Bridging the Source of the Global Digital Divide

Jeffrey James

Paper prepared for the Digital Opportunity Forum, 2006, held in Seoul, Korea, from August 31 to September 1, 2006

Introduction

The topic that I have chosen for this important occasion is based on the recognition that the impact of all new technologies depends heavily on the way in which they spread across regions or countries and that these patterns of diffusion are no less heavily influenced by the way in which the technologies are generated. When translated into the specific case of IT innovations, this logic translates, first, into the notion that the differential impact of these innovations on rich and poor countries, can be ascribed in large measure to what is known as the global digital divide, or, in other words, to the more widespread use of IT in rich as opposed to poor countries. This global pattern of diffusion, in turn, is no less importantly influenced by the way in which IT is generated (eq. where? by whom and for whom?). In order to tackle the digital divide at its 'source', therefore, one needs to examine and alter the way in which various forms of IT are actually generated. Let me begin then by sketching what I regard as the major source of the global digital divide and the concerns about its impact that have been expressed by international institutions, developing countries and academics. On the basis of this analysis, I then present a classification of ITs that would be involved in countervailing policies designed to redress the divide. This classification is used, finally, to examine possibilities for international cooperation in each of the categories thus identified (My focus on the generation of IT should not, however, be taken to imply the unimportance of other relevant policy issues).

THE GENERATION OF INFORMATION TECHNOLOGY

Whether one uses expenditure on R&D or numbers of patents taken out as indicators of innovative activity, the generation of IT takes place in a world where over 90 per cent of innovations are concentrated in developed, rather than developing countries. IT innovations are unlikely to alter this highly concentrated pattern of global R&D expenditure and patenting activity. Indeed, if anything, the requirements for generating at least some forms of IT, are likely to make for an even more concentrated pattern of global innovative activity. I am referring here to the fact that R&D activities in many parts of the IT sector have become more science based and research intensive, leading, among other things, to new forms of strategic alliances between major companies almost exclusively from the developed countries.[1)]

From the point of view of developing countries, however, the patterns of innovation described in the previous paragraph are not *in themselves* problematic and certainly cannot be regarded *per se* as the source of the digital divide. For, as Singer (1970) pointed out many years ago, the acute inequality in global innovative activity,

> would not matter if the direction of advance, the scientific and technological priorities and the methods of solving scientific and technological problems, were independent of where the work is carried on. This, however, is patently not the case ….. research and development expenditures in the richer countries are spent on solving the problems which concern the richer countries, according to their own priorities, and on solving these problems by the methods and approaches appropriate to the factor endowment of the

> richer countries. In both respects – selection of problems and methods of solving them – the interest of the poorer countries would be bound to point in completely different directions (Singer, 1970, p 22).

In fact, innovations in developed countries reflect far more than just their factor endowments. They are designed in addition to fit in with average income levels, infrastructure, institutions, other technologies in use and so on.[2)] For this reason, technological innovations in general and in IT specifically, are most likely to be adopted in countries, and regions within countries, that most closely resemble the socio-economic circumstances prevailing in the innovating (developed) country. At the risk of oversimplification, it seems reasonable to suppose that these circumstances are likely to be prevalent in the more advanced developing countries and within a given country, the modern, high income, urban sector (though one should note that this expectation applies more to the Internet than to mobile phones, for the reasons given below). In general, the available evidence on the pattern of IT diffusion in developing countries tends to support the postulated link between the generation and diffusion of most innovations in the sector. Before I proceed to examine specific policy options based on this link, however, one of its *general* implications for future policy making (as well as for interpreting recent rates of IT diffusion in developing countries) deserves prior emphasis.

