Research Article

Bottom of the Pyramid Expenditure Patterns on Mobile Services in Selected Emerging Asian Countries

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Abstract

This article analyzes patterns of expenditure on mobile phone services at the bottom of the pyramid (BoP), following users in six Asian countries: Bangladesh, Pakistan, India, Sri Lanka, the Philippines, and Thailand. We examine whether mobile phone services in the selected countries display characteristics of a luxury good or those of a necessity. We first evaluate the expenditure patterns of mobile phone services among five income groups within the BoP. Then, we estimate the income elasticity of mobile phone services using Engel curves. Based on these analyses, we conclude that mobile phone services are necessities at the BoP. We also find that any increase in price or tax adds the greatest burden on the poorest of the poor. We argue that the current high tax on mobile phone services in developing countries in Asia has an adverse effect on the poor.

1. Introduction

Over the last decade, mobile telephony has seen exponential growth across the world due to cost-effective network technologies, the influx of investment, affordable devices, and falling prices. Mobile phones are widely used not only by the affluent consumers, but also by the poor who were previously unable, or unwilling, to pay for other communications or electronic devices. Nowadays, it is not unusual to find mobile phones even among rural farmers and villagers in Africa, Asia, and Latin America.

Excited by this widespread diffusion of mobile phones, development practitioners and researchers around the world are looking at ways to foster socioeconomic development through this small personal communication device held in the hands of the poor. Indeed, there is evidence to show that mobile services can enhance economic development at the aggregate level (Qiang & Rossotto, 2009; Waverman & Meschi, 2005), as well as improve living conditions at an individual level (Abraham, 2007; Aker, 2008; Esselaar, Stork, Ndiwalana, & Deen-Swarray, 2007; Jensen, 2007).

Nevertheless, it is still unclear how the poor in developing countries actually afford to use mobile phone services. Although their prices are falling, the expenses of these services may not be negligible to those under severe financial constraints. Some studies point out that mobile services are not fully affordable to low-income users, as they have come up with various coping strategies to manage their expenses, such as missed-calls, beeping, phone-sharing, and texting instead of calling (Donner, 2007; Sey, 2007, 2009). As a consequence, further study is needed on how much

the poor value mobile services over other goods and services in the context of limited income.

While we have sufficient information on the supply side of mobile services in developing countries, not much is known about the nature of the demand for such services among the poor. In fact, it is not clear yet whether mobile phone service exists as "a necessity" service to serve the basic communication needs among the poor, or as "a luxury" service that they have a choice to consume or not.

One way to look into this affordability and use issue is to analyze the percentages of the poor consumers' incomes that are spent on mobile phone services, and how this expenditure pattern varies with increasing income. By analyzing their expenditure patterns and comparing them to those of people with differing income levels, we can determine how mobile phone service is valued by the poor, and whether the service is a necessity or a luxury in the economic life of the poor. Such classification can also be relevant to government decisions concerning taxes and subsidies, as well as social policies for the poor. In this article, we examine the pattern of expenditure for mobile services at an individual level in emerging Asian countries (Bangladesh, Pakistan, India, Sri Lanka, the Philippines, and Thailand). In particular, we focus on the group of low-income, unskilled, and less-educated users by analyzing the consumption pattern of mobile services among "the Bottom of the Pyramid" (BoP) (Prahalad, 2004).

The article begins with two key economic concepts used in the analysis, Engel's law and the Engel curve, followed by the literature review on the applications of these concepts to services in general, and to telecommunications services in particular. Subsequently, the empirical analysis shows a graphical examination of the pattern of mobile service expenditures among different socioeconomic groups within the BoP for the six countries under consideration. We then estimate Engel curves and calculate income elasticity for mobile phone services in the chosen population. Finally, policy implications of the findings are discussed.

2. Key Concepts and Literature Review

The Origin of Engel's Analysis

Differences in consumption between wealthy families and poor families have been debated for centuries. According to Stigler (1954), the first quantitative analysis of the subject was conducted in the 1790s by Davies and Eden. The two British researchers succeeded in compiling workers' budgets to study working class poverty at that time, but the collected information did not lead to a further analysis, as it was considered to be merely historical, nonquantitative data.

Almost 70 years later, in 1857, Engel studied different consumption patterns among 153 Belgian families who were classified into three socioeconomic groups: 1) families dependent on public assistance, 2) families capable of surviving without that assistance, and 3) well-to-do families. The study resulted in one of the most famous economic laws, Engel's law: "The poorer the family, the greater the share of income devoted to food." He also proposed that the wealthier the country, the lower the share of food expenditure relative to total expenditure. This was the first empirical generalization on household consumption data.

