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The Role of Technological Change in Increasing Gender Equity with a Focus on Information and Communications Technology

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Abstract

This paper considers the potential role of various transformative general-purpose technologies in affecting gender equity. The particular technologies considered at length and contrasted are four network technologies: electricity and water provision on the one hand, and the newer information and communications technologies of the Internet and mobile phones on the other. Available evidence on the effects of transformative technologies, both historically and in recent developing country contexts, is surveyed. The results indicate difficulties in finding cleanly measurable factors due to the complex nature of the effects of the technologies, as well as the containment of many effects in the household/nonmarket sector rather than the market sector. However, there is some optimism regarding continued expansion of electrification and the use of mobile phones in particular for improving women's empowerment.

Introduction

Human progress occurs through use of, and is manifested through the creation of, technology. Without technological progress, there would be no economic development. However, while it is the case that human progress cannot occur without technological innovation and diffusion, it is unlikely that technology affects all groups and individuals equally. And even if all are helped by technology, if the amount of help varies, then technological change could increase rather than decrease inequality. In particular, for the purposes of this paper, the question arises as to whether or not technological change affects women and men differentially, and if so, whether the difference affects differences in well-being between women and men.

For the purposes of this paper, I define a change that leads to greater gender equity as any change that reduces a measured difference between women and men, for example earnings, income, participation in a particular activity (including paid labor as a whole, or a particular work sector), or educational attainment. I first outline the theoretical arguments for why technological change might be lead to either greater or less gender equity. While I draw primarily for inspiration from the standard economic theory, I also consider ways in which outcomes that are not always of primary interest from an economic development standpoint could be affected. I then consider what evidence is available regarding the gender equity effects of a number of technologies of current interest.

I focus on two particular sets of technologies, both of which may be considered as infrastructural in nature as other technologies and uses depend on their existence, and they are difficult to provide without the cooperation of others. One set is what we might consider both rather old, in the sense that they have been available since at least the nineteenth century and inhabitants of high-income countries take their availability for granted, and also fundamental to

development. These include the provision of electricity and potable water. The other set is quite new, though also now considered a taken-for-granted part of life for many inhabitants of high-income countries. These include current-generation information and communications technology (those firms first made available in the later quarter of the twentieth century), in particular Internet connectivity (whether through computers or other access points) and cell and/or satellite phones. Using the Lipsey et al. (2005) framework, these could all be considered to be general-purpose technologies (a term apparently invented by Bresnahan and Trajtenberg 1992) that are transformational in nature (i.e., reaching into a number of realms and changing the nature of other technologies that utilize or are complementary to them), though they agree that it is hard to classify technologies. I contrast these two sets to consider both how they may be used differently by women and men, and how they are used differently in the household, informal work, formal work, and leisure sectors. While many of the cited articles focus on rural area development, where infrastructure development is most likely to be lacking, provision of these technologies can be spotty in many neighborhoods in many cities as well. Nonetheless, the focus throughout is on how to interconnect people more readily and provide networked services.

In the concluding section of the paper I consider alternative ways of measuring how technology affects well-being, as well as consider additional outcomes that may be affected differentially across women and men.

Concerns from the literature on feminism and technology

There is a sizable literature on feminist concerns with technology that is the main source of writings that explicitly consider the possible differential effects of technology by gender. Particular concerns that occur as main threats in this literature are threefold. One thread regards

documentation of and concern regarding women's underparticipation in the process of developing technology, including women's underrepresentation in the science and technology (notably engineering) professions (Fox et al. 2006; Kitetu 2008 considers this issue in the African development context). A second thread considers the gendering of technology, asserting that it is not gender neutral, but rather more often masculinized, and also whether technology is controlled by men, and thus serves men's interests rather than women's, including being less likely to lead to the invention of technologies that women want (Cockburn 1985; Wajcman 1991). A third thread considers whether technology is controlling women and their bodies; this thread focuses in particular on reproductive technology but also considers market and nonmarket work technology, and whether technology increases rather than decreasing the dual burden on women (Layne et al. 2010).

The first waves of this literature (starting in the late 1970s up through the 1980s) tended to be more pessimistic; a more recent wave of this literature has been guardedly optimistic regarding how the Internet and other information and communication technologies (ICT) might be able to liberate rather than oppress women (Wajcman 2004, Rosser 2006); "cyberfeminism" has been coined as a term to indicate the potential empowerment that could occur through proper use of these resources, and a number of writers explicitly consider possible links between ICT and feminism (Zorn et al. 2007). Jensen (2007) discusses the UN summits on ICT in 2003 and 2005, explicitly citing ICT as a "contested political field because they are a source of political and economic power as well as a potential means of empowerment for marginalized regions and groups" (p. 33), including women. However, the more optimistic, pragmatic vein appears to be prevailing to date, as reflected in the International Center for Research on Women's (2010) recent report.

In addition, particularly in the low-income and middle-income country context, it is certainly the case that there can be constraints to access by gender that do not fit in well with the standard economists' model of free choice. If women are unable to access various technologies due to cultural considerations or patriarchal standards (rather than due to low income), then growth in income will not lead to take-up rates that one would expect based on income growth predictions alone. Thus continuing differentials in gender access need to be considered in culturally specific contexts and dealt with in those contexts as well. A number of the programs considered below, particularly in the area of expanding mobile phone access and computer access, take these additional constraints into account.

How could technological change affect women and men differently? The economists' take

In contrast to the broader set of concerns considered by the feminist technology theorists, much of the economic research to date on the effect of technological change on women's position relative to men has focused on the increased participation of women in the labor force and the concomitant rise in their labor market earnings. The economic literature concludes that these rises have occurred because of both labor market demand-side and supply-side factors.

Technology, through increasing economic growth in general, may of course have redistributive effects if growth paths do not affect the genders equally. It does appear that the technologies discussed in this paper, including the most recent developments of computers and ICT, have had an effect on growth though it took awhile for investments in these technologies to have measurable effects on even the US economy (Brynjolfsson and Hitt 2003). Now it is also difficult to measure their specific effects as they have become more ubiquitous, as well as break

apart growth due to computers themselves vs. growth due to the increased interconnectivity of computers—the ICT applications (Jorgenson et al. 2000),

Over time, as economies evolve, different forms of labor are required, reflecting the changing mix of goods and services demanded and produced. Additionally, technological change can influence the substitutability and complementarity relationships between labor and other input factors. To date, in those countries that have already undergone significant degrees of economic development, technological change in the work sector appears to have increased the demand for female labor in the formal work sector, both in an absolute sense and perhaps also increasingly relative to men. For example, Goldin (1987: 204), in considering the US from 1800 to 1980, concludes: "…where technological advances have been greatest, women's employment share relative to the average has increased the most."

In these countries, demand for particular types of labor has fallen, in particular for unskilled farm labor (where other inputs, in particular capital, have been substituted for labor) and for both skilled and unskilled labor for use in manufacturing (where some capital substitution has occurred and growth in demand for manufactured goods has been lower than growth in demand for services). Meanwhile, demand for other types of labor has been growing faster than average. In the first wave of postindustrial growth, demand for clerical occupations rose rapidly; in the later wave, demand for service occupations has risen. This has led some to argue that the modern economy has shifted to requiring "female occupations" in the sense that they require skill, but do not require either long-term commitment to work or specialized geographic location (Oppenheimer 1976).

In addition, shifts in demand for goods and services and the complementarity between capital and skilled labor—along with the substitutability of capital for unskilled labor—have led

to increased demand for skilled workers relative to unskilled. In developed countries, as women have become more educated, the consequent rise in their potential wage has made it more profitable for them to enter into market work (Black and Juhn 2000).

Thus, demand-side technological change factors appear to have increased gender equity to some degree by facilitating women's entry into paid labor, thereby increasing both their potential and actual productivity.

