CHAPTER 1.2

ICTs, Income Inequality, and Ensuring Inclusive Growth

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> There is in our opinion no good reason why by the early part of the next century virtually the whole of mankind should not be within easy reach of a telephone and of all the benefits this can bring.
>
> *The Maitland Report, 1985*

In 1985, a special commission of the International Telecommunication Union (ITU) released what is commonly known as "The Maitland Report," expounding upon the impact of telecommunications as "an engine of growth and a major source of employment and prosperity," particularly in developed economies.[1] The commission's focus concerned the growing division in telecommunications access between advanced economies and developing nations, and the report presented detailed recommendations for closing this "digital divide" with the aim of accelerating the positive impact of telecommunications for all citizens of the world.

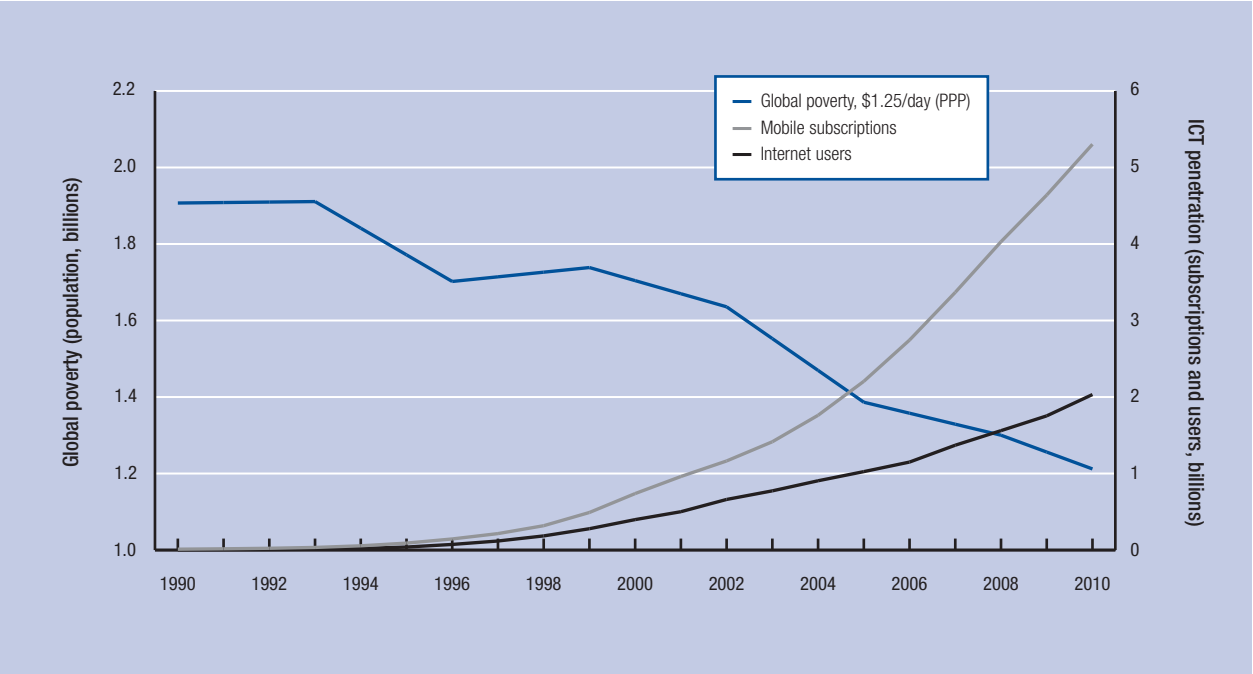
Thirty years later we can look back on the overall impact of telecommunications on economic growth, income gains, and poverty alleviation. Has the goal of bridging the digital divide been realized? And have information and communication technologies (ICTs) brought benefits and shared economic prosperity to both advanced and emerging countries?

This chapter reviews the impact of ICTs on income, economic growth, and poverty alleviation. It first reviews trends in income inequality and presents the paradox of the impact of ICTs on global income inequality and within-country inequality. It then reviews the macroeconomic and microeconomic literature on the income growth impacts of ICTs and posits explanations for the mixed relationship on income inequality. The chapter concludes with a vision of greater ICT-driven inclusive growth, highlighting specific policies and programs to enhance the income effects of ICTs on lower-income and marginalized populations.

