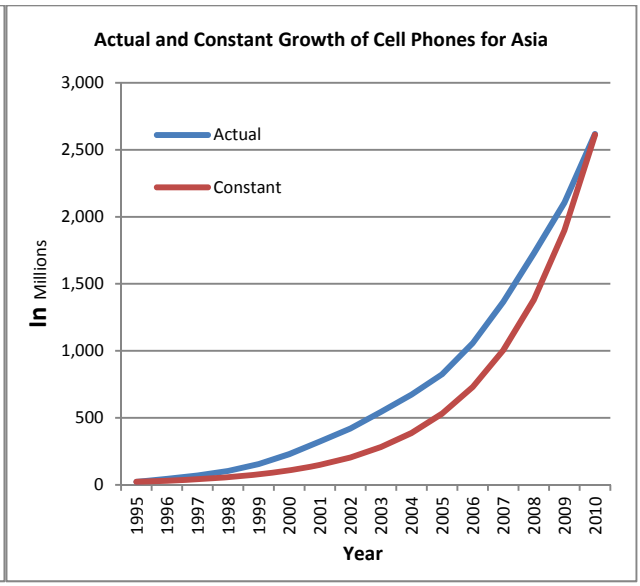


Figure 2B: Mobile Phones Subscriptions for Asia

Figures 3A and 3B show the annual percent increases in the number of mobile phones. Figure 3A shows that the percent increase started with 60percent in 1996, increased to about 95 percent in 2000, and then steadily declined to about 28% in 2010. Figure 3B shows that the annual percent increase in the number of mobile phone started with about 50% in 1996, steadily declined to about 20% in 2005, and remained appromately 20% since then. These observations show that the number of mobile phones grew more rapidly during the earlier part of the 1995-2010 period, supporting our observations regarding Figures 2A and 2B.

V. MOBILE PHONE PER 100 VERSUS FIXED PHONES PER 100

One interesting observation is how the reliance on fixed and mobile phones has changed over the years for the individual countries in the ESS Asia. For this, we created XY charts where the horizontal axis depicts fixed phones subscriptions per 100 and Y axis depicts mobile phones subscriptions per 100. A line is drawn from the origin in such way that a point on that line depicts equal uses of both types of phones. A country below that line would indicate that it uses more of fixed line phone than mobile phones, for example. We have created charts for four selected years – 1996, 2001, 2006, and 20011.