Subsequently, in 1875, Carrol Wright advanced Engel's work and concluded that: 1) the higher the income, the lower the relative percentage of expenditure for subsistence; 2) the percentage of clothing expenditure is approximately the same at all income levels; 3) the percentage of housing, fuel, or electricity expenditure is the same, regardless of income level; and 4) as income increases, the percentage of expenditure on various items increases. He noted that negative savings could be a proof of poverty, and based on this, he recommended the implementation of a minimum wage.

The Engel Curve and Income Elasticity

The Engel curve, which compares the amount of expenditure on an item with total household income or expenditure, is another important tool for analyzing social welfare. Prais and Houthakker (1955) provided a pioneering work on Engel curves, proposing five forms to be fitted: linear, semi-log, hyperbolic, double-log, and log-inverse. They also estimated total expenditure elasticity for many food and nonfood items based on these functional forms.

This approach of using the Engel curves and income elasticity are deeply rooted in the theory of demand analysis. One of the main issues in demand analysis is to find the change in demand for a particular good that corresponds to a change in a specific explanatory variable. In general, the per capita

expenditure on any good can be expressed as a function of a series of variables, including per capita income, time, tastes, preferences, etc.

According to Haque (2005), when choosing a demand model for a particular good or service, previously used functional forms should be taken as a basis for estimation. It is also advised to estimate only a few parameters for each consumption item, so as to better focus on the relationship between expenditure on a specific good and income while considering prices as fixed. This relationship is what defines the Engel curve,[1] and it can be expressed as $Y_i = f(X)$, where Y_i represents the expenditure on good i, and X is the consumer's total income (expenditure). The estimation of such a curve is based on the assumption that, on average, the differences in consumption patterns between high- and low-income households can be attributed to their differences in current income, and thus, in total expenditure.

The relevance of accurate estimates of income elasticity is acknowledged if we consider their usefulness for classifying goods in terms of economic criteria of "necessity" and "luxury." If the income elasticity of a good lies between 0 and 1, it will be considered income inelastic, i.e., a necessary good, which implies that the demand for it rises as income increases, but a smaller percentage of income is spent on this good. On the other hand, a good is regarded as a luxury if its income elasticity is greater than 1 (income elastic), meaning that the demand rises as income increases, and a larger percentage of income is spent on this good. As Lewbel (2006) mentions, goods with income elasticity below 0, between 0 and 1, and above 1 are respectively called inferior goods, necessities, and luxuries.[2]

Engel Curve Applications for General Services

In general, the Engel curve has been applied to evaluate the share of expenditure dedicated to goods or services commonly regarded as essential, including food, healthcare, and housing. Using quadratic Engel curves, Girma and Kedir (2002) identified the proportion of urban households in Ethiopia in which food has the characteristics of a luxury item. The main objective was to estimate the total consumer

expenditure level beyond which food is no longer a luxury. Another example is found for households in rural areas of China: Gong, Van Zoest, and Zhang (2000) found economies of scale in families' expenditure patterns, as well as certain differences in consumption patterns related to gender differences in children.

Several studies have also been conducted in the area of healthcare. For instance, Freeman (2003) analyzed data on household healthcare expenses in the United States from 1966 to 1998, finding income elasticity well below unity, ranging from 0.817 to 0.844, which confirms that healthcare is a necessity. Further evidence is found in the work of Sen (2005). His study evaluated the impact of per capita income on trends in health expenditure in 15 OECD countries between 1990 and 1998. It found that income elasticity ranged from 0.21 to 0.51, showing that healthcare is, again, a necessary good in rich countries. In the context of African countries, Okunade (2005) analyzed how healthcare expenditure in Africa responds to changes in GDP and other variables of interest. A comparison between 1984 and 1995 found that the GDP elasticity of health expenditure was roughly unity in 1984, while 1995's GDP elasticity was 0.65, indicating that healthcare had changed from a luxury to a necessity over time.

Social protection, such as public spending on pension, unemployment benefits, and healthcare support, has also been studied in a similar way for a group of countries in the OECD. Auteri and Constantini (2004) find that social protection does not seem to have the characteristics of a luxury good, as it has an elasticity of 0.837. Hansen, Formby, and Smith (1996) estimate income elasticity for housing services in the United States with an alternative methodology. Their results indicate that the demand for this kind of service is income-inelastic at all income deciles, as well as for an overall elasticity, both for owners and renters.