In addition to demand-side factors operating through the wage to cause movement upward along the female labor supply curve, changing technology of household production may have shifted the female labor supply curve so as to increase the supply of female labor to the formal work sector. Changes in the technology of household production have two aspects: the greater availability of market-produced substitutes for household goods, and increased efficiency of household production. As more market substitutes become available for household goods at lower prices, this will have the effect of increasing labor supply because the efficiency of market production has increased. However, if both market and household production are normal goods, when potential income rises, more of both will be consumed. Then economic theory does not tell us whether increased efficiency in either form of production will lead to more or less time spent in the relatively less efficient form of production. The opposite directions of the substitution and income effects may actually lead to some household members spending more rather than less time in household production.

It is important to note however that regardless of whether household members spend more or less time in household production (thus potentially reducing market earnings), it is still the case that the technology has made the household better off in total. Thus measurement of the effects of technological change that concentrate on the market sector to the exclusion of the

household sector may significantly underestimate the amount of improvement that is created through adoption of household technologies. Nonetheless, even if the household is made better off in total, it can also be the case that the allocation of improvement between household members may or may not end up improving gender equity. For instance, in situations where women can increase production, but do not have control over its distribution, it is not clear if their well-being is improved. Freed-up time could also be moved to pure leisure, which could generate improved well-being, though there may be barriers to "efficient" use of leisure time, such as lack of complementary capital (where the technologies we consider can be complementary to leisure time as well, such as use of phones to socialize, and the Internet to get information of use in leisure).

This simple labor supply/demand focus misses a number of other ways in which technology may affect the genders differently. First, technology may also have an effect in the production of knowledge/education. If it becomes relatively cheaper to achieve a particular level of educational quality through technological change, then one would expect a greater investment in human capital. This may or may not affect the genders equally depending on their relative access to education. In addition, it is possible that particular technologies of education might benefit one gender more than the other. For example, if it becomes easier to provide scientific education, say through increased use of computers, but boys are more likely to receive scientific education, then it will advance boys' well-being over girls' well-being.

Second, technology may affect the structure of society through reducing various overhead costs, such as reduced costs of transmitting and processing information and reduced transactions costs. This effect could increase productivity in both the market and household sector without causing a distortion in favor of one or the other, but in general one would expect this to increase

the demand for market transactions relative to nonmarket transactions by the very nature of the idea of market efficiency being enhanced by such cost reductions. Thus the market sector would tend to expand relative to the household sector even without creating any particular favoring of one form of labor over another within either sector. This could have the effect of drawing more people into the market sector, including women, as well as increasing the productivity of those in the market sector. Again, there is no necessary effect on gender equity and thus it becomes an empirical question whether or not women are helped more relative to men by this effect.

Third, technology may affect the timing and location of economic activities (with or without a concomitant change in the actual costs of undertaking those activities). In particular, it may increase the flexibility of when such activities can occur. Again, this could increase productivity in both sectors, but again one might well expect this to increase the relative demand for market transactions through improving market efficiency. And thus again it will be an empirical question as to whether or not this has an effect on gender equity.

So we will look for multiple pathways to change in gender equity through technology: 1) capital substitution for manual/physical labor in both the labor market and the household sector, freeing time up for more productive uses; 2) capital complementarity to skilled labor in the labor market, the household sector, and in the education process, making the labor inputs more productive; 3) reduction of transactions costs for transmitting and processing information and for making transactions in various markets; and 4) increased flexibility as to where and when economic activities can occur.

What has actually occurred?

Thus we see that theory presents only potential pathways by which gender equity may be affected without serving as a full guide as to what will actually have happened. And thus the question of effects of technology on gender equity becomes one that can only be answered through empirical evaluation

In the following sections of the paper, two kinds of evidence will be presented. First I document increases in use of/access to particular technologies. This is the easier part of the problem, though even here it is difficult to assess differential use of and access to technologies. The more difficult problem is to try to assess the impact of technological diffusion on measurable outcomes, like labor force participation and earnings or income. The even more difficult problem is to try to assess the impact of technological diffusion on goals like well-being and empowerment.

It is very difficult to find either countrywide or even smaller scale statistical studies that can tease out cause and effect while adequately satisfying concerns regarding sample selection and reverse causality. It may be that advancement of technology follows rather than leads economic growth and development, and that the more enterprising villages and households are the earlier adopters of technologies. The gold standard of random assignment, for instance, of whether or not a particular village receives electricity, or whether a particular household receives Internet access, is not found in these studies.

However, such evidence need not come only from statistical studies. Case study evidence, including simply asking people how they think technologies have affected them, can also be used. Case study evidence is particularly useful for documenting the range of ways in which technologies can affect individuals.

In addition we can learn not only from contemporary evidence, but also from analogous cases in the past. We can consider not only how the adoption of identical technologies (such as electrification and water) has affected both past adopters and current adopters, but also how the adoption of older technologies (such as the wired telephone) can tell us something about the adoption of newer technologies (such as mobile telephones).

Current patterns by country and level of development of technology adoption

It has become relatively easy to access country-level data through household surveys and other (often industry) sources regarding the extent of connectivity and provision of water and electricity, and the adoption of technologies that utilize this infrastructure, such as phones and household appliances. Table 1 shows the data available from World Development Indicators on two measures of Internet usage, fixed broadband subscribers and Internet users per hundred people (not surprisingly a broader category, since this could include those who use the Internet at a generally accessible location), one measure of mobile phone usage, number of mobile cellular subscriptions per hundred people, and two measures of water access, one for the rural population and one for the urban population. These measures are available for many countries, and the WDI database also aggregates the information by both country group and income level (as shown in Table 1). Table 1 also contains data on electrification (rural, urban, and overall) from

Not surprisingly, broadband Internet subscription is not particularly widespread even in North America, as it requires significant ongoing expenditure and related home or office infrastructure to support this investment. Even in high-income countries, less than a quarter of the population is represented as subscribers. Internet users are reported at a much higher rate,

though still extremely low in large portions of the low and middle-income countries and regions, and even in upper middle-income countries, Internet users are in the minority.

Mobile cellular subscriptions, on the other hand, have proved highly popular and exhibit much higher growth rates over the past ten years than either Internet use measure. Even in low-income countries, over twenty percent of the population is represented as having a subscription, implying an even higher rate of access to mobile phones for the population (assuming sharing in households and borrowing between households). Middle-income countries have very high rates of take-up, implying almost ubiquitous availability of this technology now within their communities.

Improved water sources, a much older technology, shows much higher rates of occurring from further back (1995 is the start date for observations in this table, as opposed to starting the Internet and phone series at 1998 since almost no adoption either is tracked or occurs as far back as 1995). Water for the urban population in particular is mostly a given at this point in time, but there are notable variations still in water provision for the rural population across regions and still low rates of improvement for the rural population in low income countries.

Information on household electrification and use of electrified appliances for a number of lower-income countries are available through the Demographic and Health Surveys program. Table 2 contains the available data for countries surveyed within the last five years, sorted by region. Very few middle-income countries are represented in these tables, and no higher income countries, with the implication being that access to electrification and to baseline electrified appliances approaches 100 percent of urban households and almost as high a percent of rural households; for those developed countries that still collect electrification rate information, this 100 percent figure is borne out (Table 1). Information is available for urban and rural areas as

well as an overall percentage of electrified households, and for the percent of households (again by urban and rural as well as overall) that own a radio, a television, a phone (here meaning with a landline rather than mobile), and a refrigerator. In general, rates of appliance ownership are lower than electrification rates (on the view that electrification is a necessary precondition), but not always—it is possible to have a battery-powered appliance (particularly a radio or television), or to have access to television or radio through another household or location. Electrification rates lag behind water source improvement rates. Interestingly, the rates of television access are high, higher in many cases than for radio access, perhaps because households now find televisions to be more of a necessity than radios. As we will see below, the existence of televisions is hypothesized to be an important medium for potential empowerment of women and change in their behavior patterns, including such important matters as their fertility rates. Landlines are not particularly common, and may lag further now that mobile phones provide a substitute product. Refrigerators are less common than televisions or radios in general, but more common than landline phones.