It is that in the early phase of diffusion, IT will tend to be adopted primarily among a relatively small group of affluent, educated and urban, producers and consumers. Beginning from a base level close to zero, very high rates of diffusion will occur as the technology penetrates this minority (as, indeed has been true of the decade beginning in 1994). But given the acutely dualistic character of most developing countries, this initial phase will rapidly give way to the completely different and more

difficult problem of bringing IT to the poor, uneducated, majority of the population. Rates of diffusion will tend to drop sharply, falling possibly below those in developed countries. To this extent, therefore, simple extrapolations of current trends into the future serve only to engender a false sense of optimism about the time required for bridging the digital divide.[3)]

POLICY TOWARDS THE GENERATION OF IT IN DEVELOPING

My discussion of this very large topic has necessarily to be partial and incomplete and I have given it more focus partly by relying on the analysis in the previous section and partly by means of the recognition that micro-based policy interventions need also to be considered in a national (innovation systems) context. In particular, I begin by making a distinction between hardware/software and institutional innovations in IT and suggest that the latter form will become increasingly important as the diffusion process extends beyond the privileged minority of users described above. I suggest finally that a suitable framework for thinking about the generation of IT cannot be confined only to the project level. One needs to look also at the entire system of innovation in any particular country.

Hardware, software and institutional innovations[4)]

It follows from what was previously mentioned, that the heavily biased way in which new forms of IT are generated, can be offset in principle by innovations that match the circumstances prevailing in poor, as against rich countries. Indeed, with respect to hardware and software there is already a long and growing list of examples that could be cited. These range from ultra low-cost computers (such as

the 100 dollar laptop from the MIT Media Lab), inexpensive handsets for mobile phones and refurbished versions of older IT technology vintages, to software based on Linux, or that can be run on older, 'obsolete' computers (that are perfectly well suited to many basic applications in developing countries). These and other similar innovations will surely be relevant to individuals or firms that would not have been able to afford the original developed country versions of the technology and to this extent the digital divide will be narrowed. A the same time, however, it is essential to recognize that even those who can afford a low-cost computer (and to a lesser degree an inexpensive mobile handset), will tend, in most developing countries, to be drawn from the richer deciles of the population. That is the group I described previously as being not only relatively affluent, but also educated and located in urban rather than rural areas. And that is the very group, I further suggested, which will drive the early, rapid pace of IT diffusion in developing countries (especially, but not only, in the case of the Internet). But what happens thereafter, when incomes fall below the level that prohibits individual ownership of even the lowest cost forms of IT? When, that is to say, the prevailing socio-economic conditions become increasingly distant from those prevailing in the richer countries. It is at this point, I would argue, that institutional changes are required to replace the ownership model if IT is to have a mass impact on developing countries (though, of course, there will be many occasions on which hardware/software innovations can fruitfully be combined with change of an institutional kind).

Institutional innovations for IT

There are basically two directions that institutional change can take in order to replace ownership as the means of extracting the benefits of IT. One of them involves institutions that allow use of IT without ownership and the other permits the *benefits* of technology to reach people who make no individual *use* of it whatsoever. For reasons that have to do with differences in the user capabilities they require, the first form of change applies best to mobile phones, whereas the second is most obviously suited to extracting the benefits of the Internet in rural areas of developing countries. In particular, the former type of IT makes no demands at all on users (not even basic literacy), in contrast to the latter which demands a high degree of literacy and language skills, as well as computing skills and computer literacy (in between these extreme cases, there will of course be intermediate ones in which the user capabilities required lie above zero and below those demanded by the Internet). Such differences as these are important because they indicate the direction of institutional change that is required in relation to mobile phones, on the one hand, and the Internet on the other. For, whereas with respect to the former type of IT, the need is to extend the limits imposed by ownership, using sharing mechanisms of one kind or another, the Internet requires innovations that bring the benefits to the rural majority, without any need for individual use of the technology itself (given the vast gap between the user capabilities available to this group and those that are actually required).