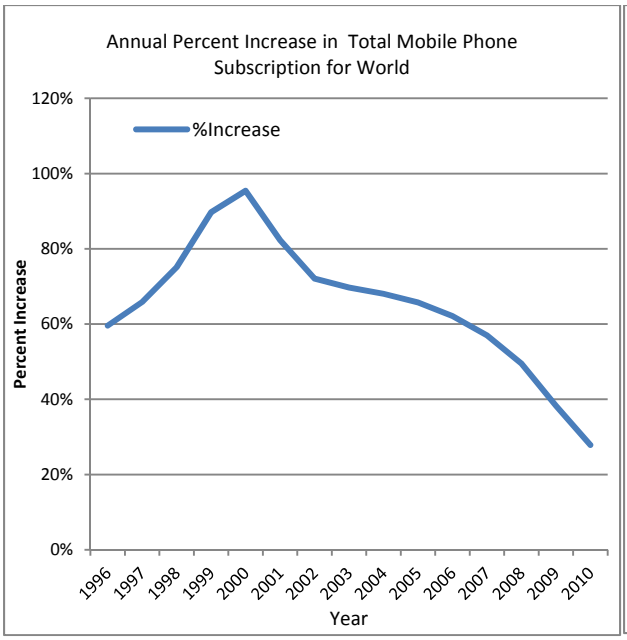


Figure3A. Annual % Increases of World Number of Mobile Phones

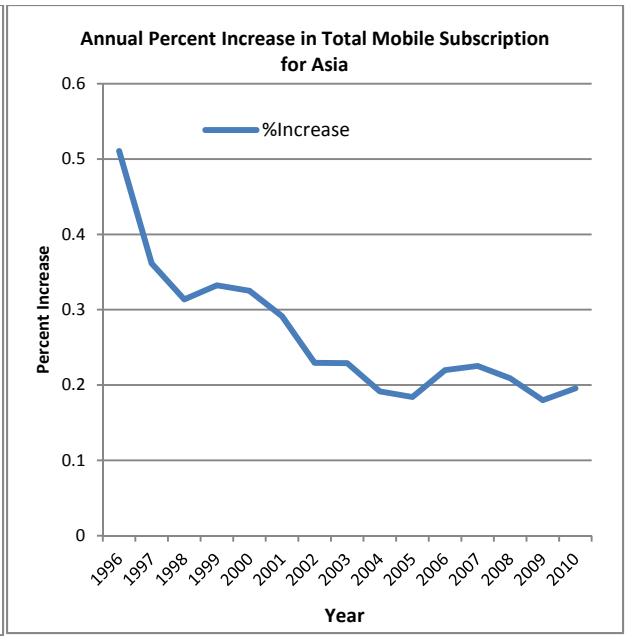


Figure 3B: Annual % Increases of Asia Number of Mobile Phones

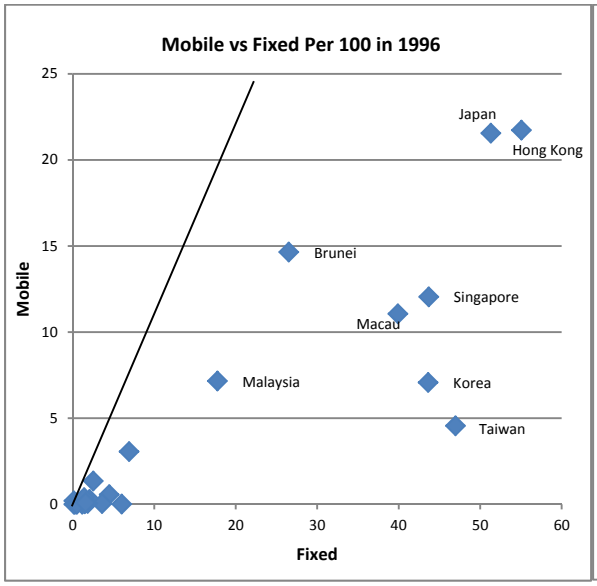


Figure 4A: Fixed vs Mobile Penetration in 1996

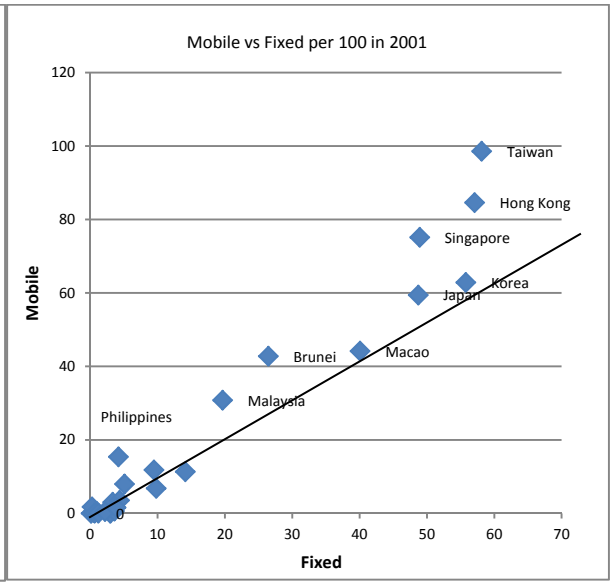


Figure 4B: Fixed vs Mobile Penetration in 2001

Figure 4A, a chart for 1996, reveals that there is not any country either on the line or above it. This observation is not surprising in view of the fact that most countries in the ESS Asia did not have mobile phones in 1996. Figure 4B, a chart for 2001, reveals that about one half of 25 countries had more mobile phones per 100 than the fixed phones per 100. Note that the countries have more mobile phones per 100 than the fixed phone per 100 are indicated on Figure 4B. The list includes Hong Kong, Singapore, Korea, Japan, Macau, and Brunei, economicall developed countries at the time.

Figure 4C, a chart for 2006, reveals that, with an exception of Myanmar, all of the remaining countries are above the Fixed=Mobile line. Figure 4D, a chart for 2011, shows that, with exceptions of Myanmar and Nepal, the remaining twenty three countries have mobile phones per 100 that exceed their fixed phones per 100 by at least 50.

VI. MOBILE AND FIXED RATIOS

A ratio of mobile phone subscriptions per 100 to fixed phone subscriptions per 100 is another measure of the importance of mobile phones relative to fixed phones. This ratio is a measure of importantce of mobile phone uses relative to the ues of fixed phones. A ratio of less than 1 for a country indicates that the mobile phone uses for that country is less than that of fixed phone uses.