Table 3 utilizes data from the Socio-Economic Database for Latin America and the Caribbean to track a broader group of household appliances and provide some comparative data over approximately five-year recent periods (while Table 2 simply uses the most recent data available). These data show relatively high and rising rates of appliance availability, though washing machines and air conditioners are much less frequently found than refrigerators. These data also allow us to compare for some surveys the relative rates of landline and cell phones. The rise of cell phone penetration is particularly notable over this period for the countries that track this measure. Many of the countries in this group had high levels of landline service so cell phone usage tends to still track below landline for this group (e.g., Colombia), but in other

countries (e.g., Bolivia, Guatemala), cell phones have already outpaced landlines. Computer and Internet access still lag significantly behind rates of phone and television (and vcr/dvd) availability.

All of these usage or access rates in Tables 1 through 3 are measured at the national or household level. What is more difficult to find are systematic, or even nonsystematic, data that identify differences in provision and adoption by gender. For data collected at the national or household level, it is not easy to unravel provision and adoption by gender. One might expect relatively small differences by gender for many of these factors. For instance, if a village or household has a relatively equal gender composition, then improved water supply in the village or the household would have little measurement difference by gender.

Here commentators have varied on whether they think that women have lower or equal access to technologies. Some have argued that changes such as electrification or water source improvement affect genders equally. For instance, Madon and Oey-Gardiner (2002), in their sampling of 19 rural villages in Indonesia, find that there is no differential access to electricity either by gender overall or by gender of household head. On the other hand, even if a village receives electricity, not all villagers may be able to afford to use it. If women are disproportionately represented among the poorer households, including female-headed households (which may be more likely to be poor), then they would be less able to take advantage of the new capability, or at least not able to utilize it to the same extent as members of wealthier households. For instance, the evaluation of one rural electrification pilot in Laos (Rex and Tang) makes this argument, and shows that rural electrification projects that concentrate on increasing the share of female-headed households that can utilize electricity, in part through subsidizing their usage, are more likely to equalize usage rates by gender.

In the case of Internet and landline phone access, since much of this access is through worksites in the formal work sector and because men have higher rates of participation in the formal work sector than do women, the argument is that men have significantly higher rates of access to these technologies. Mobile phones hold the promise of increasing access significantly to women through the obviation of the need for a landline. However, GSMA (2010) reports significantly lower ownership rates for women, even in the middle-income countries.

The historical case of laborsaving household technology

One of the most interesting recent debates in the economics and sociological literatures has been over whether expansion of household electrification and running water, and the subsequent laborsaving household appliances that utilized those technologies, are responsible—and if so, to what degree—for the rise in female labor force participation that occurred in developed countries during the twentieth century.

During the twentieth century, technology became widely adopted that enabled families to produce nonmarket output at lower cost. In particular, we saw the spread of market goods and services that serve as critical inputs into nonmarket production. In the United States in 1920, one-third of homes had electricity; by 1930, over two-thirds were electrified (although only ten percent of farm homes) and by 1960, practically all homes were electrified. By 1940, 70 percent of rural homes had running indoor water (17 percent of farm homes, 93 percent of urban homes); by 1970 90 percent of rural homes had running water (Vanek 1978: 363).

Numerous household technologies then developed that rely on the availability of one or both of electricity and running water, including washers and dryers, refrigerators, vacuums, and numerous smaller household appliances. A number of these appliances reached high adoption

levels relatively quickly. For example, the microwave oven rose from adoption by 13 percent of married-couple US households in 1978 to 81 percent in 1987 (Oropesa 1993).

As discussed above, productivity gains in the nonmarket sector may or may not translate into less time spent in the nonmarket sector. After all, as the cost decreases of producing housework, and of producing higher-quality housework, households might well demand more of it. For example, Mokyr (2000) argues that the rise in understanding of the causes and transmission of infectious diseases in the early part of the twentieth century increased housewives' attention to home hygiene. Bose and Berano (1983) consider four types of household technologies: utilities, appliances, convenience and prepackaged foods, and private sector market services (p. 85), but don't conclude that any of them truly saved, or freed up, household labor (though they do suggest that utilities saved physical exertion). Indeed it appears that many supposedly timesaving innovations were widely adopted in the first half of the twentieth century with no apparent significant reduction of nonmarket time (Manning 1968, Cowan 1983, Robinson and Milkie 1997). This pattern implies that the families who own these appliances must be creating greater value of household production, since they both invest more capital and the same amount (or more) of time in meal preparation, clothing maintenance, and other household chores. The composition of housework has changed over time however, with less time spent on food preparation and more on shopping and family managerial tasks (Vanek 1974). It has thus been disputed as to whether or not the increased and lower-cost availability of household utilities and durables goods has led to a rise in women's labor supply, with researchers coming down on both sides of the argument (Greenwood et al. 2005, Jones et al. 2003).

However, there is increased recent evidence that the latter half of the twentieth century did see time freed up from the household sector by laborsaving technology being devoted to

market work. Cavalcanti and Tavares (2008) find a relationship between the decrease in home appliance prices in OECD countries from 1975 to 1999 and the increase in female labor force participation. For the US, Coen-Pirani et al. (2010) argue that the increase in married women's labor force participation during the 1960s is related to increased appliance ownership (specifically freezers, washers, and dryers). Cardia (2010) also tests the Greenwood et al. hypothesis that there was an effect for the period of 1940 to 1950, using US Census data that includes information on presence of indoor plumbing and refrigerators. She finds some effect of indoor plumbing, but not of refrigeration, on differences in female labor force participation across states in 1940, and some evidence of increased female participation in the clerical sector.

Even more recent data (2003-2006) from the American Time Use Survey shows that time spent by women on housework has been dropping, with much of the freed-up time is going into paid work, though some of it is spent in increased childcare (Connelly and Kimmel 2010). However, Ramey (2009) concludes that while there was a fall in women's housework hours from 1900 to 1965 of six hours per week, and an additional fall of twelve hours per week in the latter part of the twentieth century; however, this is balanced by a rise in housework by other persons, such that the total housework done actually increased slightly over the twentieth century.

Thus the evidence from the historical record appears to show that on the one hand, some time seems to be freed up for market pursuits, but on the other hand time is also devoted to increased quantity and quality of nonmarket production. This implies that these technologies applied to the household sector, where women predominate, have had only a small effect on increasing gender equity. In contrast, technological change in the market sector, (along with demographic changes leading to smaller families and in some cases later marriage, may have had a larger effect through drawing women into the market sector. We now turn to more recent

adoption of water, electricity, and related technologies, as well as adoption of the more recent ICT to see if a similar pattern holds.

Contemporary examples of technology adoption

In this section I first consider evidence from specific case studies on water and electricity provision in the low-income country late twentieth-century context and then consider the more recent provision of ICT, again in the low-income, or developing, country context.

While commentators overall argue that "women work more than men in almost all regions" (Ilahi 2000:6), there is a specific issue in many countries, particularly in rural areas, of women having to spend long hours every day collecting water and/or fuel. For example, Schreiner (1998: 65) mentions "up to six hours per day" in her study in Bamshela, South Africa. Thus it appears that one way to free up women's time both for more productive uses and for leisure would be to reduce the time spent on those activities. But it turns out not to be straightforward how providing better access to fuel and water, or more efficient appliances that utilize fuel and water (in particular cooking appliances) affect time use.