Table 1. *Illustrative cases of institutional change in mobile phones and the Internet*

Institutional change to expand users	Institutional change to derive benefits without use
Mobile phones	The Internet
a) *Non-commercial* Sharing a mobile phone by the friends and family of owners b) *Commercial* - Buying time from vendors situated in villages, small towns, roadside kiosks - People who cannot afford a mobile phone use prepaid cards to make calls from a handset belonging to someone else - Renting prepaid cards (users provide the code belonging to a card in order to make a call at a payphone and pay the vendor for just the number of units that were used. The vendor, in turn provides the code to another client and the process continues until the card is depleted).	a) *Face-to-face intermediation* Rural Internet kiosks that are operated by people familiar with the technology and the local community (enabling poor, illiterate rural inhabitants to have e-mails sent and government documents received). b) *Distance intermediation* Community radio stations that transmit, translate and contextualize information from the Internet for the benefit of listeners (even those living in remote, rural areas). For example, in one project, there are experts such as doctors, teachers and lawyers in the radio station who, on air, use the Internet to provide information in their own area of expertise to the listening public. The information is translated, contextualized, and otherwise made accessible to the audience.

The first column indicates just some of the many institutional innovations that have helped to spread the use of mobile telephones well beyond what would have been possible on the basis only of the ownership model. Indeed, the best-known sharing mechanism, Grameen Telecom, has used village phone operators to spread mobile phone use among millions of rural inhabitants in Bangladesh. Note, however, that the success of this and other institutional innovations listed in Table 1, would probably have been even greater if appropriate hardware innovations, such as ultra low-cost handsets, had also been adopted (The pre-paid card is also a technical device that has greatly helped to promote the sharing of mobile telephones in certain developing countries). The general point here being that hardware/software innovations in IT can be relevant not only for the Western-based ownership model, but also for the mostly indigenous forms of sharing that have emerged in relation to mobile phones.

The second column in Table 1 reflects the fact that even if computers with Internet connectivity were made freely available in rural areas, they would tend to go unused because of the user capabilities gap referred to above. What are required instead are intermediaries who are familiar with both the technology and the community. Such persons can then deliver services and provide information that is required in a particular area, at rates that even the rural population can often afford. Internet kiosks, for example, offer a range of services to rural clients such as sending e-mails; lodging complaints with local government institutions; requesting land records and other deeds; searching for farm prices in different markets and so on. Institutional innovations involving intermediaries can also occur, as indicated in Table 1, at a distance, involving, in the particular example given there a blending of radio

and the Internet. This form of intermediation is especially promising because the radio is so widely used throughout rural areas of developing countries. And if information gleaned from the Internet can be used to provide relevant, contextualized information to isolated listeners, then the scope for intermediation can be widened, in principle, to the vast numbers who own or use a radio. Indeed, in one developing African country, Mali, some 70 per cent of the entire population is said to tune in to radio broadcasts about market price information, which are transmitted via a solar powered computer network that links local market information systems across the country through e-mail sent over HF radio. The local information offices, in turn, are tied to local radio stations that broadcast in French and local languages (the role of a solar powered computer network in this project underscores yet again the potential complementarity between technical and institutional innovations).

Although these and many other innovations mentioned above can often usefully serve as models worth emulating elsewhere, overall policy to bridge the digital divide in developing countries also needs to take into account that individual projects form part of a broader national system of innovation.

National systems of innovation for IT

Some definitions of a national innovation system focus directly on the issue of institutional interdependence at the country level. Nelson and Rosenberg (1993, p4), for example, refer to a set of institutions whose interactions determine the innovative performance of national firms.[5)] The institutions in question are likely to involve, among others, R&D institutes and public labs, private and public firms, technology institutes and foreign actors, such as aid donors and multinationals. Note in this regard that the institutional interactions described in the national systems perspective

are not the same as the interactions that occur in relation to a specific project. The former are systemic features of the economy as a whole rather than institutional interactions at a micro level. A commonly mentioned weakness in the national innovation systems in developing countries, for example, is a pervasive failure of R & D and other technology institutions to make positive connections with the industrial sector. Other commonly cited weaknesses include the isolation of multinational firms from the host environment, the separation of modern and traditional sources of knowledge and innovation and the failure on the part of government to concern itself with the overall technological system, including the systems of innovation. The essential point I am trying to make is that the progress of successful project innovations in IT can be undermined by these and other weaknesses in the national innovation system. Consider, for instance, the early years of Grameen Telecom, one of the institutional innovations mentioned above. What has turned out to be perhaps the most successful IT innovation in a developing country, reaching some 45 million inhabitants of rural areas in Bangladesh, was initially hampered by a major element of that country's innovation system, namely, a poorly functioning telecommunications network. Subsequently, the telecommunications sector was reformed and the number of village phones increased substantially. Similarly, the success of attempts to blend the radio and the internet via community radio stations depends crucially on the legal framework that governs the status of these and other types of radio ownership in a particular country.