THE ICT AND INCOME INEQUALITY PARADOX

Although global inequality trends and measurement techniques generate much debate, the latest available data from the World Bank show income inequality (the distribution of income across all people in the world) to be on the decline.[2] The most recent analysis measures global income inequality from 1988 through 2008, and illuminates shifting patterns in global income growth as it decomposes income shares within each of the 146 countries measured. The authors find that global income inequality has fallen steadily from a Gini coefficient of 72.2 in 1988 to 70.5 in 2008.[3] They attribute the decrease in inequality to the large overall income gains around the global median (50th percentile) of the population. The global top 1st percentile also

Figure 1: Falling global absolute poverty and rising ICT penetration



Sources: World Bank *PovCal* database (1990, 1993, 1996, 1999, 2002, 2005, 2008, 2010); authors' calculations and interpolation, ITU *World Telecommunication/ICT Indicators* database June 2013.

realized significant income gains over this period, but the former (gains around the median) outweigh the latter. In China, for example, the richest decile rose from the 68th global percentile in 1988 to reach the 83rd percentile worldwide in 2008. This rapid increase translates into a leapfrogging over approximately 15 percent of the world's population—almost a billion people.

However, the decrease in global income inequality masks the income inequality increases observed within individual countries. The same study notes that the "within-country component of global inequality has increased continuously over this twenty-year period," and an analysis by the International Monetary Fund in 2009 found that income inequality rose in most of the 51 countries analyzed.[4] The authors find that technological progress, measured as the share of ICT capital stock, has a statistically significant impact on inequality, and the effect of technological change was greater than that of financial globalization.[5] The study is limited in country coverage and the period tested ended in 2003, when Internet penetration was still nascent in many regions. But the results do present a paradox: are ICTs driving economic growth and leading to decreasing global inequality while at the same time contributing to rising within-country income inequality? We posit that, although this paradox appears to exist, the impact of ICTs on income growth and poverty alleviation are undeniable, and greater adoption of ICTs in lower-income groups will accelerate income gains at the base of the economic pyramid.

GLOBAL MACROECONOMIC GROWTH AND POVERTY ALLEVIATION

Macroeconomic evidence of the impacts of ICTs on growth at the national level is mounting. A number of meta-analyses review the wide body of economic literature demonstrating the causal impact of ICTs on growth.[6] A landmark study by the World Bank in 2009 demonstrated the increasing impact of different ICTs on economic growth.[7] The study measured the causal impact of fixed telephony, mobile telephony, Internet use, and broadband use on gross domestic product (GDP) growth over 26 years (from 1980 through 2006) across 120 developing and developed countries. A 2012 update, using data for 86 countries for 1980 through 2011, arrived at a similar result, demonstrating that a 10 percent increase in fixed broadband penetration results in a 1.35 percent increase in GDP growth in developing countries and a 1.19 percent increase in developed economies.[8]

More recent analysis links mobile broadband and intensity of use with economic growth, demonstrating that doubling mobile broadband data use leads to a 0.5 percent increase in GDP per capita growth rates.[9] This body of evidence highlights the fact that we are long past the days of the "Solow paradox," when, in 1987,

Nobel Prize–winning economist Robert Solow noted, "you can see the computer age everywhere but in the productivity statistics."[10]

Four main mechanisms dictate the process by which ICTs contribute to macroeconomic growth by affecting inputs to GDP growth:[11]

1. ICTs contribute to GDP directly through the production of ICT goods and services as well as well through continuous advances in ICT-producing sectors,
2. ICTs contribute to total factor productivity growth through the reorganization of the ways goods and services are created and distributed,[12]
3. ICT industries generate positive employment effects, and
4. increasing applications of ICTs (capital deepening) leads to rising labor productivity.