Water

Given the fact that women do the majority of water collection for home uses (and often for agricultural uses as well), there is a great deal of interest in improving women's access to water. Technological innovations abound, but generally relate to reducing the distance to the water source (e.g., digging a local well or bringing water closer by pipe or other means), improving its potability, increasing its quantity, and reducing the amount of physical effort necessary to get it (e.g., pumping technology). The NGO International Development Enterprises

(IDE) has been particularly interested in small- and medium-sized technologies that improve access to water. Prabhu (1999) discusses IDE's promoting of treadle pumps to women in India to replace use of hand pumps, pointing out that one effect is that it improves the ability of women to grow vegetables on their own.

The number of studies that are able to find a measurable outcome related to improved access to water are small. The two main focuses have been whether time is freed up for more market participation by women, and whether there is better participation of children in schooling.

One issue is whether reducing distance to water source actually reduces time allocated to water collection. Again, as the cost of collection decreases, it is possible that households decide to allocate more rather than less time to water collection and usage, at least in an intermediate range where water is not available at the turn of a faucet in one's house, but is made closer at hand than previously. A study by Ilahi and Grimard (2000), using 1991 data from Pakistan, finds that greater distance to a water source does raise the time spent in water collection for women and lowers their participation in income-generating activities. However, in households with "private water technology" (as opposed to public infrastructure outside the home), women spend the freed-up time on leisure rather than on market work. Boone et al. (2010) question whether reducing the distance to the water source affects women and men equally in terms of freed-up time, as their study of 2004-05 household data from Madagascar finds that it seems to reduce men's time in water collection rather than women's. Keskin (2010) also points out significant differences in water collection time can occur by other dimensions, such as caste, and finds that crowding at wells based on caste mean that time savings can be greater if wells are provided in cases where there is a larger percentage of lower-caste members in a village. Menon (2009), using 1995-96 household data from Nepal, focuses on the predictability of water rather than

distance to source, and finds that household members, including women, are less likely to work in agriculture if rainfall in their area is less predictable, implying that improving water source predictability would increase agricultural activities.

Several other studies find little effect on off-farm work for women, including notably Koolwal and van de Walle (2010), using data from countries in several regions (sub-Saharan Africa, South Asia, and MENA). This was also the case in earlier studies by Lookshin and Yemtsov (2005) for rural Georgia between 1998 and 2001 (no effect on women's wage employment) and Costa et al. (2009) for rural Ghana.

However, a number of these studies do find other measurable effects. Koolwal and van de Walle (2010) do find that both boys' and girls' enrollments in school rise as the time spent collecting water falls. They also find some improvements in children's health in data from Yemen and Malawi. Lookshin and Yemtsov (2005) find a significant reduction in the incidence of water-borne diseases due to the improvements in water supply. And Costa et al. (2009) do find a reduced time burden on women, just no increase in the time spent in paid work.

Electricity

While there are a number of potential substitutes for traditional fuel sources used for cooking and lighting (mainly wood), including solar power, rechargeable or long-lasting batteries, and propane, electricity can serve as a substitute as well as being usable in many other ways (in particular, to power computers and thus lead to Internet access). Thus, we might expect electricity to have perhaps a more significant effect on women's market labor than does water, because not only does it free up time spent getting fuel, but also may be complementary with other market-related activities.

Indeed, Costa et al. (2009) find that in rural Ghana, unlike for improved water supply, improved electricity availability increases the time spent in remunerated activities. Similarly, Dinkelman (2010) finds that in South Africa, women's employment rates increased significantly (by about 9.5 percentage points) in electrified areas; men's employment was not significantly affected. Grogan and Sadanand (2009) find a similar effect for rural Guatemala, with electrification associated with women spending more time in market work and having increased earnings. Note that given that electricity is essentially a precondition for much of ICT, it may be that some of the effects seen on women's employment relate to their ability to access ICT once electrification comes into being; however these studies do not break down the effects of electricity so finely.

In contrast to these rather sizable effects of improved electricity service, simply improving fuel efficiency by creating more efficient cooking stoves has not been very successful to date. Otsyina and Rosenberg (1999) mention how the rate of adoption of improved stoves (less wood needed, less smoke produced) in the area they studied in rural Tanzania was quite low. However, Otsyina and Rosenberg stress the problems in disseminating the technical knowledge necessary to construct and utilize the stoves, pointing out that transmission of this knowledge is related to gender roles as the women (who would be the primary users of the stoves) were not used to attending technical workshops, and were not out and around in the world as much as the men in order to learn new things. Indeed, there has been a round of more successful adoption of improved cook stoves in Kenya due to more attention paid to dissemination and training (International Centre for Research on Women 2010: 14).

ICT-general

Attention has turned substantially in this first part of the twenty-first century to the question of how ICT can affect gendered development. One of the earliest discussers is Schreiner (1999), who draws a "hard" vs. "soft" technology distinction for ICT, where soft would include interactive learning while hard would include radio, video, and print. Another early offering is Rathgeber and Adera (2000), which contains a range of essays covering various issues related to improving ICT delivery in Africa and how to make sure women are fully included as beneficiaries of these improvements. Hafkin and Taggart (2001) provide a very complete study of the kinds of potential uses for ICT, and discuss thoroughly the idea that it is important for women to have good access to ICT for a variety of reasons (economic, political, educational, social). This work is often cited for saying that access to ICT is the third most important issue for women after poverty and violence. A number of other reports and sources expand on these themes (Jorge 2002, Bonder 2002, Primo 2003, Radloff et al. 2004, Gurumurthy 2004, Hafkin and Huyer 2006, International Centre for Research on Women 2010). Primo (2003) and Gurumurthy (2004) emphasize issues of barriers to access; women discouraged from studying technology, discouraged by their illiteracy or their not knowing the languages used on the Internet; lack of comfort in visiting technology centers. Anthropologists Buskens and Webb (2009) consider the degree and type of potential empowerment that ICTs might create for women, ranging from passive and limited on the low end of the spectrum, to creating new women-only space, increasing control over their time and space in their personal and professional lives, and enhancing their lives according to their own design (pp. 5-6).

A number of development agencies, for example the International Development Research Centre's (Canada's development agency) Acacia Initiative (which began in 1998), have been actively working on trying to empower poor African communities through ICT. Notably though,

some of the most comprehensive studies of ICT installation make little or no mention of gender (e.g., Douta and Mia 2010). It is also not clear by exactly how much ICT can increase overall economic growth; though preliminary evidence looks promising (cf. Deloitte 2007, p. 24, using a cross-country data set, finds a 10 percent increase in mobile phone ownership leading to a 1.2 percent increase in GDP per capita in developing countries, and about a 0.6 percent increase in developed countries over the recent past).

It is certainly the case that the spread of ICT in developed countries has affected the organization and fundamental nature of work. This includes changes in where work is performed, leading to a concomitant rise in part-time work and telecommuting in many developed countries. The use of more flexible work arrangements appears to have primarily affected women, as they are more likely to take on part-time work or work from home so as to combine paid labor with household labor. Part-time work rates for women are quite high in a number of high-income countries (the Netherlands and Switzerland in particular), though part-time work is still the exception rather than the rule for both genders (OECD 2010). However, telecommuting, or telework, has by no means replaced the formal workplace (nor does it appear to be particularly correlated with part-time work for women), and many workers both telecommute on occasion and go into the office on occasion rather than eschewing a formal workplace completely. The OECD (2008) has indicated that telecommuting growth within its member nations has been disappointingly below what they would like to see (based more on principles of reducing congestion and transportation use rather than on gender principles) (p. 98).

Below I consider in more depth two particular manifestations of ICT, multimedia or telecentres and mobile phones, that have been considered by a number of researchers using case study formats with regards to their impact on improving women's relative standing.