Clearly, therefore, policy needs to address itself not only to the generation of individual IT innovations as described above, but also to the systems of innovation in which such innovations occur. In the next section, I discuss some of the policy alternatives that lend themselves to international co-operation.

IMPLICATIONS FOR INTERNATIONAL COOPERATION

Very near the beginning of this paper, I showed how overwhelming was the concentration of R&D in developed countries. I also cited an early paper by Singer (1970) who pointed out that, although scientific activities in those countries could in principle be devoted to the problems of poor countries, in practice they were not. Thus, there is scope both for changing the allocation of R&D expenditure in favour of poor countries, as well as making developed country R&D more responsive to the needs of the former. As regards the former, international cooperation can take the form of much-needed financial support for research projects in developing countries, as well as the establishment or expansion of research centres in IT in those countries (Aubert, 2004). As measured by its impact on the country as a whole, the research conducted at the Indian Institute of Technology in Chennai, is by far the best example of what can be achieved by an institution devoted to generating new forms of IT in the Third World.

Among many other achievements, the IIT in Chennai invented an indigenous, low-cost, version of the WLL system, 'corDECT', which is widely used in rural areas in India. This technology also forms the technological basis of a firm (n-Logue) which has succeeded in extending telecom and Internet service to small towns and rural areas in the form of cheap kiosks. Given moreover that the indigenous WLL technology has been exported to other developing countries, it is certainly one of the most successful forms of hardware innovation that are currently available (Indeed, one of the more promising areas for international cooperation is to draw up a list of the IT projects that have had an especially large effect on the population of

developing countries. Existing lists of success stories tend not to make this important distinction).[6)]

In addition to supporting the generation of IT innovations in developing countries, international cooperation also needs to concentrate on the identification and replication of projects that are successful in one particular context to another context, be they other parts of a particular country or other developing countries. There is considerable scope, for example, in supporting microfinance institutions that are so central to the Grameen Telecom project and may also be in attempts to replicate that model elsewhere. (eq. Uganda) Another institutional innovation described above which concerned the blending of radio with the Internet and originated in Sri Lanka, has been replicated with some degree of succes by UNESCO and the Swiss Agency for Development and Cooperation, in three African Countries.

I turn next to the category where research initiatives are undertaken by developed countries with the goal of reaching those in developing countries who are generally neglected by the focus of global research on IT. A good example of international cooperation in this area is the involvement of UNDP in the ‘one laptop per child project’ that is associated with the 100 dollar laptop designed by the MIT Media Lab. UNDP had the role of working with local and international partners to design and deliver OLPC technology and other learning resources to schoolchildren in the least Developed Countries.

Although other examples could be cited in this regard it is clear that developing country oriented research in the North has still only made a small dent in the problem of re-orienting global research in IT towards the needs of developing as opposed to developed countries. There is accordingly a huge gap here that international cooperation could help to fill.

The final category that emerged from previous sections deals with the interaction of the various participants in national systems of innovation. The role of international cooperation in this category would thus generally be to facilitate positive interactions among the various actors involved in the national system. One could think here, for example, of cooperation designed to strengthen the capacity of national governments to formulate and implement coherent IT programs and policies (a capacity that played a large part in the design of effective policy in the national systems of innovation in the East Asian experience).[7)] Or again one could think of cooperation in the many facets of designing and implementing IT clusters in developing countries (UNIDO for example has already done some work on the general criteria for establishing clusters in those countries). Still other possibilities focus on improving the national institutions that determine the overall industrial environment in which individual actors operate. An interesting case in point is the Mauritius Standards Bureau, which, in the mid-nineties was assisted by a World Bank loan and twinning agreement with the Singapore Institute of Standards and Industrial Research, to upgrade its capabilities. This apparently successful endeavor 'suggests the potential for learning from collaborating, with world best-practice institutions' (Lall and Pietrobelli, 2001, p21).

