

- **Part II: Statistical Appendix**

Key Trends in the Development of the Mobile Sector

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Access

Measuring mobile take-up

Mobile telephony has been one of the most quickly adopted technologies of all time. While 128 years passed before fixed telephone lines reached 1 billion users, mobile networks achieved this milestone in just over two decades (figure A.1). Even more astounding, mobile networks have roughly doubled in size every two years since 2002. By the end of 2011, there were 5.9 billion mobile cellular subscriptions worldwide.

This huge growth in mobile subscriptions has led to a significant increase in penetration. The traditional measure of mobile telephony penetration is the number of subscriptions per 100 people. By the end of 2011, more than 8 of every 10 people around the world had a mobile subscription, up from just over 1 in 10 in 2000, with particularly strong gains in middle-income countries (figure A.2). Over the span of a single decade, mobile telephones have changed from an elitist gadget that was mainly the preserve of high-income countries to a mass-market tool spanning the globe.

Some 90 economies—almost half of the member countries of the World Bank—had a mobile penetration exceeding 100 percent in 2011. Because there are more mobile subscriptions than inhabitants in these countries, these statistics do not reflect the number of people who actually have use of a mobile phone, because the same person may possess multiple SIM cards (for example, to avail themselves

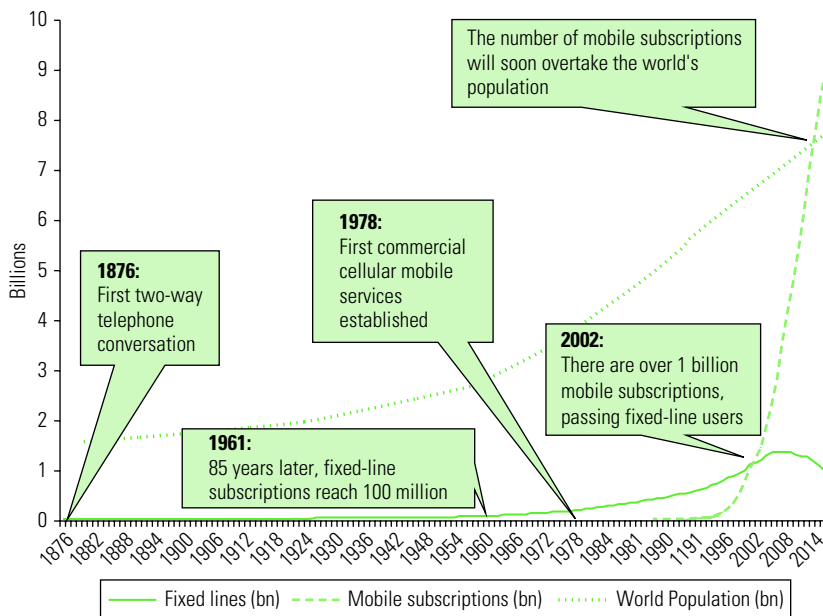
of lower on-network calling prices or to separate business from personal calls), and thus have multiple subscriptions. In the United Arab Emirates in 2010, for example, 28 percent of subscriptions were duplicates, mainly for these reasons, as well as for roaming and gaining better coverage in different parts of the country (UAE 2011).

Another factor skewing the figures in some countries is the number of mobile cellular subscriptions taken by people residing in bordering nations. Subscriptions can also be inactive, with the length of time that must pass before the subscription elapses varying by operator. At the same time, an increasing number of devices are connected to mobile networks that do not use voice services or do not interface with humans. These include laptop computers, as well as equipment such as automated teller machines. In Spain, these types of subscriptions accounted for 10 percent of the mobile market in 2010.

Although methods other than counting subscriptions may be more precise for measuring access to mobile phones, subscription data are most widely available. For example, another useful measure could be the number of persons with access to a mobile phone. But gathering that data requires the use of surveys, which are conducted only infrequently or, in many countries, not conducted at all.

Another measure is the number of households where at least one household member has a mobile phone. This metric is useful because it is precise: it cannot exceed 100. If a mobile phone exists in a household, then all members

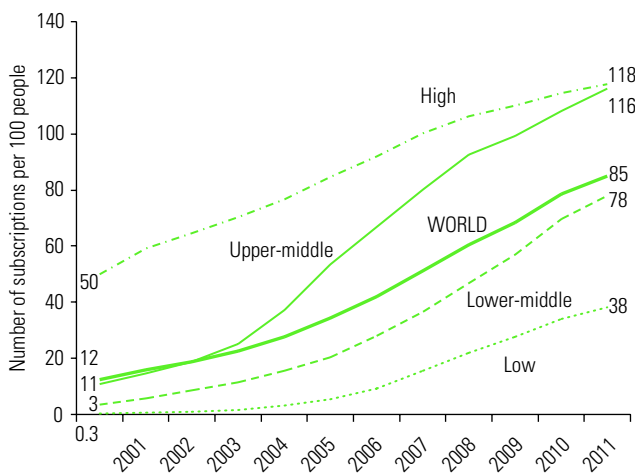
Figure A.1 Worldwide fixed and mobile telephone subscriptions



Source: Adapted from ITU, World Bank estimates.

Note: Log scale.

Figure A.2 Mobile cellular subscriptions per 100 people, by income group



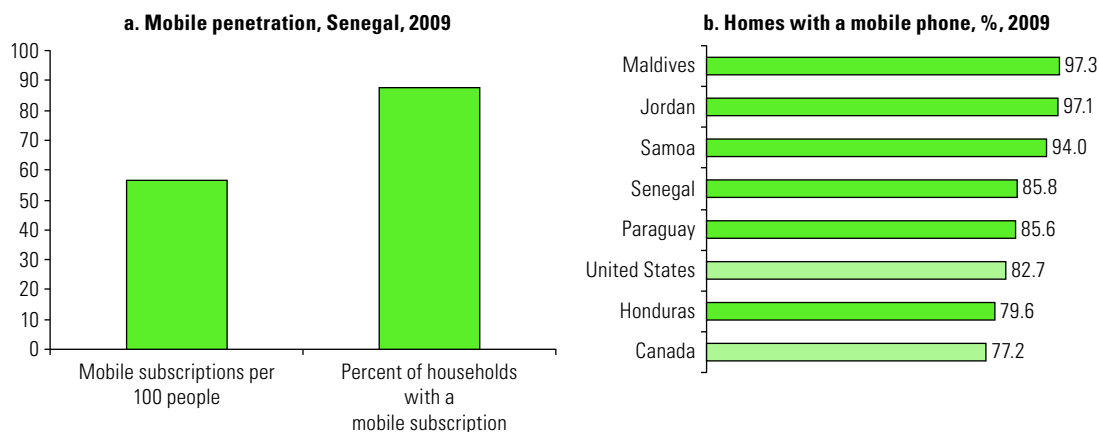
Source: Adapted from ITU, and author's own estimates.

could theoretically use it, thereby extending access. Household availability has thus been the traditional indicator for measuring universal service. This indicator is collected by a growing number of countries through ongoing household surveys, as well as special health surveys. The United

Nations recommended in 2008 that the question “Household having mobile cellular telephone(s)” be included in the questionnaires used for the 2010 round of censuses.¹ Based on the surveys carried out by a significant number of countries, almost three of four households were estimated to have mobile phone service in 2010.

Another factor to consider is household size. Individual use surveys tend to exaggerate subscription penetration rates in developed economies, while household surveys suggest that the level of access to mobile is higher in many developing countries than subscription penetration figures would suggest. Access is particularly high in countries with large households. Take Senegal, where the subscription penetration was 57 per 100 people in 2009, but household penetration was estimated to be 30 points higher at 87 (figure A.3a). This larger household size can dramatically extend access to mobile phones, considering that on average nine persons are in each Senegalese household. Several low-income nations have higher mobile phone home penetration than some developed economies. For example, Senegal, along with some other low- and middle-income economies, has a higher proportion of homes with mobile phones than either Canada or the United States (figure A.3b).

Figure A.3 Mobile household penetration, Senegal and other selected countries, 2009



Source: Adapted from Autorité de Régulation des Télécommunications et des Posts (Senegal) and national household and health surveys.

Reaching the base of the pyramid

At the turn of the new millennium, most analysts would have considered a world with 6 billion cellular phones impossible. At the time, there were some 700 million mobile subscriptions, 70 percent of which were located in high-income economies. This link between mobile penetration and national income gave rise to a belief that there was a price below which mobile service would be unprofitable, thereby making it commercially unviable and unaffordable for many in lower-income countries. After all, fixed telephones had been in existence for more than a century, yet penetration rates were still less than 1 in 100 in many developing nations.

The mobile industry has defied that theory. Every year, it expands its user base, reaching more and more low-income users. This has been made possible by cheaper equipment, falling handset prices, prepaid subscriptions, flexible regulation, competition for marginal users as markets become saturated at the top, and rising incomes.² A recent study carried out in three provinces in China found that 95 percent of rural households had a mobile telephone (box A.1). Nonetheless, a significant proportion of the world's population has no mobile connection. Of the some 5.9 billion mobile subscriptions in the world, 3.4 billion were in low- and middle-income economies (figure A.4). Given some 4.8 billion residing in those countries, that leaves a gap of 1.4 billion without a mobile subscription. The number of people living on less than \$1.25 a day (purchasing power parity) in low- and

middle-income economies, estimated to be 1.1 billion, might be considered outside the target market.³ That leaves an addressable unserved population of just 300 million people worldwide at the start of 2012.