ICT—multimedia and telecentres

A number of development agencies and governments have followed the strategy of setting up village "telecentres" or multimedia centres for public use, generally with fees charged for services (e.g., the M. S. Swaminathan Research Foundation has set up a number of "village resource centres" and "village knowledge centres" in India). These centers generally offer the same features that offices in general have available, such as computers linked to the Internet and available for word processing and graphics work, faxes, email, photocopying, and phone lines. They may also feature training on the equipment and in some cases also incorporate a radio broadcasting station and/or video resources.

These centres have varied in their overall level of usage, their usage by women (generally at lower rates than by men), and by which features have proved most popular. Schreiner (1999), in comparing the offering to women of computers, telephones, and photocopiers through a telecentre project in South Africa, found that the telephone was by far the most popular with the women. The women stated a particular need to communicate over long distances, often with their male partners who had migrated for work. Notably, the centre encountered many problems in setting up, including getting dependable electricity and encouraging usage of its paid services. Macueve et al. (2009) find the attached community radio station to be the most popular aspect of a similar program in Mozambique that started in 1999, including that volunteering at the radio station was viewed by the women as a good opportunity for socializing. Other functions, in particular the Internet and email, were hardly used at all. Bakesha et al. (2009) also laud the use of telecentres as ways to improve networking and socializing among the women using the centers, using the case of Uganda. They also discuss use of a CD-ROM with a simple graphic

interface and spoken text at the centers as a way to impart entrepreneurship-related information to rural women, though they also note the issue that the women's businesses were hard to expand because their profits tended to go to family matters rather than being reinvested in the businesses. Indeed, it is less clear if these centres have contributed much to business, particularly for entrepreneurial women in the local community. Yitamben and Tchinda (2009) study use of the local multimedia centre in Douala Cameroon by women entrepreneurs working in the textile sector. They fin that half of the women that they interviewed were not using the centre, but the other half did use it for both professional and social uses, and extolled its usefulness for business-related communication (including e-mailing) and information.

Thus, while these telecentres have proved popular as a development strategy, a full formal evaluation of their effects has yet to be made. Telecentres are also relatively expensive to set up and maintain, even with a fee-based structure (Hafkin and Taggart 2001: 78), and more so if they are to serve as training centers as well. Clearly their functions will need to evolve over time as well to fit the needs of the local population as well as changes in ICT.

ICT-telephony

One of the main such changes has been the huge shift in many areas away from telephone landlines to use of mobile phones (generally cell phones rather than satellite phones). While women are still significantly less likely to own a mobile phone than are men (GSMA 2010 reports 23 percent less likely in Africa, 24 percent in the Middle East, and 37% in South Asia), and face continued barriers to getting a phone including price, technological and fundamental literacy, and attitudes towards women's ownership of assets, women's access to a mobile phone is likely to be much higher thanks to group provision of mobile phone services.

An early and influential model for mobile phone provision is Grameen Telecom's village phone program in Bangladesh (Richardson et al. 2000). Women members of the Grameen bank's revolving credit scheme retail cellular phone services in rural areas by first acquiring a phone and then selling phone calls and related services in their village. The program was purposely designed not to be gender neutral; a woman's house or business is considered safe space for other women to enter and thus it was meant to be encouraging for women to use these services. As of 2006, the program provided over a quarter of a million phones in some 55,000 villages (Grameenphone 2011). The program has been replicated and extended in other countries, including Uganda, Rwanda, and Cameroon. While there is an open question (as with telecentres) as to whether this shared access model will hold up for much longer, particularly as mobile phones become widespread, for the time being the phones can serve as a substantial additional source of income for the female vendors (Richardson et al. 2000).

In general, case studies that have interviewed users of mobile phone services report very positive reactions to their presence among women. Sane and Traore (2009) find a very positive reaction to mobile phones among female fishmongers in Senegal; the women report that it is easier to contact their clients and suppliers as well as to communicate with family while they are away from home—and that it has reduced their total traveling. Munyua (2009) also reports positive reactions among women entrepreneurs in her Kenya-based study. The Kenyan women report it is easier for them to integrate business and family matters, as they can use the phone to organize social meetings, transfer money, and in general have improved control and flexibility in their workday. Kyomuhendo (2009) also reports positive reactions among women in Uganda, in particular among those who run phone businesses. Comfort and Dada (2009) present a more mixed picture of the blessings and problems with mobile phones in rural Northern Nigeria, as

women cited that the phones were expensive and often had poor signal quality, but again those who were running a phone service cited their increased earnings, and in general women reported that the phones were invaluable for contacting distant relatives over matters such as health and mortality.

Less clearly monetary benefits include a large majority of surveyed women cell phone users in several countries (Bolivia, Egypt, India, Kenya) reporting feeling safer and more independent because of their mobile phone (GSMA 2010); on top of that, 41 percent of women mobile phone owners reported increased income and professional opportunities due to phone ownership. . Phones can also be used to encourage political participation among women, as one recent case study in Kosovo demonstrated where women were encouraged to call around so as to mobilize attendance at a forum for input on the new constitution (GSMA 2010: 24).

Some of the most interesting new uses of mobile phones go beyond simple voice or text communication into direct transfer of funds and even direct transfer of work output. While Munyua (2009) discusses how one can transfer money indirectly through the sambaza credit system in Kenya (which transfers airtime credit from one phone to another), it is now possible to transfer money directly using phones, or what is now called "mobile money technology" or MMT. This was pioneered by phone companies in the Philippines (driven by the need for internal and external migrant workers to send remittances home). Globe Telecom's GCASH system there dates to 2004; Smart Communications' system is even older, and includes SMART Money since 2000, a reloadable cash card that works in conjunction with mobile phones. Kenya was the first country in Africa to develop this system, in early 2007 (Rice 2007). This is a handy way to send small amounts with low transactions charges for both sender and receiver as compared to using the traditional banking system to move money.

Accounting for less payment volume than the cash transfer systems, but nonetheless intriguing, is entrepreneur/computer scientist Nathan Eagle's company txteagle, which enables mobile phone users to earn small amounts of money by completing simple tasks (e.g., collecting local data; answering a survey); it piggybacks on the mPesa mobile money system in Kenya to make payments and uses text messaging to send information. While this system requires that the user be literate and thus may be less accessible to women on that grounds, it nonetheless holds the promise of additional moneymaking opportunities for women as well as men and may be more compatible with the geographic spread of women and their overrepresentation in rural areas.

Interestingly, phones could even be used to improve literacy rates. An innovative pilot program in the Punjab province in Pakistan (GSMA 2010: 19) run jointly by the Pakistani mobile operator Mobilink and UNESCO used cellphones to encourage literacy among girls, having them send messages to and from their teachers several times per day in Urdu. Early returns on the program showed striking gains in their literacy.

Thus, while there is more evocative evidence in the case of mobile phones than in the case of telecentres that women's well-being is being impacted measurably, additional formal analysis needs to be undertaken to evaluate the effects of mobile phone technology on women's well-being and gender equity as a whole.

Discussion

As we have seen, progress towards specific development outcomes, like higher female participation in paid labor and higher participation of children in education, can be hard to link to specific technological innovations. Nonetheless, there may be reasons to push for expansion of

specific technologies even if they do not have the specific effects on which development groups tend to focus. These reasons can include the desire for universality of service, links of universality of service to political participation, and the view that adopted technologies that have their main effects in the nonmarket sector are nonetheless increasing of human well-being.

Both access to water and electricity can be seen as fundamental human rights. Indeed NGOs such as Practical Action (formerly the Intermediate Technology Development Group) calls for energy for all as a matter not only of good development practice, but also of fundamental humanity. Increasingly, access to ICT may be seen as a fundamental human right and thus a development goal in and of itself. Certainly the capabilities approach to human development leads to the conclusion that these general-purpose technologies are necessary conditions to full participation in modern life in its economic, political, and social aspects. ICT may not have reached its full potential yet as a medium for political participation; while Youngs (2002) optimistically suggests that women's political participation can be increased and enhanced through use of the Internet, Abraham (2009) paints a less cheerful picture regarding the difficulties faced by poor women in Zambia in trying to actively participate in activist mobile phone networks on a consistent basis.