In order for international cooperation to be effective in these and other ways, however, a closer relationship needs to be effected between those who design policy at this level and those who approach the topic from a more academic point of vieuw. All too often, unfortunately, in the area of IT, as with technology in general, the interactions between these two groups tends to be highly limited, depriving both of potentially valuable insights and information.

Conclusions

My intention in this note has been to provide an introductory framework for thinking about overcoming the inter-country biases in the generation of IT, that I have referred to as the source of the digital divide. The framework makes a distinction between increasing the amount of activities devoted to innovations within developing countries and research conducted within developed countries that is oriented to conditions prevailing in the former. I also make a distinction between hardware/software innovations on the one hand and institutional changes on the other. The latter are necessary for the large majority of poor, rural and uneducated inhabitants of the Third World, for whom even ultra low-cost forms of hardware/software are too expensive or complicated. Within the category of institutional innovations, I argue that the challenge posed by mobile telephones is far simpler than the Internet, which requires intermediaries who are able to bring the benefits of the technology to those who make no personal use of it whatever. Finally, I distinguish between individual project innovations (of any of the above types) and so-called national systems of innovation, that focus on the interactions between institutions that bear on the outcome of each single micro-based intervention. The last section of the paper uses these various categories to propose or illustrate possibilities for international collaboration designed to overcome biases that underlie the source of the digital divide.

The classification is designed to bring some degree of order to an otherwise highly fragmented literature on IT innovations in developing countries. It is not meant to imply that the proposed categories are all mutually exclusive. On the contrary, I have emphasized the importance of interactions between different types of

innovations in the one hand and between different types of institutions on the other. So too should policy based on international cooperation.

Notes

1) These are well described by Freeman and Hagedoorn (1994). These authors paint a gloomy picture of technical divergence over time between rich and poor countries, especially in IT.
2) See Stewart (1977) for a full discussion.
3) This is precisely what Fink and Kenny (2003) do in a conceptually and statistically flawed analysis.
4) Many of the examples cited in this paper are described by James (2003 and 2004).
5) It is perhaps most useful to think of a system which includes numerous feedback loops and which contains the various interactions between the institutions of which it is made up. Each part of the system is important to the outcome of the innovation process as a whole and is influenced by others.
6) The annual prize awarded by the Development Gateway Foundation is heavily based on project impact, measured by numbers of beneficiaries and as such could serve as a model in this regard.
7) See Hanna (1996) for a full analysis.

References

E. Aubert (2004). 'Promoting Innovation in Developing Countries: A Conceptual Framework', World Bank.

C. Fink and C. Kenny (2003). 'W(h)ither the Digital Divide', World Bank.

C. Freeman and J. Hagedoorn (1994). 'Convergence and Divergence, in the Internationalization of Technology', in J. Hagedoorn (ed.), *Technical Change and the World Economy,* Elgar.

N. Hanna *et al* (1996), *The East Asian Miracle and Information Technology,* World Bank Discussion Paper, 326.

J. James (2003). *Bridging the Global Digital Divide*, Elgar.

J. James (2004). *Information Technology and Development*, Routledge.

S. Lall and C. Pietrobelli (2001). 'National Industrial Systems in Africa', Paper Prepared for the 2001 Conference of the European Association of Evolutionary Political Economy, Siena.

R. Nelson and N. Rosenberg (1993). 'Technical Innovations and National Systems', in R. Nelson (ed.), *National Innovation Systems: A Comparative Analysis,* Oxford University Press.

H. Singer (1970). ‘Dualism Revisited: A New Approach to the Problems of the Dual Society in Developing Countries”, *Journal of Development Studies,* Vol. 7.

F. Stewart (1977). *Technology and Underdevelopment,* MacMillan.