Engel Curves for Telecommunications Services

In the domain of telecommunications services, there is still a paucity of literature on the economic analysis of household telecommunications expenditure

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1. Lewbel's (2006) definition is as follows: *An Engel curve is the function describing how a consumer's expenditures on some good or service relates to the consumer's total resources holding prices fixed.*
2. *Both necessary and luxury goods are normal goods because their elasticity is nonnegative.*

using Engel curves.[3] Some of the findings from the early studies conclude that telecommunications services, in general, can be classified as luxury goods.

Ureta (2005) evaluated households' telecommunications expenditures in four countries (Albania, Mexico, Nepal, and South Africa). In his findings, Engel's law applied to food, but not to telecommunications services. In other words, as the household's total expenditure increased, more money was spent on, and greater importance in the budget was accorded to, telecommunications services, indicating that telephony was a luxury item.

In the case of Internet services, Goel, Hsieh, Nelson, and Ram (2006) analyzed income elasticity of demand for the service based on OECD data, concluding that Internet services may not constitute a necessity, even in the advanced countries. Another important finding was that the income elasticity seemed to be smaller for general users (i.e., dial-up and occasional users) than for subscribers, which indicated that policies intended to encourage Internet usage through subscriptions might not result in an enhancement of social equity.

Similar evidences were found in South America. In Colombia, Ramirez, Muñoz, and Zambrano (2005) compared households' expenditures on different goods and services for a six-year period, concluding that transportation and communications should be considered luxury items, rather than necessities. Combining the tools employed by Ureta (2005) and Gamboa (2007), Agüero (2008) finds that telecommunications services (mobile and fixed telephony, as well as the Internet) in Peru also show the characteristics of a luxury good, with an income elasticity of 1.97 for 2004. Biancini (2010) estimates price and income elasticity as part of a study of the Indian telecommunications market. In four cases of the seven model specifications, the income elasticity figures are higher than 1 (between 1.03 and 1.18). The author does not explain these results in detail, preferring instead to focus on price elasticity results, since they are found to be larger than the estimates for developed countries.

Additionally, Milne (2006) suggests that communications has the characteristics of a necessity in industrialized countries (income elasticity less than 1), while communications is considered a luxury in developing countries. The study expects that developing countries will eventually follow the trend of industrialized countries, as shown in the case of mobile services among the middle-income people in developing countries, where the criteria is blurring as "an essential luxury" or "an expensive necessity."

In fact, not much has been known about the classification of mobile services, especially in the context of developing countries. There are only a handful of studies looking at mobile services separately from general telecommunications services, and their findings are conflicting. For instance, Gamboa (2007) classifies mobile telephony in Latin America as a luxury service, with an income elasticity of 1.30. In contrast, in the study of 17 African countries,[4] Chabossou, Stork, Stork, and Zahonogo (2008) find that mobile expenditure is a necessity, as it is inelastic with respect to income.

Responding to this shortage of scholarship on mobile expenditure in developing countries, this article aims to explore the consumer behavior on mobile telephony services at the BoP in a selected group of emerging Asian countries, and to identify whether the service should be classified as a luxury or a necessity among that segment of the population.

3. Method

This article uses primary data from a multi-country study of ICT access and use at the "bottom of the pyramid" (BoP) in Bangladesh, India, Pakistan, the Philippines, Sri Lanka, and Thailand. Data collection was carried out September–October 2008 on a sample of 9,540 BoP teleusers. BoP was defined as the two lowest socioeconomic (SEC) groups (D and E), classified by the education and occupation level of the household head, with the exception of the Philippines, where only SEC group E was considered. Teleusers were defined as those who had used a telephone (not necessarily owned) in the three months prior to the survey. Teleusers between the ages of 15 and 60 in both rural and urban locations took part in face-to-face interviews using a struc-

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3. On a general level, Foster and Araujo (2004) and Foster (2004) do relate expenditure in public services to total household expenditure.
4. Benin, Botswana, Burkina Faso, Cameroon, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Mozambique, Namibia, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Uganda, and Zambia.

tured questionnaire.[5] Methodological details of the data collection process, as well as details on the target population of the study, can be found in de Silva, Ratnadiwakara, and Zainudeen (the lead article in this special issue).

4. Analysis

The Share of Mobile Expenditure Among the BoP Income

As a first step, the importance of mobile service expenditure[6] (rendered in US$) relative to total personal income (also in US$) is analyzed for each country. The analysis used two variables: monthly expenditure on mobile services and total monthly personal income. The expenditure data are obtained from both postpaid and prepaid users, since prepaid is predominant in most developing countries. For the prepaid users, monthly mobile expenditure is difficult to recall, as their expenses are scattered over several occasional top-ups. Hence, the data were imputed from the value of the last top-up and the number of days that the top-up lasts on average. For those who did not have any personal income source, the per capita income level of the household was imputed. The descriptive statistics are shown in Table 1, specified by five income quintiles among the BoP.