Mobile equipment manufacturer Nokia has calculated a total cost of ownership (TCO) measure that factors in the cost of the handset, service charges, and taxes (Nokia 2009). The TCO needs to be adjusted by income, given that levels of income vary between countries. Even if users can afford service, they still need signal coverage. Figure A.5 illustrates affordability and coverage for selected developing countries. The relationship lends itself to four scenarios bounded by affordability of 10 percent (that is, where mobile services are either less or more than 10 percent of income) and coverage (where mobile covers either less or more than 9 percent of the population). These scenarios are reflected in the four quadrants in figure A.5:

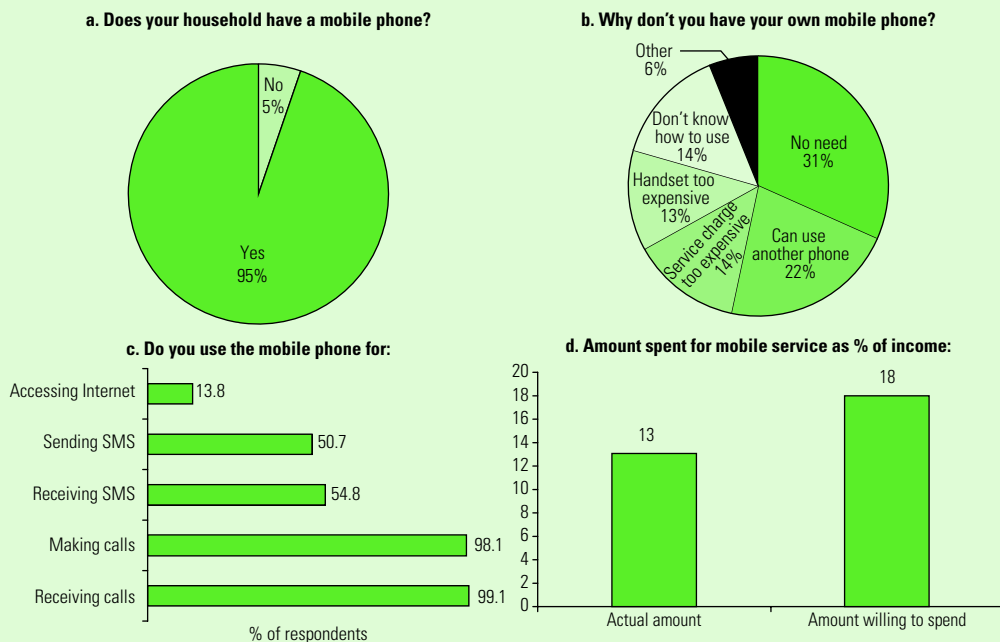
1. high affordability and high coverage (upper left quadrant)
2. high affordability and low coverage (lower left quadrant)
3. low affordability but high coverage (upper right quadrant)
4. low affordability and low coverage (lower right quadrant)

Countries where mobile services cost less than 10 percent of income and cover at least 90 percent of the population

Box A.1 Mobile use in rural China

An ongoing World Bank project has been investigating attitudes, use, and impact of information and communication technologies in rural China. Funded by the Bill and Melinda Gates Foundation, one of the activities was a survey in rural areas of three provinces (Jilin, Guizhou, and Shandong). Some 58 percent of the population in these provinces is rural; the combined rural population is 88 million, which would make the three provinces the 13th largest country in the world (about the size of Vietnam). The survey, carried out in October 2011, found very high use of mobiles, with 95 percent of rural households reporting having one. Individual ownership was lower at 85 percent, but over half of individuals without their own mobile reported they did not have one because they could use someone else's or they had no need. Around half of mobile phone owners reported sending text messages, and some 13 percent use the internet from their cell phone. One interesting finding was the relatively large amount spent on mobile services. Average monthly mobile phone service expenditure was 13 percent of income, with users willing to devote up to 18 percent of their income to mobile services.

Box Figure A.1.1 Mobile usage in rural areas of three Chinese provinces, 2011



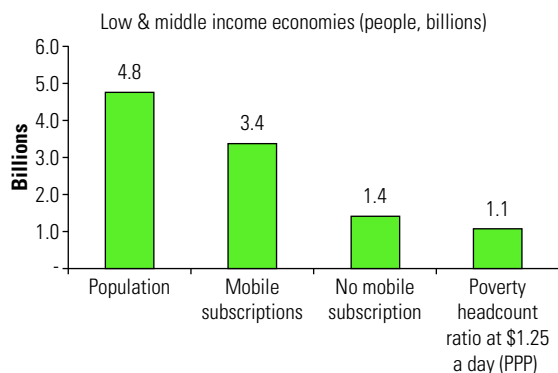
Source: World Bank.

tend to have high levels of access (measured by the availability of mobile phones in households).

Service charges alone do not explain the problem. Consider Angola, which has relatively low tariffs but also low coverage. Mainly because of lack of competition, Angola has not been successful in expanding mobile coverage compared with peer countries. While two

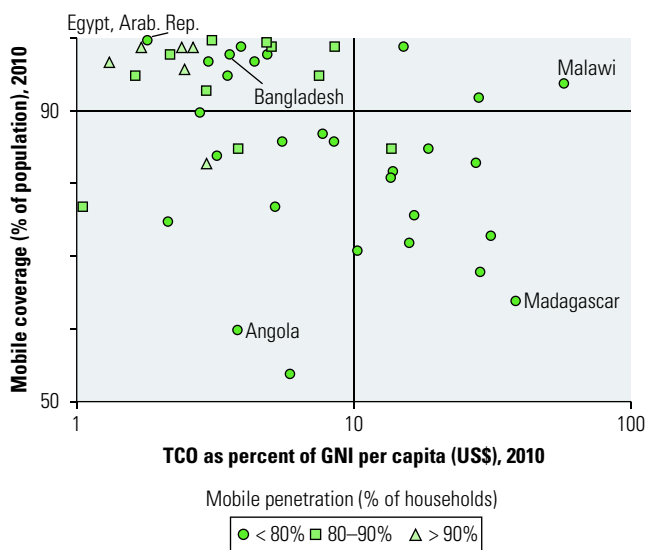
operators have worked in the country for more than a decade, they used different technologies, which drove up equipment costs and made it difficult for subscribers to switch from one operator to the other. A mobile technology (GSM) common to both operators has been available only since November 2010. Further, the market remains a duopoly.

Figure A.4 Population, mobile subscriptions, and poverty headcount in low- and middle-income economies



Sources: ITU and World Bank data and World Bank estimates.
 Note: PPP = purchasing power parity.

Figure A.5 Affordability and coverage in developing economies



Sources: Adapted from Nokia (2009), ITU and World Bank estimates.
 Note: Horizontal scale is logarithmic. TCO is “total cost of ownership,” reflecting the average costs, by country, of handset purchase, service charges, and taxes. GNI is gross national income per capita. The ratio of TCO to GNI per capita is therefore an approximate measure of affordability per capita.

At the same time, other countries have relatively high coverage along with relatively high prices. Consider Malawi, where mobile networks are estimated to cover more than 90 percent of the population but where the Nokia annual TCO amounts to more than half of per capita income.

Densely populated and relatively small, Malawi has been relatively easy to cover. Attempts to introduce additional competition have not been completely successful, however, and the market remains dominated by two operators. The least desirable position is to have high tariffs and low coverage. In Madagascar, the Nokia TCO amounts to over one-third of income, and only around three-fifths of the population is covered. Although there are three operators, competition has been affected by high interconnection charges.

In contrast, some countries have a high degree of affordability and coverage but relatively low take-up. The Arab Republic of Egypt has a high penetration of fixed telephone lines that provide an alternative to mobile. In Bangladesh mobile calls cost about one U.S. cent a minute, and, according to Nokia, its mobile tariffs are among the lowest in the world.⁴ Coverage is high at 99 percent of the population. Despite these extremely low prices and very high coverage, household penetration stood at around 64 percent in 2010. According to mobile operator Grameenphone, its attempts to expand access are difficult because of the high SIM tax, which has remained “the biggest barrier to the growth of mobile telephone industry in Bangladesh” (Grameenphone 2011). The tax of Tk 800 (\$11.60) on new SIM cards has a huge negative impact on low-end subscribers. If the SIM tax were eliminated, an estimated 90 percent of Bangladeshi households could afford mobile service. The GSM Association has called on the Bangladesh government to end the SIM tax, citing it as the “single largest obstacle to the acquisition of new subscribers.” (GSMA 2009)

Operators are looking at innovative ways to widen access, including lowering recharge values, conducting more consumer research among bottom-of-the-pyramid populations, and developing low or alternative energy base stations. Another possibility is through virtual telephony using emerging cloud networks. Users would not need to buy a handset and would instead be allocated a number that they can use on a borrowed phone. Their contacts and voice mail would be stored on the cloud, where there would also be a gateway to mobile money services. Virtual telephony also lowers the cost of acquiring new users; for example, a trial network in Madagascar claims it costs operators just \$0.20 to establish cloud-based virtual telephony services, compared with \$14–\$21 to deliver a SIM card.⁵

The barriers to increasing access to mobile communications for every household in the world are more of a regulatory and policy nature rather than technical. Introducing and

strengthening competition and eliminating special “mobile” taxes could significantly narrow the range of those not served by mobile communications. The remaining few households without access could then be captured through universal access programs. It is also important to ensure that those at the bottom of the pyramid also enjoy access to value-added services, which requires capacity building to understand how these services can benefit their lives and how to use them.