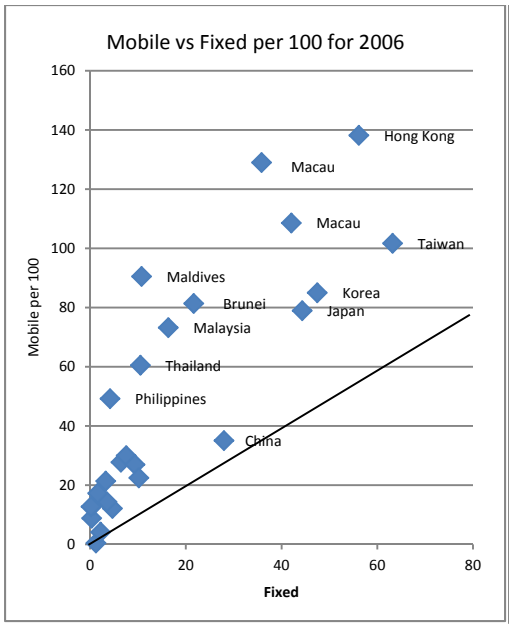


Figure 4C : Fixed vs Mobile Penetration in 2006

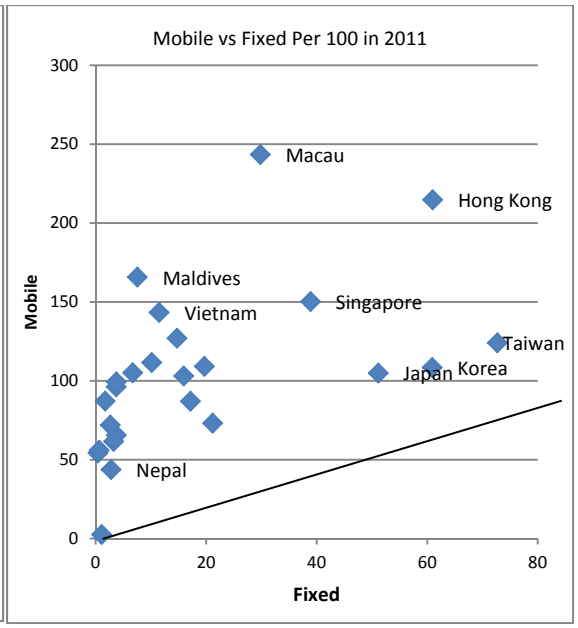


Figure 4D: Fixed vs Mobile Penetration in 2011

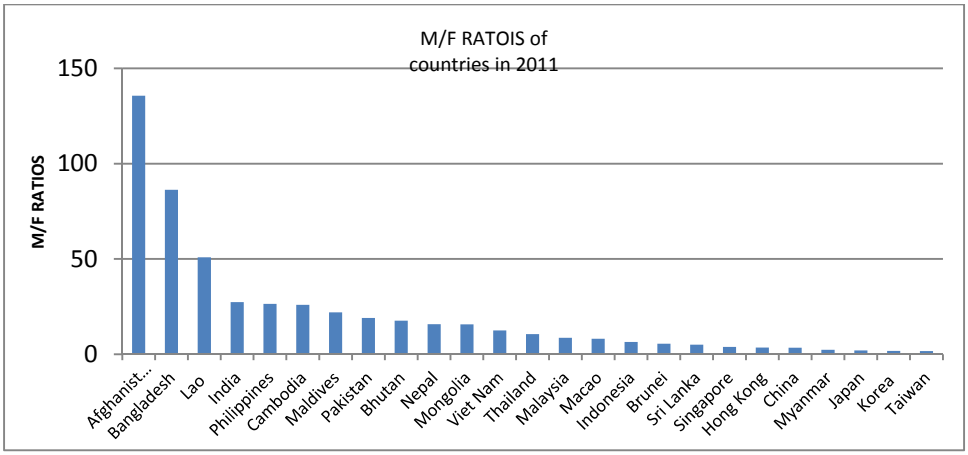


Figure 5: M/F Ratios Of Countries

However, an extremely high value of M/F ratio may also be attributable to an extremly low value of fixed phone per 100, like the cases of Afghanistan, Bengladash, and Lao where fixed phone uses are extremely low, for exampe, 4 per 1000 for Afghanistan.

A more useful chart may be provided by Figure 6 below where M/F ratios are presented with corresponding fixed phones per 100.

Figure 6 shows that those countries such as Macau, Singapore, Japan, Hong Kong, Korea, and Taiwan, all with mobile phones per 100 exceeding 100, also have very low M/F ratios. As shown on Figure 6, these are due to the fact that these countries have well established fixed phone infrastructure to support the needs of their business firms.

VII. SHIFTS IN THE RANKING OF MOBILE PHONES PER 100

One interest observation is that of Shifts in the ranking of countries with respect to their mobile phones per 100 during the period 2001- 2010, a span of ten years. Figure 7A presents Mobile Phone per 100 for 2001 arranged in descending order. We note that the top 5 countries are Taiwan, Hong Kong, Singapore, Korea, and Japan in that order and the bottom five countries are Bangladesh, Nepal, Myanmar, Bhutan, and Afghanistan in that order.