The highest personal income level is found in Thailand, while the lowest levels correspond to Pakistan and India. Mobile expenditure figures show that the BoP in the Philippines spends the highest proportion of their income on mobile services, while India spends the least. In addition, it is noteworthy that there are considerable income gaps between the poorest and richest groups, even within the BoP. For instance, the biggest income difference is found in Pakistan, where the average income of the richest group in the BoP is 15 times the average income of the poorest. This difference is the smallest in Thailand: The top income group of the BoP has eight times more income than the poorest of the poor.

The graphical analysis shows clearly that Engel's law applies to the six selected countries (Figure 1). The horizontal axis of the graphs shows the quintiles of monthly personal income, while the vertical shows the percentage of mobile service expenditure in monthly personal income. As the graphs show, the magnitude of mobile service expenditure decreases as personal income increases. This finding indicates that mobile phone services constitute a necessity among the BoP in our set of Asian countries.

Income quintiles show an interesting comparison of the expenditure pattern on mobile phone services at the different poverty levels within the BoP (Table 2). The poorest quintile of each country's BoP is found to spend more than 20% of their income on mobile phone services: The first quintiles spend 24% each in India and Thailand, while the corresponding figure in the Philippines is 57%. On the other hand, the highest income groups among the BoP (fifth quintile) show the mobile expenditure in a range of 3% in Sri Lanka to 6% in the Philippines.

However, it should be noted that some figures, particularly for the Philippines,[7] reflect the fact that there were respondents without any income source, and whose income levels were imputed from the per capita income level of the relevant household. To address this issue, the same analysis was performed for only the respondents whose income levels were not imputed. The expenditure patterns remain the same. In other words, mobile phone services for this subset of respondents are, again, a necessary service.[8]

In this respect, it is important to discuss the possible effects that a fixed tax may have. For the U.S. case, Hausman (1999) measures the economic efficiency effects of the taxation of wireless services, considering taxes in the range of 14–25%. As the taxes are raised from wireless consumers and they constrain the demand for the service, they impose an efficiency loss on the economy equivalent to $0.53 for every $1 raised in taxes. In addition, new taxes would imply efficiency losses of $0.72–$1.14 per additional dollar of tax revenue raised.

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5. The fieldwork was conducted by a market research company that specializes in surveying developing countries.
6. Expenditure in mobile phone services includes money spent on all kinds of services available on mobile phones (calls, SMS, Internet browsing, etc.).
7. For the Philippines, almost 40% of the observations for personal income were imputed. In addition, the survey considered only SEC group E in this country.
8. The resulting figure for the Philippines, instead of 57%, is 32% if we consider respondents whose incomes were not imputed (respondents with an income source). For a comparison of the figures, see appendix 1A.

Table 1. Descriptive Statistics of Monthly Personal Income and Mobile Telephony Expenditure by Country (US$).

Quintiles	Personal income				Mobile expenditure			
	Mean	SD	Min	Max	Mean	SD	Min	Max
				Bangladesh				
1	16.5	5.8	1.4	25.2	4.1	2.7	0.0	12.9
2	36.1	6.4	25.9	43.2	4.0	2.6	0.1	17.3
3	56.2	5.0	46.0	64.7	4.4	2.7	0.0	12.9
4	83.3	11.0	71.9	100.7	5.3	3.0	0.1	17.3
5	170.5	130.4	107.9	1,007.2	5.7	3.2	0.2	18.5
				Pakistan				
1	13.2	4.7	1.6	21.0	4.9	4.2	0.1	19.7
2	32.5	6.2	21.9	39.4	5.2	4.7	0.1	19.7
3	57.7	7.5	41.0	65.6	5.6	5.2	0.1	19.7
4	89.5	10.9	72.2	105.0	6.1	5.1	0.2	19.7
5	196.9	177.3	105.0	1,181.1	7.9	6.4	0.1	19.7
				India				
1	17.6	5.1	3.8	25.9	3.9	2.5	0.1	16.7
2	38.8	6.5	26.7	44.4	4.3	3.5	0.1	20.0
3	63.5	5.3	46.7	66.7	5.3	3.8	0.1	19.0
4	85.5	5.2	71.1	88.9	4.9	3.7	0.1	18.8
5	135.1	42.7	93.3	333.3	5.6	4.0	0.2	18.5
				Sri Lanka				
1	21.3	7.8	5.5	34.4	5.1	3.4	0.7	13.8
2	48.3	8.3	36.7	61.2	5.4	3.4	0.3	15.3
3	82.3	10.1	63.3	91.7	5.3	3.6	0.1	13.8
4	127.7	13.6	95.0	137.6	5.8	4.1	0.3	13.8
5	199.1	44.1	145.0	367.0	5.8	4.3	0.3	13.8
				Philippines				
1	18.9	5.7	6.5	27.2	9.5	4.4	2.2	19.6
2	37.4	5.5	28.3	43.5	10.5	5.2	2.4	19.6
3	58.9	6.1	47.8	65.2	10.8	5.0	2.1	19.6
4	93.5	12.9	67.0	109.6	10.8	5.0	1.3	19.6
5	165.0	52.8	115.2	434.8	9.6	4.8	1.9	19.6
				Thailand				
1	34.7	9.8	8.7	48.3	7.7	5.0	0.4	17.4
2	73.5	13.3	49.3	87.0	8.0	4.8	0.4	17.4
3	128.0	17.2	95.0	144.9	9.2	4.8	0.9	18.6
4	173.5	8.1	145.0	188.4	9.1	4.5	0.2	17.4
5	264.9	53.8	195.0	347.8	9.5	4.3	1.4	17.4