Interestingly, perhaps the most transformative ICT of all is one that is both now rather old but also new: videos. While video began with the cinema in the early twentieth century and expanded to television and then subsequently first to videotapes and then to digital video discs (DVDs) in the late twentieth century, these latter manifestations, particularly satellite television and the DVD, have proved highly effective for propagating information and changing social norms. La Ferrara et al. (2008) find TV novelas in Brazil to have had a significant effect on lowering fertility in that country. Jensen and Oster (2009) consider the effect of cable television

on women's status in rural India and find significant effects not only on fertility, but also in reducing the acceptability of domestic violence and son preference, as well as increased measures of female autonomy and possibly school enrollment (they speculate through the increased participation of women in household decision making). World Bank Independent Evaluation Group (2008: 44) also found a significant effect on reducing fertility through television watching which they credited as one of the benefits of electrification. And video is only now spreading significantly through Africa, *The Economist* (2010) noting the rise of Nigerian cinema (Nollywood) since 1992, spread through DVDs, as a unifying feature of African society.

The issue of what is done with freed-up labor time, if indeed time is freed up at all, still looms in the back of planners' minds. For countries with apparent excess labor, the advantage of laborsaving devices may not be obvious, and neoclassical economists' views regarding increased productivity leading to higher demand for labor not sufficiently enticing. It is certainly the case that one reason we do not see larger paid work effects from improved water supply may be that there are no paid work opportunities for the women to step into, particularly in the rural areas. In Peter Hessler's (2010) profile of former Peace Corps member Rajeev Goyal, who successfully developed a pipe-and-pump water delivery system for Namje, a remote Nepalese village, it mentions his concern with "what Namje women would do now that they no longer spent six hours a day hauling water" (106). Indeed, they started a women's co-op and made hats for export (which he sold), but after a while this plan fell through. Without sufficient human and physical capital available that is complementary to paid work, it is not clear that the time can be rechanneled into remunerated work. Thus the secondary development issue is how to develop such outlets once the necessary infrastructure of water and electricity delivery is laid down.

Conclusion

This paper considers four network technologies (water, electricity, Internet and other telecentre services, mobile phones) in the framework of multiple pathways to change in gender equity through technology. In the case of water, it was not clear that the freed up time was available for remunerated uses, but it is possible that additional productivity in the household sector occurred. Electricity provision appeared more promising for increasing remunerated activity on the part of women, perhaps because it is both substitutable for physical labor and complementary to a wider range of production activities. Internet services did not appear substitutable for physical labor but was significant for reducing transactions costs on information flows, albeit the Internet is only lightly utilized to date by female entrepreneurs in low-income countries. Mobile phones, however, appear to be useful in all four ways, reducing the physical labor of travel to discover information (including fruitless trips to get supplies or meet customers which could then be avoided), reducing the costs of money and transfer, and increasing the ability of women entrepreneurs to coordinate their family and work lives. Given their relatively low cost relative to the other infrastructures and their multiple uses, it is not surprising that they have proved so popular and reached such high infiltration levels in many societies.

Significantly more research needs to be carried out in evaluating both the overall effects and the gender-differentiated effects of these transformational technologies. The lack of both carefully crafted case study evaluations and larger statistical studies for the contemporary cases (as opposed to the historical studies) is notable. However, the multiple possible effects of truly general-purpose transformational technologies make it hard to isolate their effects from the other related effects that occur simultaneously or in short order. Thus how much of economic growth

and changes in gender equity can be credited to any one, or any set, of technologies may be ultimately unanswerable given the holistic nature of transformation. This is small comfort for development researchers looking for payback on particular innovations, but the danger is overlooking the larger transformational effects by overfocussing on the smaller, more easily measurable changes. In addition, a capabilities framework for considering economic development would argue that the very ubiquity of these technologies is reason enough to advocate for their extension to all members of any society where they are widespread so as to allow for full participation of both genders in the fundamental interactions of the society.

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Table 1: rates of internet subscriptions, internet users, mobile cellular subscriptions, and electrification and improved water source population percentages, various years

all rates per 100 people	fixed broadband internet subscribers			internet users			mobile cellular subscriptions			electrification rates (%) 2009			improved water source, rural population (%)				improved water source, urban population (%)			
Country Group	1998	2003	2008	1998	2003	2008	1998	2003	2008	urban	rural	overall	1995	2000	2005	2008	1995	2000	2005	2008
South Asia	0.0	0.0	0.4	0.1	1.9	4.7	0.1	2.7	32.6	89.1	51.2	62.2	71.5	76.0	80.4	82.9	90.2	91.9	93.6	94.5
Sub-Saharan Africa		0.0	0.1	0.3	1.3	6.5	0.7	5.2	33.3	59.9	14.3	30.5	38.3	41.6	45.0	46.8	81.5	82.0	82.4	82.5
East Asia & Pacific	0.0	2.1	6.9	1.9	11.1	25.4	5.4	25.0	57.6	96.4	86.5	90.8	65.8	71.9	78.9	82.2	96.2	96.6	96.7	96.6
Middle East & North Africa		0.4	1.7	0.5	5.2	21.1	1.7	13.3	68.3	98.6	72.2	89.5	76.7	78.5	79.6	80.4	96.0	95.6	95.8	95.2
Latin America & Caribbean	0.0	0.5	4.9	1.2	11.7	28.9	4.2	23.5	80.5	98.8	74.0	93.4	67.8	72.4	77.4	79.9	95.3	95.8	96.5	97.1
North America	0.3	10.0	24.6	30.1	63.2	75.7	24.4	54.0	86.7				94.5	94.5	94.5	94.5	100.0	100.0	100.0	100.0
Europe & Central Asia	0.0	2.9	15.6	5.4	27.1	47.0	12.3	55.1	116.3				90.6	92.0	93.7	94.5	98.9	99.1	99.3	99.3
Low income		0.0	0.0	0.0	0.6	2.3	0.1	1.7	22.0				46.8	50.5	54.2	55.6	82.2	82.9	84.0	84.6
Middle income	0.0	0.3	3.1	0.4	5.4	17.0	1.5	14.5	56.5	90.7	60.2	73.0	67.9	73.0	78.4	81.2	94.4	94.9	95.4	95.4
Upper middle income	0.0	0.4	5.2	1.3	11.3	29.9	3.5	24.7	91.8				76.7	80.2	83.9	85.7	96.4	96.6	97.2	97.5
High income	0.1	8.3	23.6	16.2	50.1	68.3	24.5	70.3	106.3	100.0	99.5	99.8	96.2	97.3	97.7	98.0	99.7	99.8	99.8	99.9
World	0.0	1.7	6.2	3.2	12.5	23.9	5.4	22.6	60.8	93.6	65.1	78.9	67.0	71.3	75.6	77.9	95.2	95.5	95.7	95.8

Sources:

electrification rates: IEA, World Energy Outlook 2010, The Electricity Access Database, consulted February 15, 2011

all other data: World Bank, World Development Indicators Database, consulted February 15, 2011

Notes:

for electrification rates, only the Middle East rate is shown; North Africa is at 99 percent overall electrification

for high income electrification, this is taken as transition economies and OECD; middle income is developing economies