With ICTs contributing to global economic growth, developing regions have experienced a steady decline in absolute poverty. The global extreme poverty rate (those individuals surviving on less than $1.25/day) has dropped from 1.9 billion people in 1981 to 1.3 billion in 2010 according to the World Bank: a drop in extreme poverty rates from greater than 50 percent to 21 percent.[13] This decline in extreme poverty has been driven by long-run economic growth in China and India, recent growth across Africa, and the impact of social programs in Latin America.[14] Figure 1 depicts the growth in ICT penetration from 1990 through 2010, when global extreme poverty has been on the decline as a result of economic growth.

Similarly, at the country level, decreases in poverty are correlated with growth in ICT adoption. From 2000 through 2010, the change in the poverty headcount ratio (measured at $5/day at purchasing power parity) is inversely correlated with the growth in Internet usage penetration with a correlation coefficient of –0.42, which is a measure of the linear interdependence of two variables.[15]

MICROECONOMIC IMPACTS ON LOWER-INCOME GROUPS

Although significant attention has focused on the macroeconomic growth effects of ICTs at the economy level in developing countries, emerging microeconomic analysis highlights the impact and mechanisms by which ICTs can drive income growth at the bottom of the economic pyramid. This work is crucial to understanding how much lower-income groups benefit from ICTs—particularly because these groups spend a disproportionately larger share of their income on ICTs. For example, survey analysis of the lowest-earning 75 percent of mobile users in Africa found that low-income households spend large proportions of their income on communications—averaging from 27 percent for Kenyans to 11 percent for South Africans.[16] In Sri Lanka, communications costs range from 12 to 15 percent of household income; the average Chilean spends more for telecommunications than for water.[17]

Microeconomic analyses show the significant impact of ICTs, particularly mobile telephony and the Internet, among lower-income groups. In their survey of 1,600 East African households in 2007 and again in 2010, May et al. found that ICT access leads to rising income levels among the very poor: those with access to ICTs gained approximately $21 more a month than those without access. And the users of ICTs narrowed their income gap with others in higher-income brackets.[18]

Another study, conducted in two Tanzanian villages, links ICT investment with poverty alleviation. One village, in which a group received five months of mobile phone airtime and Internet access, experienced a reduction in all seven areas of poverty criteria measured in the study. In the second village, which received no ICTs, only two of the indicators changed.[19] A similar study in 2010 in Peru followed individuals who became Internet users between 2007 and 2009 and compared them with non-users. Over the time period, the nascent Internet users gained, on average, household incomes 19 percent higher than those of non-users.[20] Similarly, the introduction of broadband services in one Ecuadorean municipality led to individual labor income gains of 7.5 percent (or 3.7 percent annually over the 2009–11 study period).[21]

Although ICTs drive income growth at the microeconomic level with mechanisms similar to those of macroeconomic channels (the underlying gains relate to productivity growth), Aker and Blumenstock (forthcoming) highlight four primary channels whereby ICTs (predominantly mobile phones) drive economic growth in lower-income groups, particularly in Africa: "as a communication device to share (public and private) information; as a transfer device to exchange (public and private) transfers; as a savings device; and as an educational tool for school-aged children and adults."[22]

Mobile telephony especially has demonstrated how increased low-cost connectivity helps to expand markets. One study followed 300 fishing groups in the Indian state of Kerala through weekly surveys between 1996 and 2001. When mobile phone service was adopted by the groups in 1997, the study reported a 9 percent increase in weekly profits; 30 to 40 percent of the groups began to deliver their catch to buyers outside of their regular markets because they could identify better prices through market arbitrage.[23] Similarly, in Niger, the introduction of mobile phone service between 2001 and 2006 reduced the dispersion of grain prices across markets significantly and led to a 29 percent increase in average daily profits, demonstrating "that the introduction of cell phones was associated with net welfare gains for consumers and traders."[24]