Figure 7B presents mobile phone per 100 in descending order for 2006. We note that Macau and Maldives joined the top five and Korea and Japan moved out of the top 5. Note that Macau moved from the 5th to 2nd but Maldives moved from the 12th to the 5th. As for the bottom five, Bangladesh moved out to the next higher group. Within the bottom 5, Myanmar moved down to the bottom of the group.

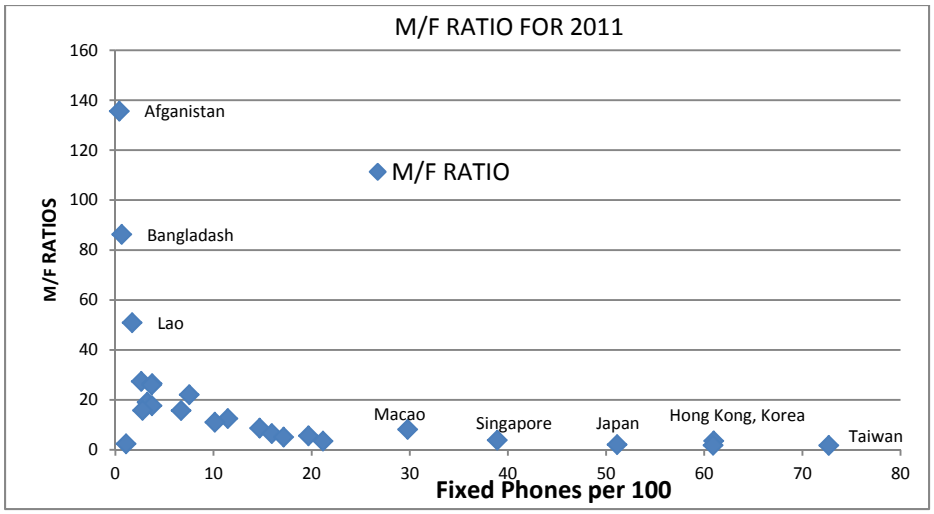


Figure 6: M/F Ratios for the ESS Asia

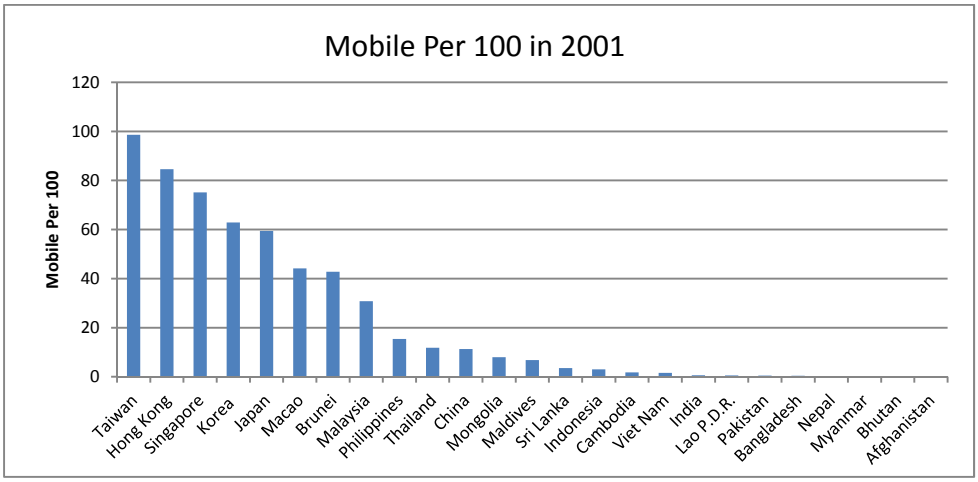


Figure 7A: Mobile Phone per 100 in 2001

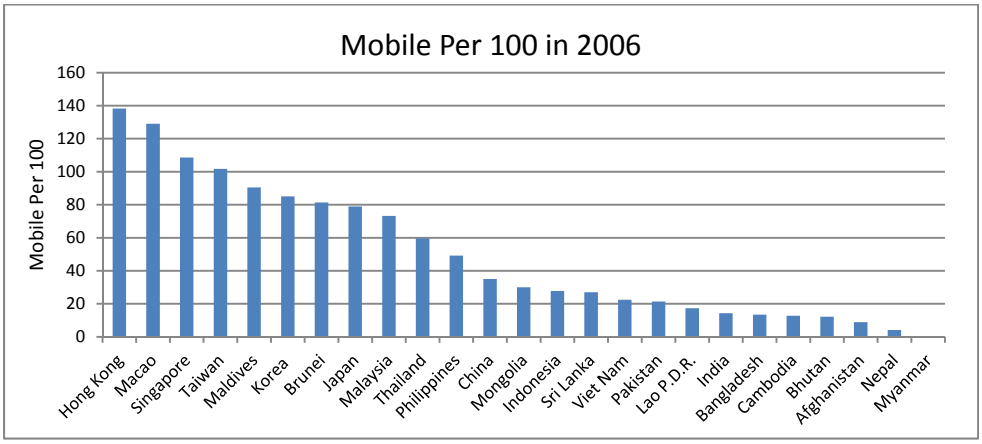


Figure 7B: Mobile per 100 in 2006

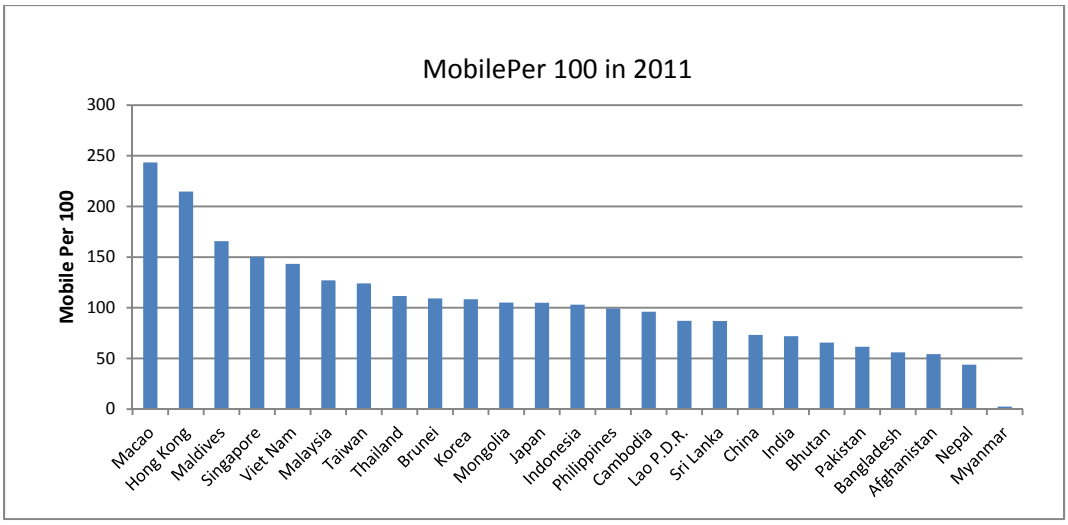


Figure 7C: Mobile per 100 in 2011.

Figure 7C presents mobile phone per 100 in descending order for 2011. We note that Taiwan dropped out of the top 5, replaced by Vietnam. We also note that Pakistan moved down to the bottom 5 and Bhutan moved out of the bottom 5. We should also note that Myanmar remained as the bottom of the bottom 5 group.

Figure 8A below shows how the top 5 countries changed during the period 1995 – 2010. It shows that the top 5 for 1995, 2001 and until about 2005 included Korea and Japan. However, Maldives rose from nowhere in 2000 to overtake both Korea and Japan in 2006. It rose from 7 in 2001 to 91 in 2006 which constitutes 1,200 percent rise during a period of 5 years. It became one of the top 5 in 2006 and remained one of the top 5 in 2011. This phenomenal rise of Maldives from nowhere