Table 2: percentage of households with electrification, radio, television, telephone, and refrigerator, most recent year available from 2005-09

all percents of hhs	electrification			radio			television			telephone			refrigerator		
2005-09	urban	rural	overall	urban	rural	overall	urban	rural	overall	urban	rural	overall	urban	rural	overall
South Asia															
Bangladesh	82.0	37.0	47.0	25.2	23.3	23.7	59.3	21.9	30.0	7.0	0.2	1.7	24.8	2.5	7.3
India	93.0	56.0	68.0	38.9	27.0	30.9	73.2	30.1	44.2	26.7	8.0	14.1	33.5	6.6	15.3
Nepal	90.0	43.0	51.0	69.7	59.2	61.0	62.9	20.8	27.9	27.2	2.1	6.3	18.8	1.4	4.3
Pakistan	98.0	84.0	89.0	28.8	33.2	31.7	80.5	42.9	55.7	65.9	35.2	45.7	61.7	23.7	36.7
Sub-Saharan Africa															
Angola	66.0	8.8	38.0	84.3	45.7	65.0	79.2	12.3	45.8	41.6	2.0	21.8	46.5	2.6	24.6
Benin	57.0	8.5	28.0	79.5	67.9	72.6	42.5	9.1	22.6	5.9	0.5	2.7	12.4	0.9	5.6
Congo, Dem. Rep.	37.0	1.1	15.0	62.3	32.8	44.6	34.2	0.6	14.0	1.2	0.1	0.5	10.5	0.1	4.3
Congo, Rep.	51.0	15.0	34.0	67.1	46.3	57.3	43.0	5.1	25.1	2.1	0.2	1.2	18.7	1.5	10.5
Ethiopia	86.0	1.9	14.0	75.6	26.6	33.7	33.1	0.1	4.9	28.2	0.1	4.2	11.9	0.2	1.9
Ghana	85.0	38.0	61.0	79.4	68.6	73.7	67.1	20.7	42.9	6.5	0.6	3.4	43.6	9.1	25.6
Guinea	64.0	2.8	20.0	76.0	59.0	63.8	36.5	1.1	11.2	20.4	0.2	6.0	24.8	0.6	7.5
Kenya	66.0	8.1	23.0	82.0	70.6	73.6	57.1	17.9	28.1	6.6	0.5	2.0	21.2	1.2	6.4
Liberia	6.9	0.8	3.0	64.2	37.5	49.9	16.5	1.7	8.6				2.8	0.9	1.8
Madagascar	69.0	8.2	17.0	79.3	56.8	60.2	60.0	7.9	15.8	9.0	1.3	2.4	14.2	1.4	3.4
Maldives	100.0	100.0	100.0	71.9	88.1	83.1	97.3	95.0	95.7	44.6	14.8	24.0	95.7	80.1	84.9
Mali	47.0	3.2	17.0	79.4	67.9	71.4	48.7	10.7	22.3	11.8	0.5	4.0	12.8	0.3	4.1
Namibia	78.0	15.0	44.0	82.0	69.7	75.4	65.6	12.3	37.0	33.3	12.9	22.3	68.9	14.8	39.9
Niger	47.0	1.5	9.3	73.5	46.6	51.2	34.1	0.5	6.2	4.0	0.0	0.7	15.9	0.1	2.8
Nigeria	85.0	31.0	50.0	83.5	69.4	74.4	69.0	22.9	39.3	3.7	0.7	1.8	32.4	6.7	15.9
Rwanda	28.0	2.0	6.0	72.0	55.6	58.1	16.2	1.0	3.3	5.0	0.4	1.1	5.0	0.2	0.9
Senegal	83.0	26.0	54.0	80.6	76.0	78.2	72.2	26.0	48.0	17.5	5.0	10.9	34.4	7.6	20.3
Sierra Leone	33.0	1.4	12.0	78.2	43.2	55.1	27.9	0.9	10.1	2.3	0.1	0.8	16.8	0.3	5.9
Swaziland	63.0	22.0	35.0	82.1	73.7	76.5	54.4	26.4	35.4	20.1	8.7	12.4	51.1	26.4	34.4
Uganda				74.8	58.2	60.8	25.5	2.6	6.2	3.1	0.2	0.7	13.7	1.2	3.2
Zambia	48.0	3.0	19.0	71.1	50.3	57.5	56.7	7.3	24.4	5.9	0.2	2.1	32.9	1.7	12.5
Zimbabwe	91.4	8.7	37.2	77.5	32.9	48.3	70.4	10.4	31.1	22.2	1.0	8.3	47.6	2.7	18.2
East Asia & Pacific															
Cambodia	67.0	13.0	21.0	62.8	47.3	49.6	72.2	52.3	55.2				15.9	0.7	2.9

Indonesia	98.0	86.0	91.0	58.3	42.3	49.0	84.9	57.2	68.7	61.3	28.5	42.1	43.1	12.6	25.2
Philippines	94.0	73.0	83.0	69.8	60.5	65.2	84.6	57.5	71.1	20.0	3.0	11.6	53.0	26.4	39.8
Middle East & North Africa															
Egypt, Arab Rep.	100.0	99.0	100.0	80.0	67.8	73.7	96.8	92.8	94.7	61.6	38.2	49.5	96.2	86.4	91.2
Jordan	99.0	98.0	99.0	50.4	38.7	48.5	98.7	96.7	98.4	25.6	12.2	23.5	97.2	95.1	96.8
Latin America & Caribbean															
Bolivia	98.0	55.0	80.0	87.4	82.3	85.4	90.8	36.0	68.7	30.9	1.7	19.1	49.5	9.9	33.6
Colombia	99.0	89.0	97.0	73.5	63.6	71.0	91.2	66.4	85.0	68.7	15.5	55.5	76.3	41.9	67.8
Dominican Republic	99.0	89.0	96.0	47.8	49.5	48.3	84.2	62.0	77.4	34.8	7.7	26.5	78.3	53.1	70.6
Honduras				86.0	85.0	85.5	88.4	35.1	62.2	43.1	3.1	23.5	67.8	19.2	44.0
Haiti	69.0	12.0	34.0	77.6	50.1	60.7	52.2	8.2	25.3	9.2	1.3	4.4	21.4	2.3	9.7
Europe & Central Asia															
Armenia	100.0	100.0	100.0	34.7	17.8	28.9	88.5	77.3	84.7	83.5	49.4	71.9	86.3	74.8	82.4
Azerbaijan	100.0	99.0	100.0	56.9	32.1	46.7	97.0	92.2	95.0	75.9	37.0	60.0	88.5	59.2	76.5
Moldova	99.0	98.0	99.0	70.4	73.0	72.0	86.4	58.1	69.4	87.5	52.7	66.7	91.2	65.0	75.5
Ukraine	100.0	100.0	100.0	73.0	67.1	71.2	98.2	94.9	97.2	68.3	31.3	57.2	97.8	88.4	95.0

Source: Measure DHS (Demographic and Health Surveys), consulted February 15, 2011

Table 3: percentage of households with various appliances and services, Latin American and Caribbean countries, most recent year available and year closest to five years back