ICTs also operate as a transfer device for money, which helps to reduce the cost of consumption. Mobile money systems, such as M-PESA in Kenya,

demonstrate the impact and popularity of using ICTs in private transfers and to pay for services. GSMA, an association of mobile operators and related companies, estimates that, at the end of 2013, over 61 million mobile money users were active across 84 countries through 219 providers.[25] Governments are also beginning to recognize the role of mobile payment systems in implementing public transfer programs. Over 30 countries have some form of conditional cash transfer program to support low-income households. Many of these programs are beginning to utilize mobile money payments to eliminate financial leakage and transaction costs. Similarly, ICTs provide a way to save and thus smooth consumption, particularly in the face of external economic shocks. In Latin America, for example, only 14.5 percent of poor households have a savings account; mobile money payments increase savings if those accounts are attached to a savings mechanism.[26] Mobile devices can also lead to better learning outcomes: in Niger, for instance, a mobile phone–based component in a standard adult education program led to writing and math test scores 0.19 to 0.25 standard deviations higher than those without mobile-based content.[27]

At the sector level, ICTs demonstrate significant impact. In agriculture, ICTs increase access to critical information such as prices, market demand, disease mitigation, meteorological information, and growing and marketing practices; they also improve the value chain for small shareholder farmers by allowing them to improve logistics and trace products from farm gate to market.[28] In healthcare, mobile health applications help to improve management and decision-making by healthcare professionals, increase real-time and location-based data gathering, provide healthcare to remote locations, increase learning and knowledge exchange among healthcare professionals, promote public health, and boost health self-care. And in energy and off-grid electricity production, innovative products help low-income families to access electricity through mobile-enabled small solar cells that are amortized and paid via mobile money mechanisms such as M-KOPA, Mobisol, and SharedSolar in Africa.[29]

TECHNOLOGY AND INCOME INEQUALITY

Although technological change has been attributed with the rise in intra-country income inequality, data on Internet penetration—particularly fixed and mobile broadband—is still nascent. Much like the time lag needed to resolve the Solow paradox, sufficient time and data are needed to be able to concretely measure the impact of ICTs on income distribution. We may not yet be able to adequately determine the full impact of ICTs—particularly high-speed Internet—on income growth. However, much of the rise of within-country inequality has clearly been driven by income growth in the top decile (and top percentile) of income distribution. To some extent, technology has led to increasing financial market sophistication and financial globalization, both of which are attributed with increasing the concentration of wealth in the top decile.[30] However, a myriad of factors lead to the concentration of wealth within countries. Acemoglu notes that "technology is far from the only reason why the preponderance of wealth created in recent decades has accrued to households at the top end of the economic spectrum,"[31] and identifies many interrelated factors such as the decline of unions, changes in tax structures, and globalization.

The network effects and externalities that multiply the impacts of ICTs require minimum adoption thresholds before those impacts begin to materialize. One analysis found a positive impact of 2.8 percent increase on GDP from a 10 percent increase in telecommunications infrastructure, but only once a minimum threshold density was reached.[32] In this case, the threshold was at 24 percent of the population: countries would experience the full growth impacts of ICTs only once penetration passed that point. Similarly, a 2009 analysis determined that increasing returns to broadband investment occurs when a critical mass of penetration—above 20 percent (20 subscriptions per 100 people)—is reached.[33]

Another limitation of income measures is that they do not reflect the full benefit that ICTs provide to users because they do not take into account consumer surplus. *Consumer surplus* is the benefit that accrues to consumers above and beyond the price they pay for a good or service. The fact that mobile telephones, broadband Internet, Internet services, and a wide array of Internet-connected devices have quickly spread throughout the world demonstrates that billions of people are receiving much benefit from their connected lives. Similarly, technology appears to be highly correlated with general measures of well-being across the world, including in sub-Saharan Africa, South and Southeast Asia, and Latin America.[34]

Greater connectivity has also led to increased political empowerment. Much anecdotal evidence demonstrates the power of technology to organize and disseminate political messaging. In 2001, for example, mass protests in the Philippines were organized via short message service (SMS) texts, and the ability for protesters to quickly gather support and demonstrate is credited with toppling then-president Joseph Estrada's government. The Arab Spring uprising, aided by ICTs, demonstrates the growing impact of ICTs on political action and activity.