Mobile broadband

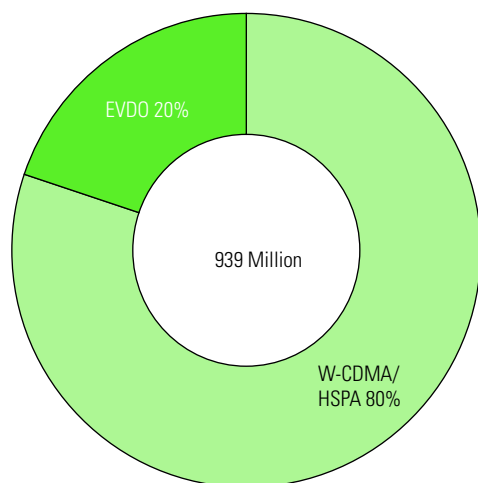
Using the ITU/OECD definition of broadband—networks with a minimum download speed of 256 kilobits per second (kbit/s)—the first mobile broadband networks were launched in late 2000 in Japan (W-CDMA) and in 2001 in the Republic of Korea (EV-DO). According to industry sources, there were 939 million mobile broadband subscriptions worldwide in June 2011 (figure A.6a). This number implies that just over 15 percent of the global subscription base can theoretically use mobile network services at high speeds.

A number of these subscriptions are not *active* users of mobile broadband (that is, they do not use the internet at mobile broadband speeds, even though they are equipped to do so). Users could have a theoretical ability to use mobile broadband by having coverage and a mobile-broadband-enabled device, but they may not necessarily be using high-speed services, perhaps because of high prices. They could also be subscribing to mobile broadband and using a high-speed mobile service (such as video telephony), but not necessarily accessing the internet. Alternatively, they could be using mobile broadband to access the internet over handsets, as well as through laptops or tablets.

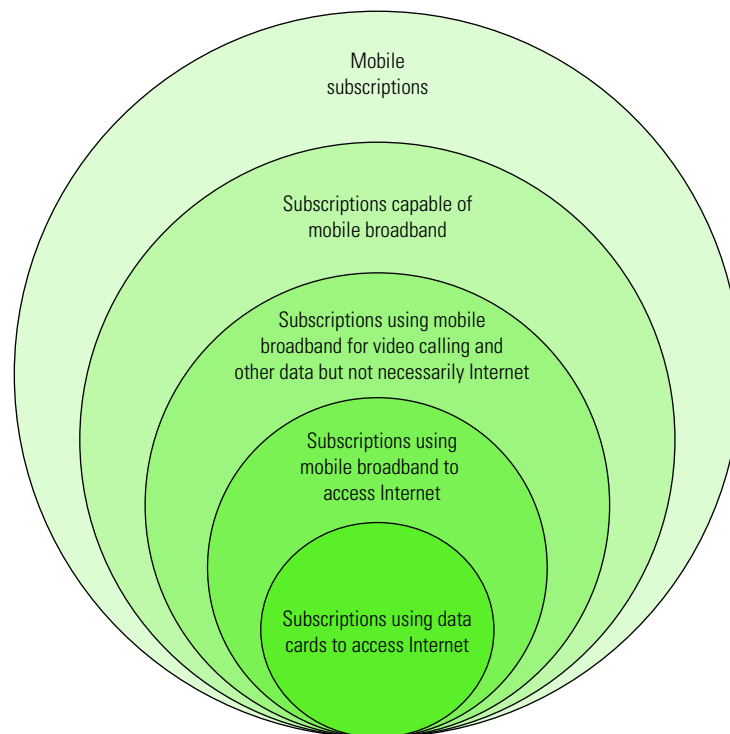
This definitional challenge presents analytical difficulties with interpreting mobile broadband statistics. The issue is whether to count and include theoretical access, active access to any high-speed service, active access using internet browsers, or active access via data cards (figure A.6b). Intergovernmental agencies have called for more clarity on mobile broadband statistics (OECD 2010). However, most countries report their mobile broadband statistics in insufficient detail,

Figure A.6 Mobile broadband

a. Estimated mobile broadband subscriptions, June 2011



b. Definitional “layers” of mobile broadband



Source: Adapted from CDMA Development Group and Global Mobile Suppliers Association (figure A.6a).

Note: Not including LTE (estimated at 2 million subscriptions) or WiMAX (estimated at 20 million).

so data comparability remains limited. Given these definitional issues, some countries have gone with the lowest common denominator, counting only internet access through data cards as mobile broadband (denoted by the innermost circle in figure A.6b).

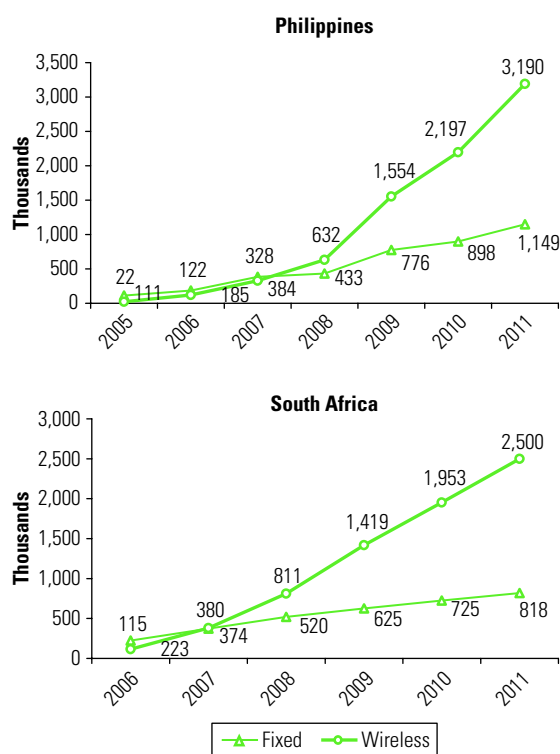
Despite confusion over statistical definitions, mobile broadband is already concretely impacting a number of developing countries, allowing them to leapfrog a lack of fixed broadband infrastructure. Based on the more certain yardstick of data cards (arguably the most direct comparison with wired broadband subscriptions), then mobile broadband far surpasses fixed broadband in nations such as the Philippines and South Africa (figure A.7). And if the wider definition for mobile broadband of plain internet access is applied, then the combination of wireless networks such as GPRS, EDGE, CDMA2000 1x, mobile broadband, and WiMAX greatly exceeds wired connections in most developing countries. An estimated 750 million people around the

world accessed the internet from their mobiles in 2010, up from some 180 million in 2005. Developing countries in Asia account for over half of this total, with some two out of five mobile internet users in China alone.

In addition to the statistical challenge of measuring active mobile broadband users, there are often significant shortfalls between the theoretical and actual speeds of data throughput. Manufacturers and operators cite ever-increasing bandwidth, but the average speeds fall far short. According to Akamai's analysis of 96 mobile networks across 58 economies carried out in the third quarter of 2011, peak speeds were around 8.9 megabits per second (Mbit/s), but average speeds were 1.8 Mbit/s (Akamai 2012). In contrast, Akamai reported average download speeds of 4.7 Mbit/s for fixed broadband networks. Further, usage over mobile broadband networks is generally "capped"; if users exceed a preset amount of data transfer, then they no longer have access to data services or their speed may be reduced or they will have to pay overage charges. Mobile data usage varies tremendously around the world. In the third quarter of 2011 it averaged 536 megabytes (MBs) per month across networks in 58 countries with a low of 22 MB per month and a high of 4,906 MB per month (table A.1).

While high-speed wireless holds promise for reducing the broadband divide, countries need to allocate spectrum and license operators to provide services. At the end of 2011, 46 World Bank members—almost all developing countries—had not commercially deployed mobile broadband services. And in a number of developing countries, a high-speed wireless service may technically exist, but it is often available only as a fixed wireless option.

Figure A.7 Broadband subscriptions in the Philippines and South Africa



Sources: Adapted from Globe Telecom, PLDT, MTN, Telkom, and Vodacom.

Note: "Wireless" refers to data cards only and not to access directly from handsets. Data are for major operators only. Figures for South Africa have

Devices

According to Gartner, global sales of personal computers (PCs) numbered 353 million in 2011.⁶ Assuming a PC is replaced on average every five years,⁷ an estimated total of 1.6 billion PCs were in use around the world at the end of 2011. In comparison, some 1.8 billion mobile handsets were sold in 2011 alone (figure A.8a).⁸ In other words, more mobile phones were sold in 2011 than the entire base of installed PCs. Sales of smartphones rose 59 percent in 2011 to more than 470 million units, about one of every four mobile handsets.

Another entry into the device world came in April 2010. The Apple iPad, which straddles the boundary

Table A.1 Mobile data speeds and volumes, Q3 2011

Economy	Network	Average speed (kbit/s)	Peak kbit/s	Average data usage (MB/month)
Australia	AU-3	1,553	7,878	222
Austria	AT-1	2,903	10,722	142
Belgium	BE-2	1,938	5,277	22
Bulgaria	BG-1	1,715	7,499	127
Canada	CA-2	1,171	2,923	608
Chile	CL-3	1,560	11,207	133
China	CN-1	1,475	3,927	247
Colombia	CO-1	1,003	6,541	156
Czech Republic	CZ-1	1,709	8,630	87
Egypt, Arab Rep.	EG-1	575	3,344	155
El Salvador	SV-3	926	4,782	353
Estonia	EE-1	1,401	7,487	264
France	FR-2	2,382	8,542	1,714
Germany	DE-1	967	3,720	93
Greece	GR-2	1,199	4,179	132
Guam	GU-1	957	4,663	101
Guatemala	GT-1	1,441	7,379	411
Hong Kong SAR, China	HK-2	1,925	10,842	583
Hungary	HU-1	1,863	8,481	130
India	IN-1	1,597	9,443	274
Indonesia	ID-1	475	7,172	4,906
Ireland	IE-1	2,880	14,055	725
Israel	IL-1	1,435	6,419	69
Italy	IT-4	1,413	8,693	219
Kuwait	KW-1	1,444	6,979	252
Lithuania	LT-2	1,973	11,945	414
Malaysia	MY-3	1,024	7,598	361
Mexico	MX-1	1,233	6,938	94
Moldova	MD-1	1,791	7,183	142
Morocco	MA-1	1,256	10,925	322
Netherlands	NL-1	1,763	4,871	36
New Caledonia	NC-1	1,070	4,757	854
New Zealand	NZ-2	1,880	9,988	768
Nicaragua	NI-1	1,551	7,886	754
Nigeria	NG-1	254	5,024	514
Norway	NO-2	2,071	6,752	58
Pakistan	PK-1	691	4,682	332
Paraguay	PY-1	643	5,850	163
Poland	PL-2	1,511	7,593	78
Portugal	PT-1	880	4,277	200
Puerto Rico	PR-1	2,639	10,975	2,703
Qatar	QA-1	1,620	10,074	281
Romania	RO-1	884	4,250	91
Russian Federation	RU-3	995	3,990	117
Saudi Arabia	SA-1	1,672	8,713	357
Singapore	SG-4	1,585	9,490	289
Slovakia	SK-1	327	2,077	38
Slovenia	SI-1	2,189	8,687	54
South Africa	ZA-1	438	1,386	168
Spain	ES-2	1,089	8,648	149