to become of the top 5 perhaps is not surprising. Maldives is one of the three islands – archipelago in the Indian Ocean along with Seychelles and Mauritius off the east coast of Sub Sahara Africa. All three countries are thought as traveler's mecca with large numbers of visitors. Maldives had about one million visitors in 2011. Seychelles and Mauritius are two Sub-Sahara countries with the top and 4th highest mobile phone per 100.

An interesting observation during the period 2001 - 2011 is the spectacular rise of mobile phone per 100 for Vietnam. It rose from 22 in 2006 to 175 in 2011, 760 percent during the 5 year period between 2006 and 2011, placing it as the top 3rd surpassing Maldives. Another interesting observation is that Macau was not one of the top 5 until about 2003 but became one of the top 5 countries and surpassed Hong Kong in 2008 to become the top 1and remained as the top 1ever since. An unusual observation is that of Taiwan. It started with 3.6 in 1995 and steadily increase to 115 in 2003, started to decline in 2004 and declined to 98 in 2005, and then began to rise again 2006 and reach rose to 124 in 2011. It

Figure 8B bellow shows the bottom 5 countries during the period 2001- 2010. Period 1995 – 2000 has not been included because of their low values. For year 2001, Bhutan and Afghanistan were two lowest countries with 0 values. For 2006, note that Pakistan is not a part of the lowest 5. For 2011, note that Pakistan is a part of the lowest 5 replacing Bhutan.