In this case, considering the expenditure patterns in mobile phone services in the countries under analysis, we see that, if a fixed tax is charged, its effect would be more severe for the poorest groups within the BoP, as they spend a higher share of their income. For example, let us assume that a 20% tax is charged in India. In this hypothetical case, the effect of the tax burden will differ among the different layers of the BoP groups. As shown in Table 3, the increase in mobile phone expenditure as a share of personal income is higher for the poorest quintile (4.9%), while for the fifth quintile, this increase is only less than one percent (0.9%). This case is valid for all of the countries, as the six of them all show the same pattern.
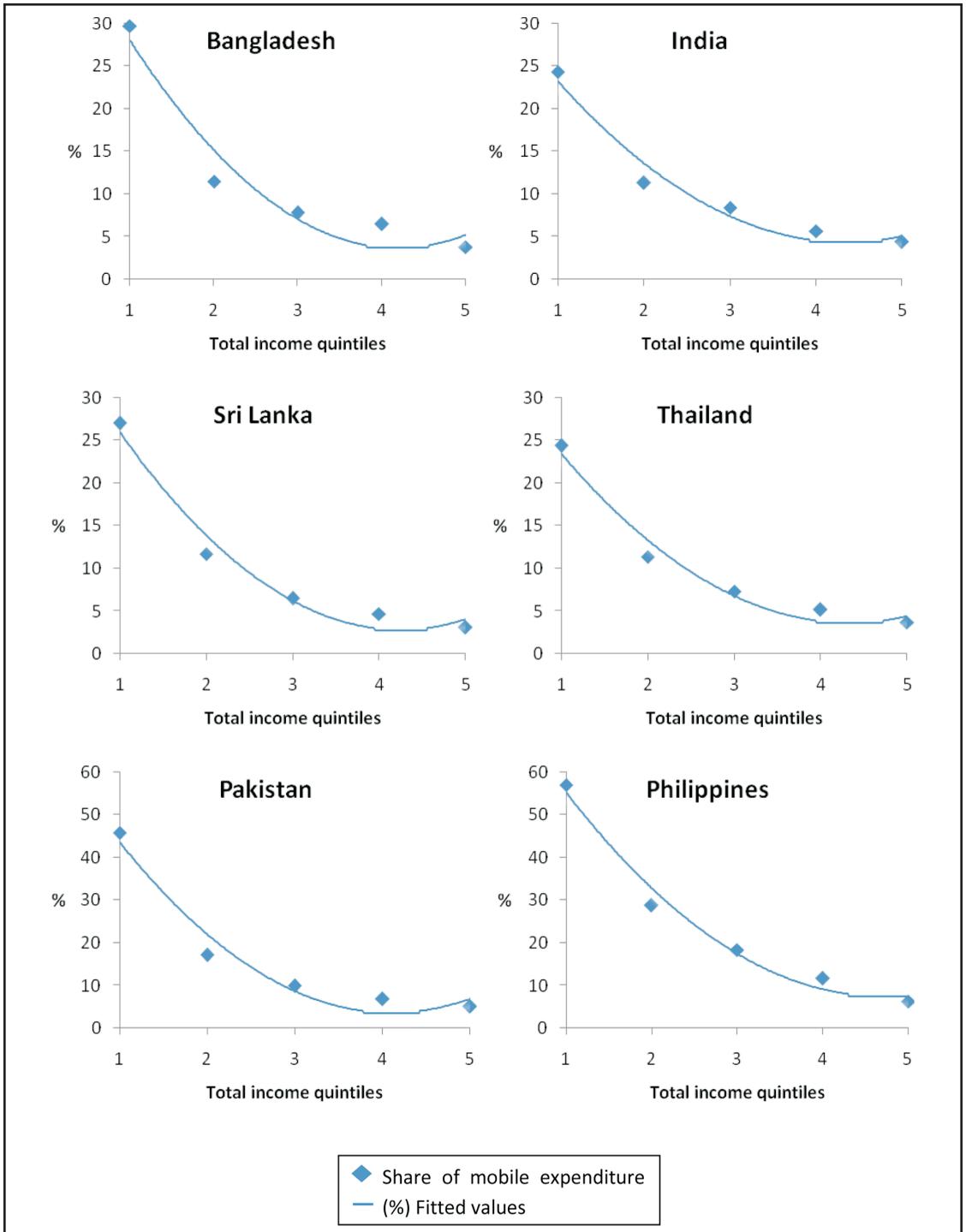
Figure 1. The Share of Mobile Expenditures by Country.