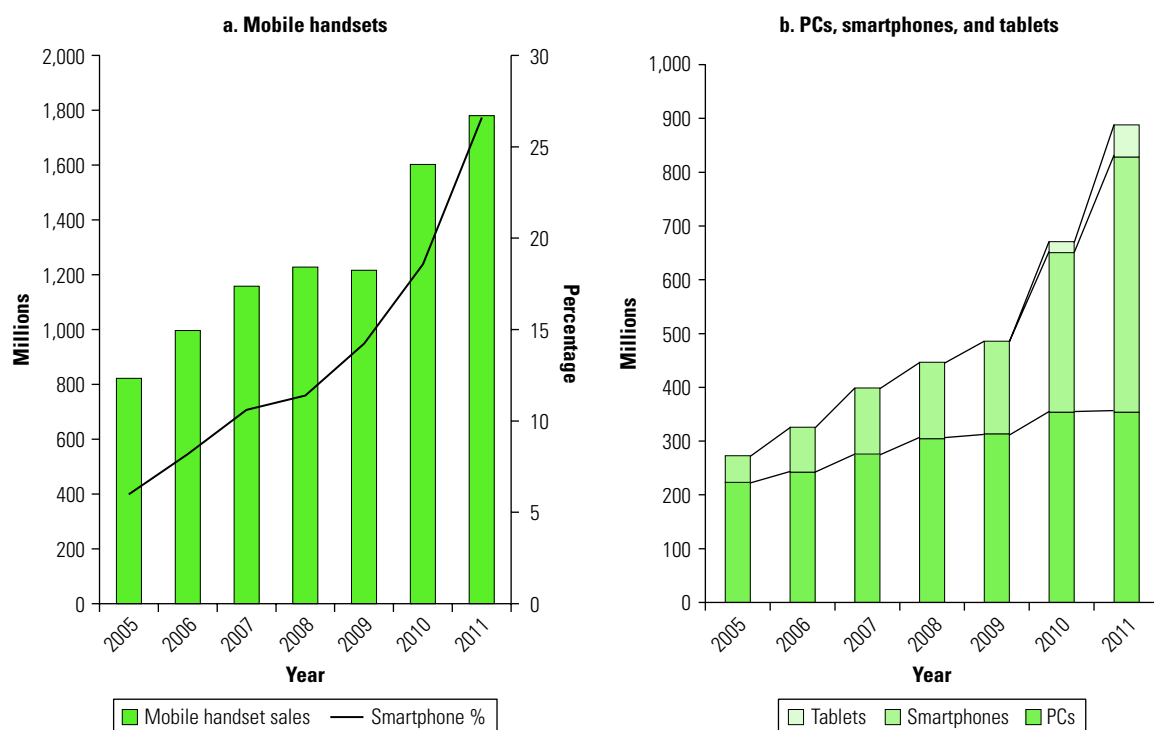
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Table A.1 continued

Economy	Network	Average speed (kbit/s)	Peak kbit/s	Average data usage (MB/month)
Sri Lanka	LK-1	894	7,373	327
Thailand	TH-1	149	1,412	135
Turkey	TR-1	1,771	7,975	203
Ukraine	UA-1	2,227	7,500	128
United Kingdom	UK-3	4,009	19,334	81
United States	US-2	1,072	4,411	47
Uruguay	UY-2	542	4,712	63
Venezuela, RB	VE-1	911	6,146	178
AVERAGE		1,818	8,960	536

Source: Akamai 2012.

Figure A.8 Global sales of mobile and computing devices



Source: Adapted from Gartner Inc.

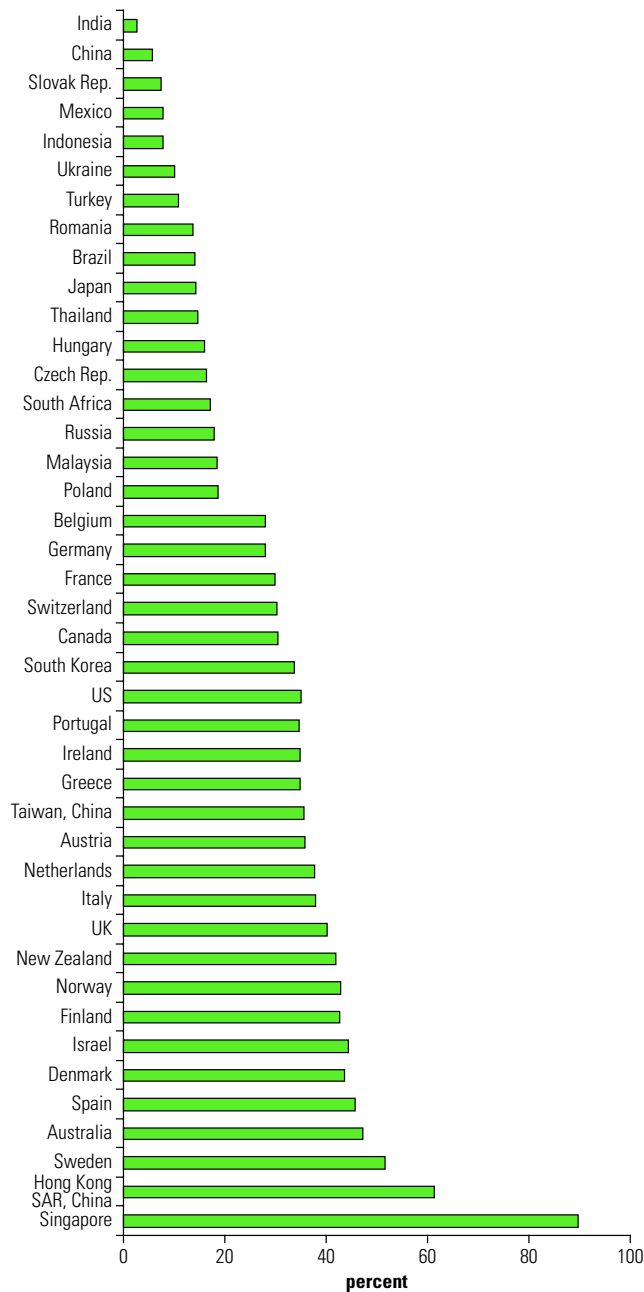
Note: In these figures, PC includes desk-based and mobile PCs, including mini-notebooks, but not tablets.

between smartphones and laptop computers, created a new category of “tablet” computers. Just over 14 million iPads were sold in 2011. The launch of the iPad has helped attract more competitors into the tablet arena, and sales of all brands are expected to be close to 300 million by 2015. Combined global sales of smartphones and tablet computers exceeded those of PCs in 2011 (figure A.8b). The outlook for internet connectivity is clearly through a

more portable and convenient device than a personal computer, with smartphones enjoying stellar growth in popularity (figure A.9).

Most mobile internet subscribers in developing countries are using low-end mobile handsets with minimal features, which limits their functionality, particularly for the development of advanced information and communication technology for development applications. For

Figure A.9 Smartphone penetration as a share of population, 2011



Source: Tomi Ahonen Consulting Analysis, December 2011. <http://communities-dominate.blogspot.com/brands/2011/12/smartphone-penetration-rates-by-country-we-have-good-data-finally.html>.

smartphones and tablets to spread more widely and be adopted more rapidly in developing economies, their price needs to fall. Google is interested in developing a mass-market smartphone for emerging nations. It has been working with Indian handset manufacturers to develop an

Android smartphone to be sold for \$150, with the price eventually dropping to under \$100. Although those prices will widen the potential target market considerably, such smartphones will still prove expensive for many Indians, who “can buy less advanced phones for \$40 that have cameras and basic data services” (Sharma 2010).

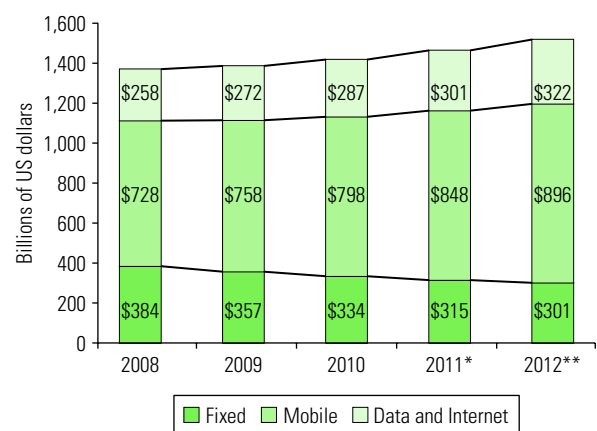
Mobile industry

Mobile economy

The mobile industry is a significant player in many national economies. Mobile telecommunication operators generated an estimated \$848 billion in revenue in 2011 (figure A.10).⁹ That is around 1.2 percent of total global annual gross domestic product (GDP) and 56 percent of overall telecommunication revenues. The direct economic impact of the mobile industry varies across regions. While revenue remains at a consistent ratio of around 1 percent of GDP in most regions, in some developing regions, its direct impact is far higher. For instance, in Kenya, financial transactions via the M-PESA platform are estimated to equate to up to 20 percent of national GDP (World Bank 2010).