all percents of hhs		refrigerator			washer			air conditioning			landline phone			cell phone			television			vcr or dvd			personal computer			internet at home			Notes:
Country	year	urban	rural	overall	urban	rural	overall	urban	rural	overall	urban	rural	overall	urban	rural	overall	urban	rural	overall	urban	rural	overall	urban	rural	overall	urban	rural	overall	
Argentina	2001	94.6			77.8						64.3			21.3			95.3			37.3			21.9			9.0			
Bahamas	2001	81.9			47.8			36.5									91.9			48.7			36.1						
Bolivia	2007	52.8	11.6	38.4	8.4	0.4	5.6				31.2	1.6	20.9	55.8	8.7	37.5	91.4	34.9	71.7	49.6	17.2	38.3	24.3	3.5	17.1				cell phone numbers are for 2005
	2002	43.8	5.0	29.3	5.6	0.0	3.5	2.1	0.0	1.3							82.5	15.7	57.5	22.1	1.6	14.4							
Brazil	2007	94.4	70.9	90.8	44.0	12.1	39.2				51.8	9.4	51.8	73.1	39.6	68.1	97.1	80.5	94.6				30.2	5.0	26.5				sample expands to include the rural north
	2002	91.4	59.0	86.8	37.7	9.3	33.6				60.1	9.1	52.9	38.3	13.4	34.7	93.8	68.0	90.2				15.9	1.6	13.9				
Chile	2006	90.4	76.3	88.6	70.8	38.4	66.5							62.5	50.1	60.9				38.6	9.9	34.8	36.7	9.9	33.2	21.7	2.9	19.2	vcr/dvd numbers are for 2003
	2000	86.0	54.7	81.7	53.8	18.6	48.9				62.5	7.9	54.9							35.7	7.5	31.7	19.2	2.2	16.9	9.2	0.7	8.0	landline numbers are for 1998
Colombia	2003	76.6	37.9	67.1	32.0	3.7	25.1	1.8	0.1	1.4	68.9	10.7	54.6	21.8	4.6	17.6	90.9	58.5	82.9	20.5	2.6	16.1	14.7	0.9	11.3	7.2	0.2	5.5	
Costa Rica	2009	95.8	91.1	93.9	93.7	87.9	91.3				73.7	54.4	65.9	76.2	59.5	69.5	97.6	93.3	95.9	65.3	52.8	60.3	47.4	24.2	38.0	26.2	7.5	18.7	
	2004	93.5	84.7	90.0	90.5	81.6	87.0				75.6	47.3	64.5	53.1	27.9	43.1	95.0	85.5	91.2	41.1	18.4	32.1	31.8	12.1	24.0	14.5	3.8	10.2	internet numbers are for 2005
Dominican Republic	2006	76.6	52.4	68.1	73.2	53.6	66.5	9.5	2.2	7.0	38.7	11.3	29.1	54.1	37.5	48.3	86.6	72.5	81.7	20.3	7.1	15.7	15.7	4.6	11.9				
	2002	82.1	50.8	71.6	74.1	48.3	65.4	7.8	0.9	5.5	48.8	12.6	36.7	36.5	21.8	31.2	90.3	71.2	83.9	17.5	4.9	13.3	9.4	0.6	6.4				
Ecuador	2009	83.1	47.1	71.5	36.9	5.9	26.9				47.2	11.3	35.6				92.3	62.4	82.7	53.6	21.6	43.3	31.7	5.8	23.4	11.0	0.7	7.7	
	2003	72.4	32.0	59.4	29.6	3.1	21.1				46.9	9.9	35.0				79.5	37.3	65.9	24.1	5.7	18.1	26.4	4.0	19.3				computer numbers are for 2006
El Salvador	2008	70.4	38.2	60.1	18.6	2.0	13.3				89.6	76.5	85.4	48.5	13.6	37.3	91.0	67.7	83.5	54.0	23.5	44.2	15.3	1.6	10.9	6.1	0.1	4.2	
	2003	64.4	28.4	50.8	14.1	0.9	9.1				56.3	22.2	43.4	50.1	12.9	36.0	87.1	57.4	75.9	23.6	5.9	16.9	8.5	0.5	5.5	3.8	0.1	2.4	
Guatemala	2006	54.8	11.1	28.4	18.2	1.9	10.6				31.4	4.5	18.9	66.8	40.9	54.8	85.1	49.4	68.6	25.9	8.5	17.9	18.3	2.0	10.7	3.3	0.1	1.8	
	2000	54.8	20.5	38.9	14.0	0.8	6.5				31.3	2.7	15.2	18.5	2.9	9.7	80.3	33.6	53.9	12.9	1.7	6.5	9.3	0.5	4.3	1.9	0.1	0.9	
Guyana	2004	41.5	19.6	27.5	3.9	0.3	1.6	0.9	0.1	0.4							41.8	16.4	25.8	13.1	7.5	9.5							

Haiti	2001	24.6	2.5	11.5	0.6	0.1	0.3	0.8	0.0	0.3	8.7	0.7	4.0	6.5	0.3	2.8	45.0	5.1	21.3	13.5	0.9	6.0							
Honduras	2007	73.2	27.7	50.0							54.2	12.2	32.9	37.5	2.6	19.9	90.4	42.3	65.8				15.6	2.4	8.8				all phone numbers are for 2006 landline numbers are for 2003; computer for 2004
	2002	61.8	17.2	39.0							31.0	1.4	15.9				83.2	28.9	55.5				10.8	0.4	5.5				
Jamaica	2002	79.7	60.1	69.2	20.7	5.2	12.4	6.4	1.2	3.6	60.8	32.8	45.7	31.9	34.3	33.2	84.9	68.8	76.2	31.7	22.8	26.9	12.7	2.6	7.3				
Mexico	2008	88.2	62.4	82.9	57.9	27.8	51.7	13.3	3.4	11.2	82.8	44.2	74.8	55.2	18.1	47.5	97.0	80.8	93.6	65.8	35.4	59.5	27.9	4.0	23.0	16.4	0.7	13.1	
	2002	84.9	49.2	76.7	65.8	28.4	57.2	9.3	1.0	7.4	61.7	18.1	51.6	51.2	7.8	41.2	95.1	71.3	89.6	45.6	13.6	38.2	17.4	2.1	13.8	6.6	1.0	5.3	
Nicaragua	2005	40.5	8.8	27.3	4.5	0.3	2.7	2.1	0.1	1.3	24.1	0.9	14.2	35.4	5.9	23.1	86.7	35.8	65.5	13.6	1.6	8.6	6.3	0.2	3.8	0.4	0.0	0.2	
	2001	29.7	6.0	20.5	2.3	0.1	1.5	1.2	0.1	0.8	16.3	0.9	10.4	5.2	0.6	3.5	76.9	30.6	58.9	8.7	1.0	5.7	3.1	0.2	2.0	2.4	0.1	1.5	
Panama	2003	78.5	38.7	65.9	65.1	35.5	55.7	13.6	1.9	9.9	44.5	13.0	33.3	54.0	21.2	42.3	92.6	55.9	80.9	23.9	3.6	17.5	18.1	2.3	13.1	7.7	0.6	5.2	
Paraguay	2008	86.0	63.9	77.1	66.5	38.9	55.3	24.6	4.9	16.6	93.4	78.8	87.5	90.6	78.4	85.6	92.3	73.2	84.6	51.3	25.4	40.8	20.3	4.7	13.9	9.2	0.8	5.8	
	2003	82.4	54.8	71.1	51.9	23.3	40.2	19.1	2.1	12.2	53.3	19.9	39.6	39.9	18.7	31.2	86.2	61.0	75.9	19.1	3.9	12.9	10.0	0.9	6.3	3.0	0.0	1.8	
Peru	2008	53.7	7.1	37.7	22.4	0.4	14.8				82.4	25.8	63.3	43.8	1.5	29.5	90.7	40.0	73.3				24.3	1.6	16.5	12.1	0.1	8.0	
	2003	52.1	4.2	34.8	14.7	0.2	9.5				41.7	0.8	27.3	34.1	0.2	22.1	88.8	31.0	68.0	20.6	1.4	13.7	10.7	0.2	6.9	2.2	0.0	1.4	
Uruguay	2007	94.2	83.5	93.8	60.8	38.2	59.3							71.1	63.9	70.6	93.1	71.0	91.6	46.2	24.0	44.8	29.3	12.1	28.2	16.7	3.4	15.8	
	2003	96.3			59.6												91.3			30.2			18.3			13.2			
Venezuela	2006	88.5			61.1			21.9			36.6			37.2															
	2002	94.4	83.9	85.4	81.4	51.7	56.0	16.3	1.9	14.2	40.8	26.8	28.9	34.7	25.5	29.6													cell phone numbers are for 2003

Source: Socio-Economic Database for Latin America and the Caribbean (CEDLAS and The World Bank); consulted November 17, 2010