ACCELERATING THE IMPACT OF ICTS ON INCOME GROWTH AT THE BASE OF THE PYRAMID

The limited impact of ICTs on income growth in lower-income populations can be partially attributed to their significantly lower ICT adoption. Several measures of ICT penetration are highly correlated with country GDP per capita. These include Internet penetration (correlation

coefficient of 0.75 with GDP per capita), fixed broadband subscription penetration (correlation coefficient of 0.74), and active mobile broadband subscription penetration (correlation coefficient of 0.69).[35]

This relationship, where lower income implies lower ICT adoption, is also observed within countries. In the United States, for example, households with an annual income below $30,000 in 2010 were less than half as likely to have broadband Internet at home as those earning more than $75,000 (40 percent versus 87 percent); similarly, individuals in those households were nearly half as likely to use the Internet in general (57 percent versus 95 percent).[36]

While affordability is one barrier to adoption, other factors include education and culture. To counter the possible disparity in the impact of ICTs between lower- and higher-income groups, the most immediate action should be to close the disparity in ICT penetration. Many of the benefits of ICTs are not accruing to lower-income populations because access and adoption are low. Five policy actions are recommended to close the access and adoption gap to increase the positive benefits of ICTs to groups at the base of the economic pyramid:

1. **Focus public resources and incentives for building broadband Internet access out to rural and underserved communities.** Well-managed universal service funds (USFs), for example, can provide the resources to connect regions and groups that are outside main urban centers. In India, a subsidy program that utilized funds from the USF began focusing on connecting regions with no previous connectivity, and by 2011 had already established more than 2.6 million broadband connections in rural and remote areas, including more than 2,500 Internet kiosks.[37] Rural service obligations are also an effective mechanism. In Chile, the regulator implemented rollout obligations for licensees of newly auctioned 700 MHz frequencies to include coverage to 1,281 rural towns and 503 educational institutions.[38]

2. **Connect schools and libraries to broadband Internet service and ensure widespread connectivity within schools.** USFs and other financing mechanisms can target connectivity in schools. In Turkey, USF funding connects over 620,000 classrooms, serving 15 million students.[39] In the United States, the Universal Service Program for Schools and Libraries (also known as the E-Rate Program) administered by the Federal Communications Commission has provided billions of dollars since 1998 to increase connectivity to over 100,000 schools and libraries.[40] In the developing world, over 230,000 public libraries serve as hubs for skills and employment development for lower-income individuals.[41]

3. **Remove excess taxation on devices and access, and consider targeted subsidies for certain populations.** In many countries, ICT products and services are taxed in a manner similar to luxury goods, but lower-income households spend a disproportionate amount of their household income on ICTs. High taxes and interconnection fees put many ICTs out of reach of the poorest citizens. However, some governments are recognizing the bigger benefit of decreasing taxes and spurring adoption. In 2007, the government of Colombia removed the valued-added tax on personal computers (PCs); over the following two years, the tax reduction lead to a 110 percent increase in PC sales in Colombia and an 83 percent rise in tax revenue benefits from PCs and related technologies.[42] And in 2012, the Ministry of ICT launched a program with the Ministry of Housing, Cities and Territory to subsidize Internet access to the country's poorest citizens. Public expenditure was utilized to purchase computers and subsidize Internet access for the lowest-income families, based on government measures. By the end of 2013, nearly 1 million families benefited from grants for access to broadband.[43]

4. **Develop robust ICT training curricula and programs.** Increasing digital literacy and training more individuals in how to utilize ICTs will help drive familiarity and adoption, even for basic ICTs such as feature phones. A recent analysis by McKinsey found the lack of user capability and digital illiteracy (in addition to language illiteracy) to be main barriers impeding many of the 60 percent of the global population who are not yet online. The study notes that most of those surveyed in Africa who are not yet online acknowledged they have yet to develop the skills to do so. In China, "approximately 60% of the offline population cited a lack of knowledge of how to use a computer as the primary reason for not accessing the Internet," and in India one-third of those surveyed indicated they too lacked the ability to use a computer.[44] Education policy can accelerate literacy and digital skills training in primary, secondary, and tertiary education. Targeted programs can equip students and adults with technical skills to participate in ICT employment. For example, Cisco's Networking Academy program has prepared over 5 million students—many of whom are low-income—for entry-level ICT jobs.[45]