Mobile communications also has an indirect impact beyond its direct impact on the economy. The consultancy and accountancy firm Deloitte has developed a framework to illustrate the wider impact of the mobile communications services sector on the mobile ecosystem (Deloitte 2008).

Figure A.10 Global telecommunication services market



Source: Adapted from IDATE.

*estimate.

**forecast.

This ecosystem includes equipment suppliers, support services, resellers, and retail shops, as well as significant contributions to government in the form of taxes (figure A.11). Deloitte considers that mobile communications has three indirect economic impacts:

1. An impact on other industries related to mobile services, including network and handset suppliers, airtime resellers, and the like
2. An impact on end users from improved productivity, such as reductions in travel costs, improved job opportunities, and greater market efficiency
3. An impact on society related to such benefits as social cohesion, the extension of communications to low-income users, stimulation of local content, and disaster relief assistance

In addition, there are multiplier effects throughout the broader economy, as the initial spending related to mobile communications ripples through other sectors of the econ-

omy. Based on various economic studies, Deloitte estimates that this multiplier effect ranges from 1.1 to 1.7.

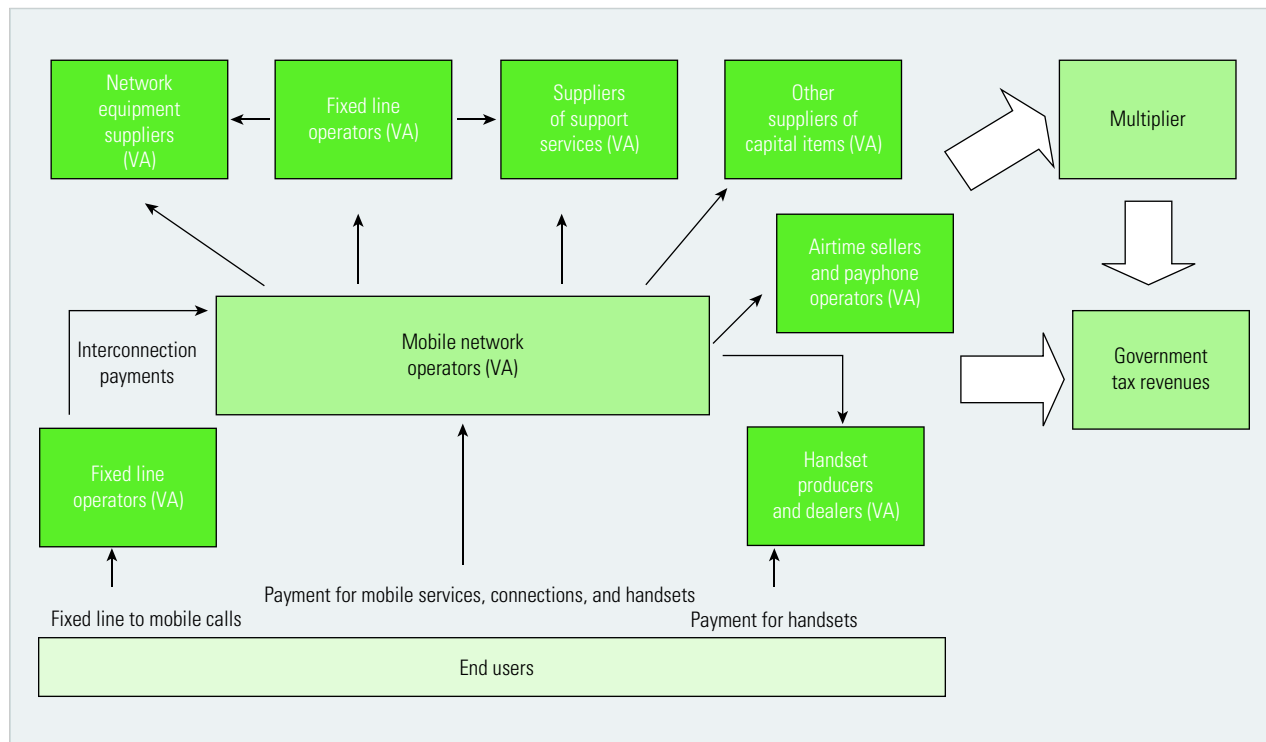
The model has been used to calculate the economic impact of mobile communications in a number of countries. One study of six countries in 2007 concluded that the direct economic impact of mobile communications ranged from 3.7 to 6.2 percent of national GDP (Deloitte 2008).

The employment impact of mobile communications is also significant. In addition to the direct employment of mobile operators, the Deloitte model includes related industries (such as equipment suppliers and airtime resellers), as well as spillover employment generated by government taxes and employment created from the consumption expenditures of personnel in mobile-related industries.

Strategic investors

The mobile services industry is one of the most globalized in the world. Practically every developing country has experienced foreign investment in its mobile cellular market, as have many developed nations. Opening up markets to

Figure A.11 Mobile value chain



Source: Deloitte.

Note: Value added (VA) is specific to a national economy and does not show international value added.

privatization and foreign investment has been a major factor driving the growth of the mobile industry in emerging markets. According to the World Bank's Private Participation in Infrastructure database, between 1990 and 2010, some 329 projects in the mobile telecommunication sector in developing regions attracted \$441 billion in private sector investment—much of it foreign and most of it from strategic mobile multinational groups (table A.2). No matter the size of a country, its political system, where it is located, or its income, private and foreign companies are willing to invest in mobile communications.

The relationship between foreign investors and host countries has changed considerably in recent years. Publicly held corporations now have to abide by a greater range of regulations and scrutiny relating to management, accounting, reporting, and governance than in the past. Deviating from these rules can have severe repercussions with investors, governments, and the public. Telenor, the Norwegian strategic investor, was rocked by reports of poor labor practices in firms that supply its mobile operations in Bangladesh. It immediately implemented reforms to remedy the situation.¹⁰ At the same time, multinationals are responding to pressing social issues such as the environment and poverty by instituting recycling, corporate social responsibility, and similar programs and policies.

Today, mobile communications markets in many developing countries have achieved notable scale. Indeed, some developing country subsidiaries now enjoy larger subscriber bases than their foreign investors' home markets. One is Vodafone, where the number of mobile subscriptions in its Indian subsidiary is seven times larger than its home market of the United Kingdom. Growth in overseas markets means that investors are responding more to the needs of these overseas markets than previously and leveraging lessons learned abroad to apply throughout their group holdings.

Many investors are developing a growing geographic focus and specialization in certain regions. Although only a few strategic investors are engaged around the world, most focus on a specific region or geography. South Africa's MTN, for example, has investments throughout Sub-Saharan Africa and the Middle East. It has grown from operations in five countries in 2000 and just 2 million subscribers to operations in 21 countries and 142 million subscriptions in 2010. Digicel, which focuses on islands in the Caribbean and Pacific, has investments in 32 countries. Some multinationals channel their investments through regional holdings; for example, Vivendi works through Maroc Telecom, France Telecom through Senegal's Sonatel, and Vodafone through South Africa's Vodacom. This trend toward regional specialization makes investors better informed about their markets and enhances roaming, potential economies of scale, and platform-sharing.

A Mobile analytical tool

This edition of the World Bank Group's *Information and Communications for Development* report features a number of mobile indicators in both the chapter text and the statistical appendix. The wide variety of indicators used can make it difficult to gauge and benchmark country performance. Combining several significant indicators into a smaller number of composite indicators and tracking changes in them over time can provide a useful analytical tool for evaluating the outcomes of different investments and policy measures. These composite indicators can also be used to diagnose the strengths and weaknesses of the mobile sector in a particular country and thereby can serve as a useful tool for future policy development. The publication of an analytical tool is consistent with the previous edition of the report, which introduced a series of ICT performance measures,

Table A.2 Private participation in mobile networks, 1990–2010

Region	Number of projects	Investment commitments in physical assets (millions of current US\$)
East Asia and Pacific	45	54,194
Europe and Central Asia	75	87,445
Latin America and the Caribbean	52	153,944
Middle East and North Africa	21	23,538
South Asia	31	69,286
Sub-Saharan Africa	105	52,305
TOTAL	329	440,7132

Sources: World Bank and PPIAF, PPI Project Database. (<http://ppi.worldbank.org>).

based on country groupings (World Bank 2009). Although the indicators used in this analytical tool are focused only on the mobile sector, the full range of ICT indicators used in the performance measures can be found in the World Bank's *Little Data Book on ICT*, the 2012 edition of which is being published in conjunction with this report.

There have been several methodological approaches and compilations of composite mobile indicators. The International Telecommunication Union (ITU) compiled a one-time "Mobile/Internet Index" in 2002 (ITU 2002). A framework for a composite mobile indicator with a focus on the internet has been proposed (Minges 2005). The ITU Digital Opportunity Index contained several mobile variables and allowed disaggregation into a mobile-only subcategory (ITU 2006) and was updated in 2007 (ITU and UNCTAD 2007). A mobile broadband composite indicator has recently been compiled for Latin American nations (A. T. Kearney 2012). None of these composite mobile indicators is particularly appropriate for this report because they have either been one-off, are not confined to mobile, or are limited to a particular region. Therefore a specially constructed mobile analytical tool, based on a series of composite indicators and building on the foundation of this earlier work, can help to fill the void.