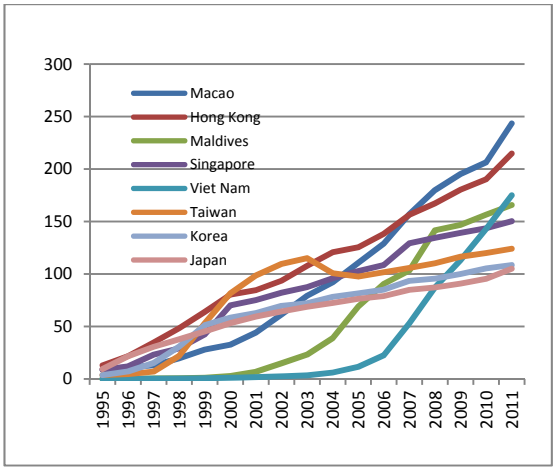


Figure 8A: Top 5 in 1995, 2001, 2006, 2011

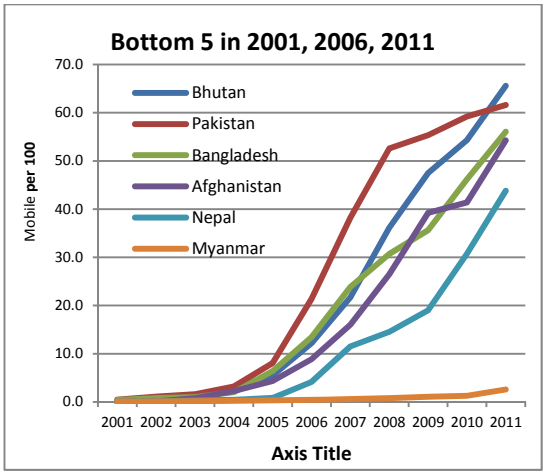


Figure 8B: Bottom 5 in Year 2001, 2006, 2011

We should also note that all of these countries with exception of Myanmar are countries in South Asia. We also note that mobile phone per 100 for Myanmar essentially remained zero throughout. We suspected that this phenomenon may be attributable to the fact that the military rulers of Myanmar, until about 2011, attempted to suppress news and prevent exchanges of views by its citizen through mobile phones[2,3].

- http://en.wikipedia.org/wiki/Internet_in_Burma

VIII. REGRESION MODELS

In this part, we will examine wheather the mobile phone per 100 be related to other economic and societal variables such as GDP-PPP, Fixed Phones per 100, and Literacy rates. We will examine the outputs of regression models. Before that, we will examine XY graphs between mobile phone per 100 and these other variables. What is not provided by the regression model outputs are how some countries in the model deviated, above or below the regression lines. Nevertheless, we have indicated how some of the countries with relatively high mobile phone per 100 deviated from the regression lines for the different explanatory variables of our models.