Table 2. Percentage of Expenditure in Mobile Services in Selected Asian Countries by Income Quintiles (%).

Quintile	Bangladesh	Pakistan	India	Sri Lanka	Philippines	Thailand
1 (Bottom 20%)	**29.7**	**45.8**	**24.3**	**27.0**	**57.0**	**24.4**
2	11.5	17.2	11.3	11.7	28.8	11.4
3	7.8	9.9	8.4	6.5	18.4	7.3
4	6.5	6.8	5.7	4.7	11.7	5.2
5 (Top 20%)	**3.8**	**5.1**	**4.4**	**3.1**	**6.3**	**3.7**

Table 3. Hypothetical Estimation on the Share of Mobile Expenditure Due to 20% Tax Increase (% values)—India.

Quintile	1	2	3	4	5
Current Share	24.3	11.3	8.4	5.7	4.4
Share with tax	29.2	13.6	10.1	6.8	5.3
Increase due to tax	4.9	2.3	1.7	1.1	0.9

Estimation of Engel Curves and Income Elasticity

To complement our findings, we also analyze the Engel curve to estimate the income elasticity of mobile service expenditure in each country. As mentioned previously, the Engel curve is a useful tool to show how consumption of different goods and services changes with variations in the consumer's income. There are different specifications for Engel curves, and the selection depends on the criteria each researcher prioritizes.[9]

Haque (2005) points out that the researcher makes a decision about the functional form for Engel curve analysis based on his or her own judgments.

As for mobile phone services, and for telecommunications in general, a particular functional form has already been estimated by Ramirez et al. (2005), Gamboa (2007), and Agüero (2008), and we consider the same specification for mobile phone owners for each country:

$$s = \alpha + \beta \ln Y + \gamma(\ln Y)^2 \qquad (1)$$

$$\text{where } s = M/Y.$$

M represents mobile service expenditure, and *Y* is monthly personal income. Estimations are run at the individual level. It must be noted that we choose this specification considering the logarithm expression to correct for heteroskedasticity, which is a common issue in income variables, while the squared logarithm expression aims to take into account any nonlinear effect. The results of the estimation for each country are shown in Table 4.

With the values resulting from the estimation of the curve described above, income elasticity at the country level is calculated as follows:[10]

$$\epsilon = 1 + \beta/s + 2\gamma \ln Y/s \qquad (2)$$

As a result, the income elasticity of mobile services for each country is summarized in Table 5.

Based on this analysis, we can confirm that mobile phone services exhibit the characteristics of a necessity among the BoP in the six selected countries: Income elasticity was estimated to be in a range of 0.1782 in the Philippines to 0.2640 in India. This indicates that the higher the income, the lower the relative importance of mobile services in the individual's budget—in other words, the expenditure on mobile phone services is not very sensitive to income changes.[11] These findings contrast with previous studies on mobile expenditure in developing countries in Latin America (Agüero, 2008; Gamboa, 2007; Ramirez et al., 2005). In the case of India, it also contrasts with results published by Moonesinghe, de Silva, Silva, and Abeysuriya (2006),

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9. Prais (1952) prioritizes, for example, the possibility for threshold and saturation levels.

10. For the derivation of the income elasticity, see Appendix 2.

11. The separate elasticity analysis was also estimated for respondents whose incomes were not imputed (respondents with an income source), and the same pattern was found. See Appendix 1B.

Table 4. Results of Estimation of Engel Curves.