In the context of the development orientation of the report, the Mobile Analytical Tool measures, on a country-by-country basis, the affordability and coverage of mobile

networks (**universality**), the degree to which operators provide voice and advanced network services (**supply**), and the ownership and usage of mobile phones (**demand**). Each composite indicator is constructed from two separate indicators that measure these three components with equal weight given to each (figure A.12). The three composites could also be combined into a single measure if researchers found this useful, but that is not the intention here. The indicators are reproduced in the statistical appendix of this report, providing transparency and allowing users to recreate the analysis.¹¹

The methodology is similar to that used for the United Nations Development Programme's Human Development Index (HDI). Each indicator has an equal weight. Indicators are converted to standardized values based on a logical 100 percent "goalpost." This is a straightforward conversion except for affordability, which is subtracted from 1 to reflect best performance. Although the affordability value may never reach 1 (where mobile service would be free), in 2010 there were twenty-six economies where the price of a mobile basket was less than 1 percent of per capita income (ITU 2011).

Table A.3 uses the data for Morocco to provide an example of the construction of the Mobile Analytical Tool.

The analytical tool has been applied to a representative range of 100 economies with data availability for the years 2005 and 2010 (table A.4 at the end of the appendix). The results provide some interesting insights into the development of mobile networks over that critical time period.

Figure A.12 Mobile analytical tool: indicators and categories

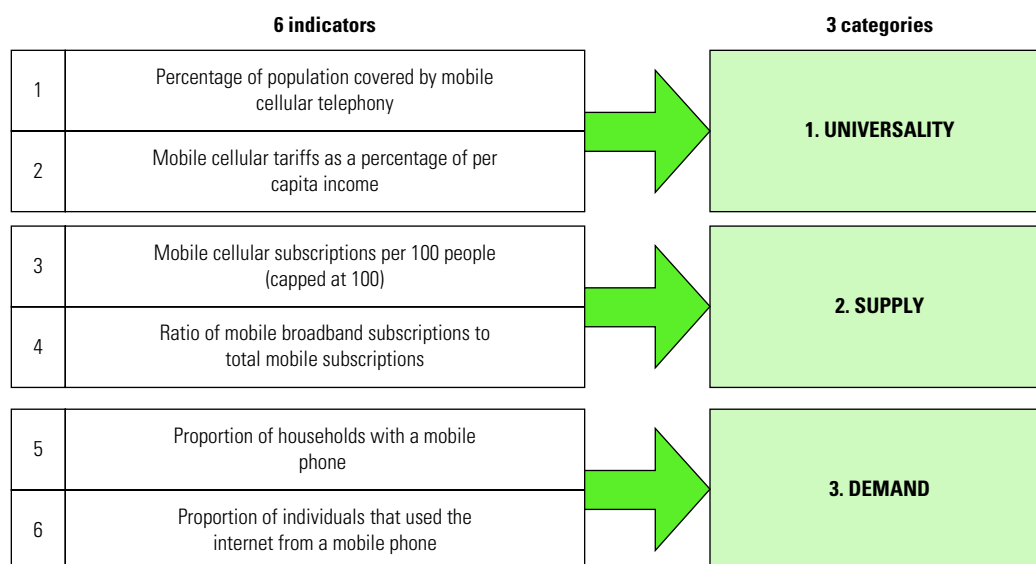


Table A.3 Worked example of the mobile analytical tool, Morocco

Indicator	Indicator value		Component scores		Category
	2005	2010	2005	2010	
Percentage of population covered by mobile cellular telephony	98	98			
Mobile cellular tariffs as a percentage of per capita income	20.1	14.3	0.88	0.93	Universality
Inverted (100-tariff/GNI)	79.9	85.7			
Mobile cellular subscriptions per 100 people (capped at 100)	41	100			
Ratio of mobile broadband subscriptions to total mobile subscriptions	0	4	0.21	0.52	Supply
Proportion of households with a mobile telephone	59	84			
Proportion of individuals that used the mobile internet	0.04	3.4	0.29	0.44	Demand

Source: Based on Agence Nationale de Réglementation des Télécommunications (ANRT) and Maroc Telecom.

Table A.4 Mobile analytical tool components for 100 selected economies, 2005 and 2010

Country	Universality			Supply			Demand		
	2005	2010	Change (%)	2005	2010	Change (%)	2005	2010	Change (%)
Albania	0.86	0.95	10	0.24	0.50	108	0.15	0.49	227
Algeria	0.90	0.96	7	0.21	0.46	119	0.25	0.48	92
Argentina	0.96	0.98	2	0.27	0.52	93	0.35	0.48	37
Armenia	0.95	0.95	0	0.11	0.51	364	0.16	0.49	206
Australia	0.98	0.99	1	0.47	0.70	49	0.44	0.51	16
Austria	0.98	0.99	1	0.55	0.57	4	0.46	0.56	22
Azerbaijan	0.92	0.99	8	0.13	0.42	223	0.26	0.45	73
Bahrain	0.99	0.99	0	0.50	0.51	2	0.50	0.54	8
Bangladesh	0.84	0.97	15	0.03	0.21	600	0.06	0.34	467
Belarus	0.94	0.98	4	0.21	0.51	143	0.15	0.39	160
Belgium	0.99	0.99	0	0.42	0.54	29	0.46	0.49	7
Bolivia	0.73	0.73	0	0.13	0.35	169	0.15	0.40	167
Bosnia and Herzegovina	0.93	0.97	4	0.20	0.43	115	0.27	0.43	59
Brazil	0.90	0.97	8	0.23	0.54	135	0.30	0.43	43
Bulgaria	0.95	0.97	2	0.40	0.52	30	0.36	0.45	25
Cambodia	0.71	0.89	25	0.04	0.34	750	0.11	0.32	191
Cameroon	0.69	0.82	19	0.06	0.20	233	0.14	0.22	57
Canada	0.97	0.99	2	0.26	0.48	85	0.33	0.48	45
Chile	0.97	0.98	1	0.33	0.53	61	0.36	0.48	33
China	0.91	0.98	8	0.15	0.35	133	0.28	0.58	107
Colombia	0.89	0.90	1	0.25	0.50	100	0.28	0.47	68
Costa Rica	0.87	0.87	0	0.13	0.37	185	0.25	0.40	60
Croatia	0.98	0.99	1	0.40	0.52	30	0.40	0.54	35
Czech Republic	0.98	0.99	1	0.50	0.54	8	0.43	0.50	16
Denmark	0.99	0.99	0	0.51	0.73	43	0.50	0.59	18
Ecuador	0.89	0.90	1	0.24	0.52	117	0.19	0.41	116
Egypt, Arab Rep.	0.94	0.98	4	0.09	0.46	411	0.14	0.39	179
Estonia	0.98	0.99	1	0.50	0.59	18	0.42	0.47	12
Finland	0.99	0.99	0	0.51	0.60	18	0.52	0.62	19
France	0.99	0.99	0	0.40	0.64	60	0.38	0.52	37
Georgia	0.93	0.96	3	0.17	0.56	229	0.15	0.43	187
Germany	0.98	0.99	1	0.50	0.59	18	0.39	0.51	31
Ghana	0.61	0.85	39	0.06	0.37	517	0.10	0.37	270

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Table A.4 continued

Country	Universality			Supply			Demand		
	2005	2010	Change (%)	2005	2010	Change (%)	2005	2010	Change (%)
Greece	0.99	0.99	0	0.50	0.54	8	0.38	0.47	24
Hong Kong SAR, China	1.00	0.99	-1	0.54	0.72	33	0.46	0.60	30
Hungary	0.98	0.98	0	0.46	0.53	15	0.40	0.48	20
India	0.72	0.86	19	0.03	0.31	933	0.07	0.27	286
Indonesia	0.91	0.96	5	0.10	0.46	360	0.15	0.39	160
Ireland	0.99	0.99	0	0.50	0.65	30	0.45	0.52	16
Israel	0.98	0.99	1	0.51	0.56	10	0.49	0.55	12
Italy	0.99	0.99	0	0.57	0.59	4	0.41	0.55	34
Jamaica	0.96	0.98	2	0.50	0.51	2	0.47	0.50	6
Japan	0.99	0.99	0	0.51	0.94	84	0.72	0.78	8
Jordan	0.95	0.98	3	0.29	0.51	76	0.27	0.55	104
Kazakhstan	0.94	0.97	3	0.16	0.50	213	0.14	0.43	207
Kenya	0.59	0.85	44	0.08	0.36	350	0.11	0.36	227
Korea, Rep.	0.99	0.99	0	0.56	0.96	71	0.58	0.69	19
Kyrgyzstan	0.59	0.90	53	0.05	0.45	800	0.05	0.45	800
Latvia	0.97	0.99	2	0.43	0.65	51	0.42	0.53	26
Lebanon	0.94	0.97	3	0.13	0.37	185	0.25	0.42	68
Lithuania	0.98	0.99	1	0.50	0.58	16	0.37	0.51	38
Macedonia, FYR	0.94	0.96	2	0.31	0.57	84	0.33	0.44	33
Malaysia	0.97	0.99	2	0.38	0.59	55	0.29	0.53	83
Mali	0.19	0.58	205	0.03	0.26	767	0.08	0.11	38
Mauritius	0.99	0.99	0	0.27	0.54	100	0.32	0.51	59
Mexico	0.92	0.95	3	0.22	0.43	95	0.21	0.35	67
Moldova	0.89	0.95	7	0.15	0.47	213	0.16	0.36	125
Morocco	0.88	0.93	6	0.21	0.52	148	0.29	0.44	52
Namibia	0.91	0.96	5	0.10	0.51	410	0.20	0.31	55
Nepal	0.48	0.85	77	0.01	0.16	1,500	0.02	0.30	1,400
Netherlands	0.99	1.00	1	0.50	0.59	18	0.50	0.55	10
New Zealand	0.98	0.98	0	0.46	0.63	37	0.37	0.54	46
Nigeria	0.63	0.79	25	0.07	0.29	314	0.20	0.31	55
Norway	1.00	1.00	0	0.50	0.58	16	0.50	0.56	12
Pakistan	0.71	0.94	32	0.06	0.31	417	0.17	0.25	47
Paraguay	0.84	0.95	13	0.13	0.49	277	0.25	0.44	76
Peru	0.75	0.88	17	0.10	0.49	390	0.11	0.39	255
Philippines	0.89	0.97	9	0.20	0.51	155	0.24	0.43	79
Poland	0.98	0.99	1	0.38	0.66	74	0.33	0.46	39
Portugal	0.99	0.99	0	0.53	0.58	9	0.42	0.47	12
Qatar	0.97	0.99	2	0.45	0.58	29	0.55	0.66	20
Romania	0.96	0.98	2	0.31	0.54	74	0.25	0.41	64
Russian Federation	0.96	0.98	2	0.44	0.52	18	0.16	0.49	206
Rwanda	0.44	0.83	89	0.01	0.19	1,800	0.03	0.20	567
Saudi Arabia	0.95	0.95	0	0.31	0.53	71	0.48	0.53	10
Senegal	0.72	0.85	18	0.07	0.32	357	0.15	0.43	187
Serbia	0.95	0.96	1	0.35	0.54	54	0.36	0.43	19
Singapore	1.00	1.00	0	0.52	0.59	13	0.55	0.61	11
Slovak Republic	0.98	0.98	0	0.42	0.63	50	0.45	0.53	18
Slovenia	0.99	0.99	0	0.45	0.61	36	0.44	0.54	23
South Africa	0.96	0.97	1	0.33	0.53	61	0.31	0.47	52