5. **Focus on closing the gender gap in ICTs.** Gender gaps exist in ICT adoption: fewer women and girls than men and boys use mobile phones and the Internet. A wide range of economic and cultural influences drives these gaps, but increasing female participation in ICTs will help spread more benefits to lower-income households. For example, one

study in Latin America found that although women are much less likely to access the Internet than men, they were more likely to use it for education and training (and less likely to use it for banking, entertainment, and shopping).[46] One analysis of sex-disaggregated statistics on Internet use in Africa found that being a woman had a negative effect on general Internet access; this relationship was causal in Ethiopia, Ghana, and Nigeria. The gender disparity is heightened with regard to income and education, and also because women and men do not have equal access to and use of ICTs. The authors point to cultural issues related to education and income equity that impact ICT access beyond the notion of infrastructure access points.[47]

Importantly, programs to increase ICT adoption and the impact of technology on poverty alleviation and income growth at the base of the pyramid may have greater impact in concert with a broad range of social, economic, and political measures to empower lower-income individuals.

CONCLUSION

In 2008, one of the world's leading international development economists, Jeffrey Sachs, wrote that mobile phones and wireless Internet will "prove to be the most transformative technology of economic development of our time."[48] The macro and microeconomic data presented above clearly demonstrate the positive income and growth effects of ICTs on lower-income countries and populations. Although an apparent paradox between the impact of ICTs on income inequality at the global level and the country level exists, more research is needed to explore the interaction among ICTs, income, and wealth, and to investigate the variable effects of targeted interventions to increase the impact of ICTs on poverty alleviation. However, the challenge of accelerating ICT adoption, particularly in lower-income groups, remains. The impact of ICTs on economic growth, along with targeted interventions to increase their impact on poverty alleviation, will help to relieve the plight of those in absolute poverty and improve the well-being of citizens everywhere.

NOTES

1 Maitland 1985.

2 Lakner and Milanovic 2013.

3 The Gini coefficient is a statistical measure of income distribution across a population. The coefficient is on a scale of 0 to 100 (or 0 to 1), with 0 reflecting complete equality and 100 (or 1) indicating complete inequality (e.g., one individual, or observation, accounting for all the wealth or income observed).

4 Jaumotte et al. 2008.

5 The study also finds increasing returns to human capital from technological changes, highlighting the importance of education and training.

6 Katz 2012; Minges forthcoming.

7 Qiang et al. 2009.

8 Scott 2012.

9 Deloitte 2012.

10 Solow 1987.

11 Jalava and Pohjola 2002; OECD 2003.

12 Qiang et al. 2008.

13 World Bank 2013. All dollar amounts are in US dollars.

14 Fosu 2010; The Economist 2012.

15 Data drawn from the World Bank's *PovCal* database and the ITU's *World Telecommunication/ICT Indicators* database.

16 Elder et al. 2013.

17 Samarajiva and Zainudeen 2008; Smith et al. 2011.

18 May et al. 2014.

19 Diga 2013.

20 De Los Ríos 2010.

21 Katz and Callorda 2013.

22 Aker and Blumenstock forthcoming.

23 Jensen 2007.

24 Aker 2008.

25 GSMA 2014.

26 Mariscal 2009.

27 Aker et al. 2012.

28 World Bank 212.

29 Nique and Arab 2012.

30 Jaumotte et al. 2008.

31 Leonard 2013.

32 Röller and Waverman 1996.

33 Koutroumpis 2009.

34 Graham and Nikolova 2012.

35 The correlation coefficient measures the linear relationship between two variables. It is calculated here using 2013 GDP per capita data from the IMF's *World Economic Outlook* (October 2014 edition) and 2013 ICT penetration data from the ITU's *World Telecommunication/ICT Indicators* 2014, 18th edition.

36 Jansen 2010.

37 Intel 2011.

38 Telegeography 2014a.

39 Intel 2011.

40 FCC 2014.

41 Beyond Access 2013.

42 Intel 2012.

43 Telegeography 2014b.

44 McKinsey & Company 2014.

45 The students are trained in elements of networking technology; annually approximately 1 million students are studying in over 9,000 academies across 170 countries (Cisco 2014).

46 Vergara et al. 2011.

47 Gillwald and Deen-Swarray 2013.

48 Sachs 2008.

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