Country	Variable	Coefficient	Std. Error	No. of Obs.
Bangladesh	Ln Y	−21.4998	3.9493	797
	(Ln Y)^2	1.5426	0.4912	
Pakistan	Ln Y	−34.6939	5.0408	510
	(Ln Y)^2	2.7833	0.6162	
India	Ln Y	−18.7184	2.2464	1,207
	(Ln Y)^2	1.3177	0.2853	
Sri Lanka	Ln Y	−21.7034	3.4680	480
	(Ln Y)^2	1.5473	0.4128	
Philippines	Ln Y	−48.9240	6.1688	457
	(Ln Y)^2	3.5566	0.7419	
Thailand	Ln Y	−23.1197	3.6403	603
	(Ln Y)^2	1.5582	0.3924	

Note: Parameters are significant at the 0.01 level.

Table 5. Income Elasticity of Mobile Services in Each Country.

Countries	Elasticity
Bangladesh	0.2262
Pakistan	0.2298
India	0.2640
Sri Lanka	0.2075
Philippines	0.1782
Thailand	0.1965

which identify mobile services as luxury items. Although there are differences in methodology with Moonesinghe's, we suggest that this change of status of mobile phone services has occurred in India, possibly due to improvements in market conditions, such as falling prices and new tariff plans that have come about through increased competition.

It can be useful to try to compare the figures we obtain to those of other basic services in the countries under analysis. Table 6 shows income elasticities for food, clothing, housing, and other important household services. In most of the cases, the elasticity is close to 1, which means that the demand for these services may be sensitive to changes in income. Since the elasticity figures in Table 6 are based on the general population and aggregate different income groups, they may not be directly comparable to our findings from the BoP group. Still, we can get a rough idea that mobile phone services are highly inelastic, necessary services among the poor in these countries.

5. Discussion

Our analysis shows that mobile phone services have the characteristics of a necessity among the BoP in Bangladesh, Pakistan, India, Sri Lanka, the Philippines, and Thailand. We demonstrate that the share of mobile expenditure decreases as personal income increases, which indicates that Engel's law operates in the selected countries. In other words, the poorer the individual, the greater share of income that is devoted to mobile services, as holds true in the case of other subsistence goods like food, healthcare, and housing. We also confirm our findings by examining the income elasticity for mobile phone services, concluding that mobile services are highly inelastic, and thus function as a necessity among the poor in the six Asian countries we study.

Our findings indicate that the demand for mobile services exists at a certain level across all income groups in the BoP, and it is serving people's basic needs for communications as a necessity. However, affordability for mobile services is still a critical issue,

Table 6. Income Elasticity for Other Consumption Categories (2005).

Country	Food, beverages & tobacco	Clothing & footwear	Housing	Household furnishings	Medical & health	Recreation	Education
Bangladesh	0.796	0.968	1.075	1.055	1.756	2.787	0.931
Pakistan	0.762	0.967	1.072	1.053	1.492	1.789	0.928
India	0.782	0.967	1.074	1.054	1.608	2.133	0.930
Sri Lanka	0.750	0.967	1.071	1.052	1.447	1.679	0.927
Philippines	0.757	0.967	1.071	1.053	1.473	1.741	0.927
Thailand	0.719	0.966	1.068	1.051	1.373	1.522	0.924

Source: Muhammad, Seale, Meade, and Regmi (2011).

especially for the poorest group of the least-skilled and least-educated population. From the analysis of income quintiles, we find that the poorest sector of the BoP spends a considerable percentage of their budgets on mobile services, including figures higher than 20% of their total income, while the richest spend only 6%, maximum.

Affordability can be achieved either by increasing the level of income of the poor, or by reducing the cost of mobile services. To some extent, the former can be dealt with by providing targeted subsidies on communication services to the poorest of the poor using universal service funds. However, considering the limited government capacity in developing countries, the targeted subsidies are onerous and impracticable. Instead, the focus should be on reducing the price of mobile services by increasing market competition or reducing the level of taxes imposed on mobile services.

As discussed, whatever fixed tax percentage rate is charged, the expenditure share in mobile services will be increased a higher amount for the poorest than for the richest sectors of the BoP. As of October 2009, the rate of taxation charged for mobile services in the countries under analysis ranges from 7% in Thailand to 29% in Pakistan. From an economic point of view, luxury goods are subjected to higher taxes; this, however, should not be the case for mobile phone services, as it has been shown that they are a necessity. Moreover, considering the absence of social welfare targeting the poor and vulnerable in many developing countries, this means that the effect of such a tax would add a considerable burden on the poorest of the poor.

Therefore, we recommend that the relevant authorities avoid charging high taxes on mobile phone services. Given that mobile phones are a part of everyday lives for not only the rich, but also the poor, policies should be designed to foster growth and social inclusion, rather than hamper service adoption and use among the BoP.