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Table A.4 continued

Country	Universality			Supply			Demand		
	2005	2010	Change (%)	2005	2010	Change (%)	2005	2010	Change (%)
Spain	0.99	0.98	-1	0.51	0.59	16	0.42	0.54	29
Sri Lanka	0.87	0.97	11	0.09	0.45	400	0.10	0.32	220
Sweden	0.99	0.99	0	0.52	0.62	19	0.50	0.59	18
Switzerland	0.99	0.99	0	0.48	0.62	29	0.50	0.56	12
Tajikistan	0.20	0.94	370	0.02	0.35	1,650	0.06	0.41	583
Tanzania	0.49	0.77	57	0.05	0.26	420	0.04	0.23	475
Thailand	0.93	0.97	4	0.23	0.51	122	0.36	0.52	44
Turkey	0.97	0.97	0	0.32	0.44	38	0.36	0.49	36
Uganda	0.69	0.85	23	0.03	0.19	533	0.08	0.27	238
Ukraine	0.92	0.98	7	0.32	0.52	63	0.22	0.43	95
United Arab Emirates	0.99	0.99	0	0.50	0.71	42	0.50	0.56	12
United Kingdom	0.99	0.99	0	0.53	0.61	15	0.50	0.57	14
United States	0.99	0.99	0	0.36	0.61	69	0.29	0.56	93
Uruguay	0.95	0.99	4	0.17	0.55	224	0.23	0.37	61
Uzbekistan	0.79	0.95	20	0.01	0.40	3900	0.25	0.44	76
Venezuela, RB	0.90	0.93	3	0.24	0.51	113	0.18	0.26	44
Vietnam	0.89	0.96	8	0.05	0.53	960	0.15	0.29	93
Zambia	0.56	0.78	39	0.04	0.20	400	0.08	0.30	275
Zimbabwe	0.82	0.63	-23	0.03	0.35	1067	0.05	0.27	440

Source: Authors' analysis.

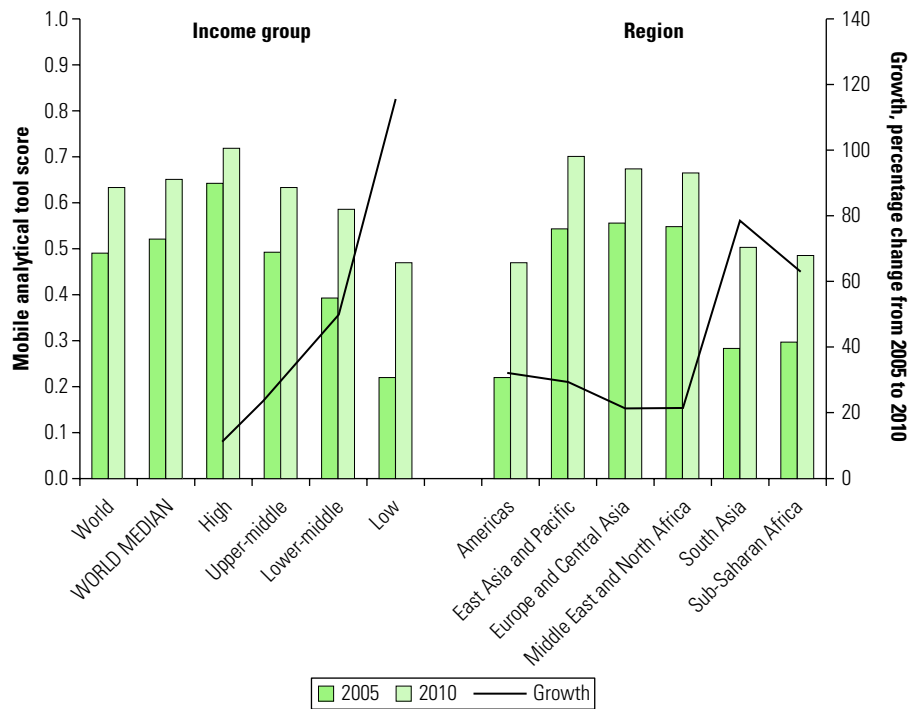
The mean score for all components added together increased by 30 percent between 2005 and 2010, from 0.49 to 0.63, attesting to the rapid growth and improvement in mobile networks over that period (figure A.13). The highest increase was among low-income countries, where significant gains in coverage were coupled with falling prices from intensified competition. Regionally, the highest growth was in South Asia, followed by Sub-Saharan Africa. The highest absolute increase was in Tajikistan, where the score rose by 0.47 points to 0.57. Mobile competition intensified in Tajikistan between 2005 and 2010, with four GSM (Global System for Mobile communications) and several CDMA (Code Division Multiple Access) operators and a number of panregional mobile groups entering the market, including TeliaSonera and Vimpelcom. Investment soared, leading to plummeting prices, an expansion of coverage, and skyrocketing access. Several other Central Asian countries also had among the highest growth in their scores between 2005 and 2010.

Looking at each of the three components individually, some 80 countries have achieved a high degree of universality (a subindex value of 0.9 or higher). Most developed and

middle-income nations had already achieved near universality by 2005, and gains since then have been marginal. Although many developing nations had large increases in universality between 2005 and 2010, many still remain below the 0.9 threshold. Universal access to mobile networks remains constrained in these countries because of relatively high tariffs, incomplete mobile coverage, or both. In Mali, for instance, mobile service covers less than half the population, and the price of a monthly basket of mobile services is one-quarter of per capita income. In Rwanda, pricing is a barrier: mobile networks cover more than 90 percent of the Rwandan population, but a monthly mobile basket is 30 percent of per capita income. In India the bottleneck is coverage: a mobile basket is just 3 percent of per capita income but only three-quarters of the population is covered.

The supply component showed the greatest increase between 2005 and 2010, with the mean value nearly doubling from 0.28 to 0.50. In developed countries the increase was chiefly attributable to the deployment of mobile broadband networks, whereas gains in developing countries came from the provision of basic voice services. Around half of the countries are “stuck” at a supply

Figure A.13 Mobile analytical tool scores, 2005 and 2010, by income and region group



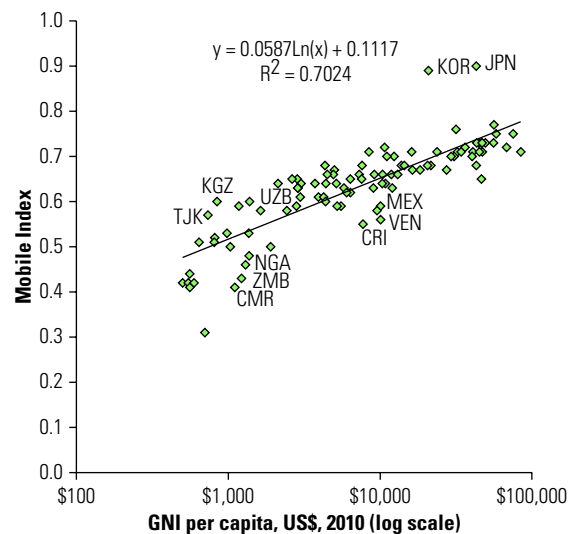
Source: Author analysis.

Note: Scores shown are the mean of the three components. Group averages are the mean of the group.

component value of 0.5; there are more SIM cards than people, but the share of mobile broadband is low.

The score achieved on the Mobile Analytical Tool is closely related to gross national income (GNI) per capita (figure A.14). None of the high-income economies had a score under 0.65, and several upper-middle-income countries exceeded that value although with much lower incomes. These include the Russian Federation and South Africa along with Argentina, Jamaica, Jordan, Lithuania, Macedonia, Malaysia, Mauritius, and Thailand. Japan and the Republic of Korea stand out as outliers—their score is significantly above where it should be considering their income. Most countries at very low per capita income averages (less than \$1,000 a year) fall below the regression line, suggesting that a certain level of economic development is necessary for balanced mobile growth. Regional clusters are also noticeable: lower-middle-income economies in Sub-Saharan Africa tend to be performing poorly whereas the opposite is true in Central Asia. A number of Latin American upper-middle-income economies are also not doing as well as expected.