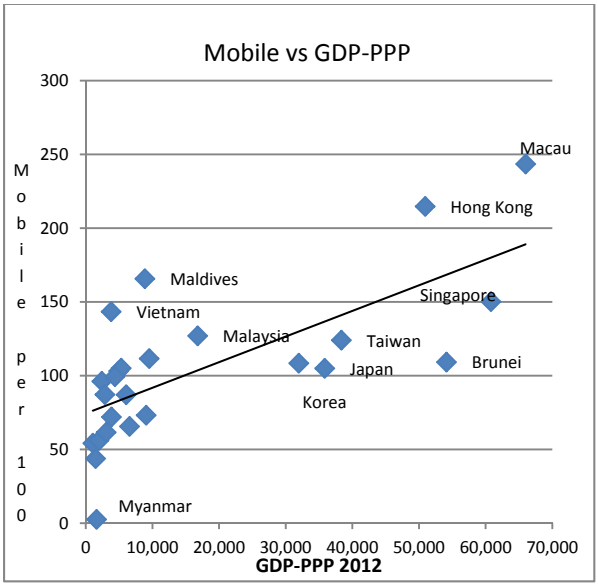


Figure 9A:GDP-PPP

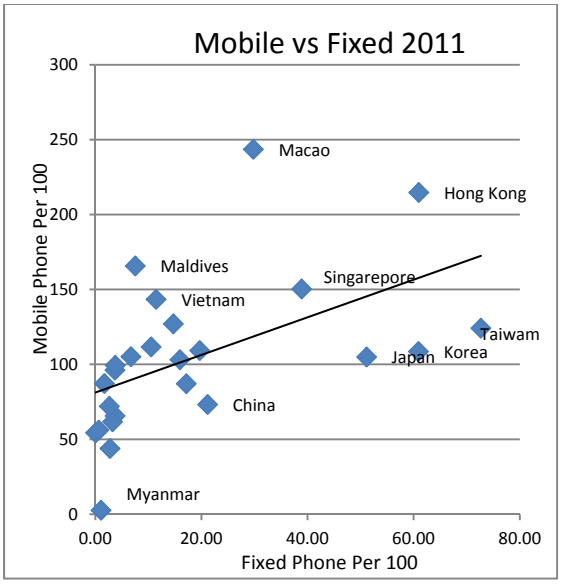


Figure 9B:Fixed Phones per 100

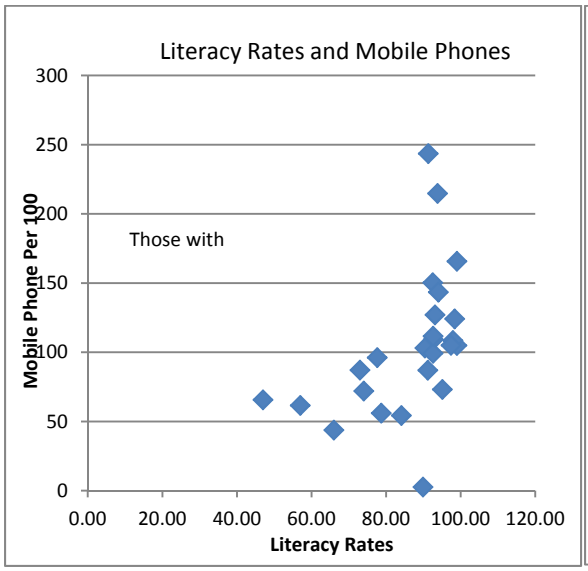


Figure 9C:Fixd Phones per 100

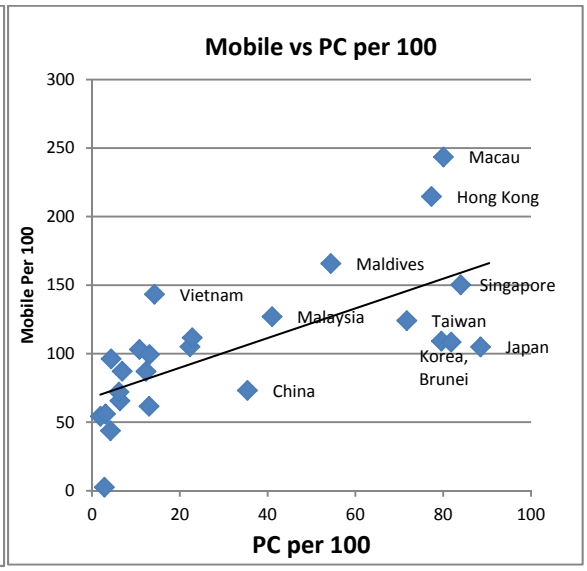


Figure 9D:PC per100

The above charts indicate that mobile phone subscription per 100 is posistively correlated with the explanatory variables with an exception of literacy rates. In Table 1 below, we present simple regression model output between mobile subscription per 100 and each of the four explanatory variables in four figures presented. We also added two dummy explanatory variables Region 1 and Region 2.

Region 1 is defined such that Region 1 is 1 for countries with mobile subscription per 100 exceeding 100 and Region 1 is 0 for countries with mobile subscription per 100 is less than 100. Region 2 defined such that the countries with the top 4 mobile subscription is given Region 2 = 1 and Region 2 = 0 other wise. The four countries with Region 2 = 1 are Macau, Hong Kong, Singapore, and Maldives.

We note that Region2 is the most significant explanatory variable followed by Region1 and GDP-PPP in that order. With respect to Region 2, we note that three of them – Macau, Hong Kong, and Singapore – are all cities with high population density. We suspect that large cities such as Shanghi, Seoul and Tokyo with large number of inhabitants are likely to have high mobile subscriptions per 100. As we pointed out, Maldives is an island nation in the Indian Ocean with more than 1 million visitors in 2011. Two island nations, Mauritius and Seychelles, off the east coast of Sub-Sahara Africa in Indian Ocean also have very high Mobile Subscription per 100 of 136 which is the highest and 92 which is 5th highest after Gabon, Botswana, and South Africa.

The fact that Region 1 and Region 2 are statistically significant, however, should not be surprising. When mobile subscriptions per 100 are arranged in either ascending or desceding order, any division of countries into two group similar to Region 1 is likely to lead to statistically significant outcome. What is significant is the fact that four countries with the top mobile subscriptions per 100 turned out to be either city nations with high population density or the countries with very high number of visitors.