Instead of imposing high taxes, policy makers in developing countries should commit to increasing the level of market competition if they aim to provide balanced benefits to the industry, as well as to the poor. In fact, competition has been the main driver leading to the mobile sector's growth and increased affordability, particularly in developing countries in Asia. As de Silva (2007) mentions on the Indian case, effective competition has been driven by lowering the barriers to market entry and reducing tariffs. In Sri Lanka, the mobile sector growth has been driven by disruptive competition enabled by wireless technology, and the main factor that enhanced the sector's growth in Thailand was dynamic competition, leading to price wars between telecom operators. For the Philippines, the competition fostered various value-added services, which led to a considerable expansion of the sector.

While tax revenue from the mobile industry can be a lucrative source of government income, policy makers should acknowledge the impact of taxation, particularly on the most vulnerable segments of their population. The article argues that the poorest of the poor are already suffering from the high burden of mobile expense, due to their essential need for communication. We suggest that more affordable and inclusive mobile services should be promoted through fair and dynamic competition, as well as through pro-poor telecommunications policies.

6. Limitations and Further Study

While the study contributes to addressing the near absence of data on the poor's income and their

expenditure on telecommunications services, we admit that income is an intangible concept, particularly among the BoP. People are often unable to recall, or unwilling to reveal, their real income or expenditure. Among the poor, it is harder, as their financial flows are not only small in quantity, but also irregular and unstable in time. Although we have used various methods to minimize the measurement error (e.g., large sample size, multiple survey questions to impute more accurate expenditure, logarithm functions, etc.), future studies should adopt more accurate measurements of the poor's income and spending. Financial diaries or field observation would provide a more accurate measurement for such studies (Collins, Morduch, Rutherford, & Ruthven, 2009). Finally, our study aims to provide more generalized understanding about mobile phone use among the poor in a set of emerging Asian countries; however, qualitative studies and cross-country comparative analysis on the same topic should be encouraged, since such studies can enrich our knowledge of the poor's mobile use with depth and diversity. ∎

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Appendix 1.

Comparison of Figures—Imputed Incomes (All the Individuals) and Non-Imputed Incomes (Only Individuals With an Income Source).

A. Expenditure Share

Q	Bangladesh		Pakistan		India		Sri Lanka		Philippines		Thailand	
	All the individuals	Only individuals with income source	All the individuals	Only individuals with income source	All the individuals	Only individuals with income source	All the individuals	Only individuals with income source	All the individuals	Only individuals with income source	All the individuals	Only individuals with income source
1	29.7	21.9	45.8	19.9	24.3	14.2	27.0	15.0	57.0	32.1	24.4	13.7
2	11.5	7.8	17.2	10.1	11.3	8.4	11.7	6.4	28.8	15.2	11.4	7.1
3	7.8	6.7	9.9	7.2	8.4	5.7	6.5	4.4	18.4	11.0	7.3	5.7
4	6.5	4.8	6.8	7.2	5.7	—	4.7	3.2	11.7	7.2	5.2	5.0
5	3.8	3.7	5.1	4.7	4.4	4.3	3.1	2.9	6.3	5.2	3.7	3.4

B. Income Elasticity

Countries	All the individuals	Individuals with income source
Bangladesh	0.2262	0.2416
Pakistan	0.2298	0.3879
India	0.2640	0.3076
Sri Lanka	0.2075	0.0833*
Philippines	0.1782	0.0539*
Thailand	0.1965	0.1989

*These results are included only as a reference, but should not be considered, since the number of observations for income elasticity estimations was too small and the coefficients were not significant.

Appendix 2.

Engel Curve Specification

$$s = \alpha + \beta \ln Y + \gamma(\ln Y)^2$$

Where: $S = \dfrac{M}{Y}$

M represents mobile phone service expenditure and *Y* is monthly personal income.

Also, it should be noted that S is a function of Y, then: $M = S(Y)Y$

Elasticity formula:

$$\frac{\delta M}{\delta Y} \frac{Y}{M}$$

Solving:

$$\frac{\delta M}{\delta Y} = S'(Y)Y + S(Y) = \left(\frac{\beta}{Y} + \frac{2\gamma \ln Y}{Y} \right) Y + S(Y)$$

Considering the elasticity formula:

$$\left[\left(\frac{\beta}{Y} + \frac{2\gamma \ln Y}{Y} \right) Y + S(Y) \right] \frac{Y}{M}$$

$$[(\beta + 2\gamma \ln Y) + S] \frac{Y}{M}$$

$$\frac{\beta Y}{M} + \frac{2\gamma \ln Y}{M} Y + S \frac{Y}{M}$$

As Y=M/S, replacing, we get:

$$\frac{\beta}{S} + \frac{2\gamma \ln Y}{S} Y + 1$$