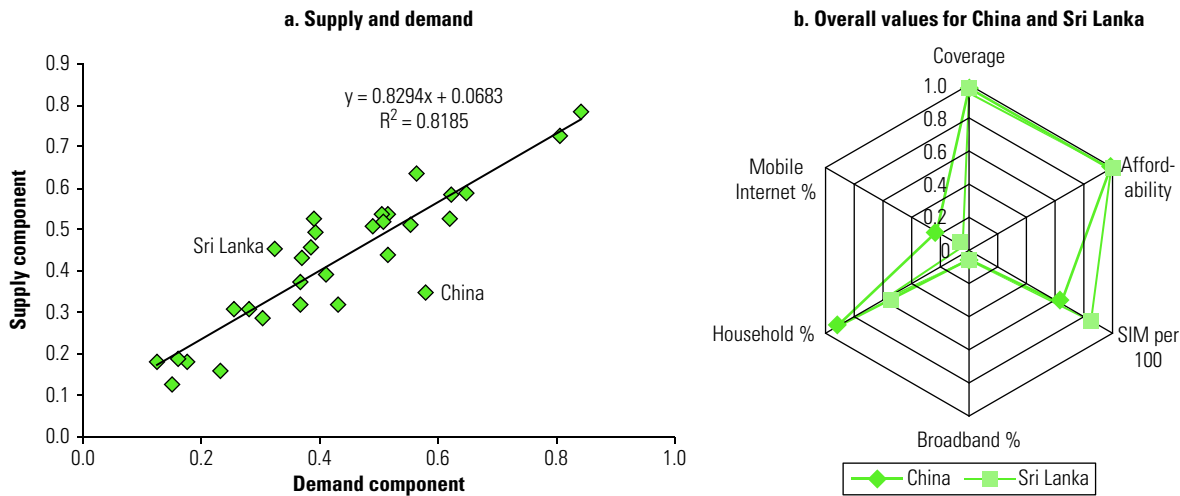
Figure A.14 Mobile analytical tool and GNI per capita, 2010



Source: Authors' analysis.

Note: Scores shown are the mean of the three components. Each point represents one economy with outliers highlighted: CMR = Cameroon; CRI = Costa Rica; JPN = Japan; KOR = Republic of Korea; KGZ = Kyrgyzstan; MEX = Mexico; NGA = Nigeria; TJK = Tajikistan; UZB = Uzbekistan; VEN = Venezuela, RB; ZMB = Zambia.

Figure A.15 Mobile analytical tool: China and Sri Lanka compared



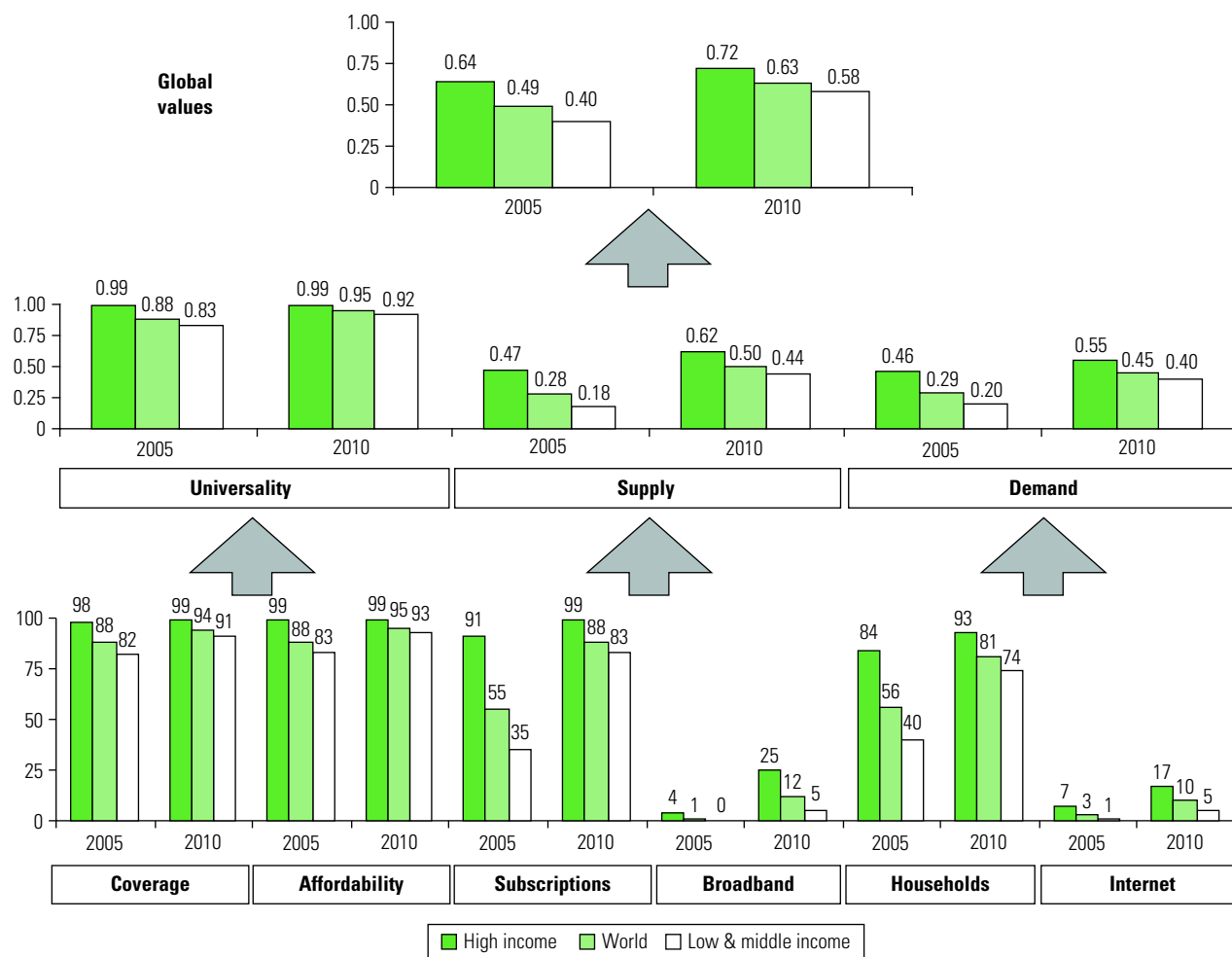
Source: Authors' analysis.

As might be expected, there is a close relationship between the supply and demand categories (figure A.15a). Outliers illustrate mismatches between supply and demand. For example in China the demand component (0.58) is higher than the supply component (0.35), suggesting further room for growth (figure A.15b). Over 90 percent of Chinese households have a mobile phone, the second-highest level among the developing countries used in the Mobile Analytical Tool (Jordan has the highest home mobile penetration among this group). China also has a relatively high level of internet access through mobile phones. According to a recent 21-country survey, some 37 percent of Chinese mobile phone owners use their handset to access the internet, a higher ratio than in France, Germany, or Spain.¹² On the supply side, China's SIM card penetration is only 64 per 100 people, relatively low because there are few incentives for multiple SIM card ownership thanks to inexpensive cross network pricing. China is relatively new to mobile broadband with networks having launched only in 2009. Subscriptions to high-speed mobile networks have grown rapidly, and by the end of 2010 China had the third-largest number of mobile broadband users in the world (after Japan and the United States). Nevertheless, mobile broadband still accounted for only 5 percent of total mobile subscriptions, with the result that most Chinese mobile internet users were accessing the web over narrowband mobile connections.

In contrast, Sri Lanka scores higher on the supply component (0.45) than on the demand one (0.32). On the supply side, there is a high degree of competition in the Sri Lankan mobile market with SIM card penetration at 85 per 100 people. Further, Sri Lanka was the first South Asian nation to launch mobile broadband networks. On the demand side, however, the penetration of mobile phones in Sri Lankan homes is only 60 percent and just 5 of every 100 people use a mobile phone to access the internet (see figure A.15b). The mismatch suggests that efforts here need to be devoted to boosting demand.

Figure A.16 illustrates the relationship between the three composite indicators and underlying indicators of the Mobile Analytical Tool. The values for high-income economies are contrasted with the world and low- and middle-income averages. As noted, high degrees of universality have been achieved with high affordability and second-generation (2G) coverage. There have also been large gains in supply of 2G networks and household demand between 2005 and 2010. However, levels of mobile broadband networks and internet usage are low, and these will be the growth areas in the future. Care is needed to ensure that an advanced mobile digital divide does not develop as a result of restricted mobile broadband coverage (such as poor coverage in rural areas) and limited mobile broadband affordability.

Figure A.16 Mobile analytical tool components summarized



Source: Authors' analysis.

Note: The scores shown at the top are based on the mean of the three components of the Mobile Analytical Tool.

The Mobile Analytical Tool provides different insights into the availability and demand for mobile communications. It overcomes the limitations of using a single indicator to gauge mobile performance. For example, the number of mobile subscriptions is often used as a comparator of development, but it can be misleading because of underlying variations in multiple SIM card ownership, which in turn reflects interoperator pricing strategies. As the case of China and Sri Lanka illustrated, Sri Lanka has a higher SIM card penetration but much lower rates of actual mobile ownership and internet browsing from cell phones. The Mobile Analytical Tool provides a holistic and integrated perspective of country

mobile network development compared with using single indicators to measure performance.

Notes

1. "The importance of availability of information communication technology (ICT) devices is increasing significantly in contemporary society. These devices provide a set of services that are changing the structure and pattern of major social and economic phenomena. The housing census provides an outstanding opportunity to assess the availability of these devices to the household" (United Nations 2008, 215).
2. A major factor has been the development of low-cost models: "... the spread of mobile phones in developing countries has been