IX. TWO VARIABLES REGRESSION MODELS

In this section we will build regression models with two variables. In view of the that GDP-PPP is the most influencial variable among the four variables, we will run two variables regression models where GDP-PPP is included in every model. Table 2 presents the outputs of our regression models.

We note that the equation with the highest F-value is that include Region 2, followed by that include regression 1. In both of these regresion equations, we note that both Regio1 and Region 2 are statistically more significant that GDP-PPP. With respect to the remaining four models, while GDP-PPP is statistically segnificant at the .01 level or less for three models that include Fixed Phones, Internet, and Literacy and at .20 level of significant in the model that include PC per 100, the P-values of the remaining variables are .195 or higher. What this observations suggest is that once we take into account the influence of GDP-PPP on the variations of Mobile Phone per 100, what each of these four variable explain is not singificant.

X. SUMMARY OBSERVATIONS

We proposed that we will examine the patterns of growth of mobile phones relative to that of the fixed phone during the period of 15 years between 1995 and 2010.

We showed that the number of mobile phones for the world and for the ESS Asia grew exponentially during the period 1995-2010 but the growth rates were much higher during the earlier parts of the period. We also showed the growth rates were much higher for the world compared to those of the ESS Asia. As for the number of fixed phones, both grew during the earlier part of the period 1995- 2010 but the growth rates were much lower than those of mobile phones. Growth stopped about 2005-2006 and slowly declined thereafter.

TABLE 1: OUTPUTS OF SINGLE VARIABLE REGRESSION MODELS

Variable	R-Square	Coefficient	t-Value	P-Value
GDP-PPP	0.500	0.002	4.794	0.000
Fixed Phone	0.254	1.277	2.798	0.010
Internet	0.344	1.111	3.473	0.002
PC Per 100	0.473	1.159	4.543	0.000
Literacy	0.174	1.668	2.200	0.038
Region 1	0.548	79.417	5.285	0.000
Region 2	0.569	110.274	5.515	0.000

TABLE 2: TWO VARIABLES MODELS WITH DATA THAT EXCLUDE 4 ISLANDS

GDP-PPP			Second Variable				Model		
Coefficient	t Value	P value	Variable	Coefficient	t Value	P value	R square	F Value	P-Value
0.002	3.125	0.005	Fixed Phone	0.018	0.034	0.973	0.496	10.832	0.001
0.001	2.828	0.010	Internet	0.273	0.718	0.480	0.508	11.343	0.000
0.001	1.424	0.168	PC 100	0.331	0.569	0.575	0.503	11.153	0.000
0.002	3.094	0.001	Literacy	0.805	1.334	0.196	0.534	12.596	0.000
0.001	2.477	0.021	Region 1	45.644	2.628	0.015	0.617	17.683	0.000
0.001	2.389	0.026	Region 2	74.093	3.413	0.002	0.671	22.393	0.000

We showed next that in 1996 there was not any country in the ESS Asia that relied more heavily on mobile phones over the fixed phone. However, in 2001, about one half of the countries in the ESS countries relied more heavily on mobile phones than fixed phones. In 2006, all countries with exception of Myanmar relied more heavily on mobile phones. In 2011, all countries including Myanmar relied much more on mobile phones.

We showed next the ratios of mobile phones per 100 inhabitants over that of fixed phones per 100 inhabitants and presented in the descending order. These ratios are measures of how extensively mobile phones are utilized relative to uses of their fixed phones. It ranges from 135.7 for Afghanistan to 1.7 for Taiwan. However, these ratios by themselves alone are not good measures of how well telecommunication needs of the countries are met. Fixed phone also contribute toward meeting the telecommunication needs of countries. Therefore, we present Figure 6 which present both M/F ratios and fixed phones per 100. We note that countries with well-endowed fixed phones infrastructure are the countries with very low M/F ratios even though their mobile phones per 100 are over 100.

We show next how the rankings of the top 5 and the bottom 5 countries with respect to mobile phone 100 changed over the course of 15 years and hypothesize what might have led to some of these changes. A significant obsertation is that Japan and Korea were among the top 5 until about 2006 and they became 7th and 8th in 2011and Vietnam was a distance 8th until about 2007 became the 3rd in 2011.

The last two parts deal with the outputs of the regression models with some of the widely used explanatory variables for this type of studies. We found that GDP-PPP is the single most influential variable explaining the variations in mobile phones subscriptions per 100, followed by whether countries belong to Region 1 or Region 2 where each Region consists of a set of countries select using some criteria.

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