Public policy towards the Internet and development

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September 2001

This paper was prepared for presentation as the keynote address of the TIPS Forum on 10 September 2001, Johannesburg, South Africa.

Two years ago, the Internet was seen as changing the world. The most prestigious business schools were rushing to create concentrations in E-commerce, and the conjunction of the entrepreneur (preferably with a Stanford degree) with the venture capitalist was heralded as the key to the "new economy", in which, according to some, there would be no more recessions. Today, the dotcoms are perceived to be dying, and the firms in the information technology sector seem to be leading the world towards a recession.

What are policy makers supposed to do in these confusing circumstances? Is an Internet policy still important for a developing country? What sectors of the economy will be affected? What are the links to telecommunications policy? The aim of this paper is to provide some elements to help analyze these problems and to discuss what economists know and do not know about the answers.

I feel somewhat nervous speaking about this topic in front of this audience. Indeed, South Africa has gone through a remarkable public debate on the issue, which has cumulated in the "Green Paper on Electronic Commerce for South Africa" and the answers that have been given to that Green Paper.

However, I feel that there might be some benefits to take a somewhat more academic approach to the topic. This will lead us to the following conclusions. First, the Internet is indeed an important phenomenon, that is progressively changing many aspects of the way in which modern economies function. Second, the Internet creates opportunities, but is also a source of threats; policy makers cannot afford to ignore it. I will argue in particular that the exporting sector of all economies need access to a first rate communications infrastructure. Third, public policy is important, and it should be oriented to the creation of a high quality telecommunications infrastructure. In this perspective, the rapid introduction of competition in the telecommunications sector, and I know that this is a subject of debate in South Africa, is a necessary component of any forward looking policy in this domain.

What is the Internet?

It is important to understand that the Internet is simply a set of communication standards, but as we will see later communications standard impose constraints: if one ignores them, one is excluded from the conversation.

Physically, end users, which can be individuals, firms, government agencies, non-profit organizations, buy connection to the Internet through an Internet Service Provider (ISP). These ISPs specialize in providing the connection between end-users and the Internet. They also generally provides software and support and, usually, an Internet address, such as whyme@nonsensemail.com. A second type of players, Internet Backbone Providers (IBPs), sometimes called top-level ISPs, transmit data over long distances, typically using long haul fiber. ISPs pay IBPs to transmit data; large IBPs typically exchange data between each other without paying (through so-called peering contracts). The costs of connecting to the rest of the Internet have historically been quite high for non American ISPs.

It is important to realize that although the Internet is not regulated in itself, it is substantially affected by government regulations and policies. This is a theme to which I will come back repeatedly, and the costs incurred by ISPs provides us with an important first example. The connection between the computers of end users and their ISP travels across regulated telephone lines, or lines that are substantially affected by government regulation, and the form of that regulation has important consequences for the cost and pattern of the use of the Internet. For instance, the American "all you can eat" pricing of local calls has certainly favored the development of the Internet; or again, the unbundling of the local loop, which is greatly influenced by public policy, is very important for the rapid deployment of DSL, which allows high bandwidth on standard telephone lines.

Data is exchanged in the Internet under the form of packets, and the way in which this exchange takes place is controlled by a number of standards, of which I will present rapidly the two most important. The Internet Protocol (IP) explains how to address these packets. Think of each packet as a postcard: it contains an address, useful for the Post Office, and some content, which is of interest to the recipient. The IP protocol explains how the address should be written. A second standard, the Transmission Control Protocol (TCP) manages the way packets are sent. In the case of a short message, the job of TCP would be to ensure that the computer of the recipient knows that a message is forthcoming and is ready to receive it. It would manage the exchange of postcards with questions and answers of the type “Can you receive a message?”, “Yes”, “Here it is”, “Welle received”, and so on. TCP also defines how larger messages should be cut in smaller pieces, that each fit on a postcard.

From an organizational viewpoint, it is very important to understand that the two protocols are independent of each other: the standard defines precisely the way they communicate between each other, but not the way in which each one of them is implemented. This layering of standards on top of each other is typical of the organization of the Internet, and determines its organization.

We can see the importance of this layering of standards, by considering the function of an alternative to TCP, the User Data Protocol (UDP). UDP does basically the same job that TCP, except for the fact that it is less careful to make sure that every packet travels safely between sender and recipient: whereas TCP slows down the rate at which it sends postcards if it understands that there is congestion in the network, the UDP will keep out pumping them out. This makes it an appropriate standard for applications such as video and audio where it is not crucial that every piece of information arrives (speech is still understandable is some sounds are omitted), but where it is important that the information arrives at a regular pace. We see here one of the advantages of the layering of standards: two different applications can use the same protocol for some functions and

different ones for others. The system does not have to be redesigned in its entirety for each different use.

There are a large number of other standards, used to manage bits and pieces, some very large of the Internet. Most of them are managed by the IETF, a volunteer organization with no enforcement power.

The most spectacular and one of the most important of the applications, along with E-mail, file transfers and instant messaging, of the Internet is the World Wide Web. It was developed by Tim Berners-Lee, a physicist employed at CERN, to enable users of computers connected to different networks to easily share information (note here an other example of the impact of public policy on the Internet: the web was invented in a public institution). Three interrelated innovations were required:

- The URL, that is the address of the form www.keynes.edu/economics.great, that identifies the file economics.great on the computer keynes.edu;

- The http protocol, which enables a browser to ask the server for a file, and to explain the types of file it could accept (this is why you type http before the Internet address);

- A new file format, "html", which has three important features: it allows for a very simple description of a simple page, it enables the inclusion of other files, and in particular graphics within the document; most importantly, it provides for the possibility of links to other documents.

The standards that define the World Wide Web are managed by the World Wide Web Consortium (W3C), a consortium of interested parties, firms, governmental agencies and non profit organizations.

I would like to point out two aspects of the Internet that are specially relevant for public policy. First, although its local use is affected by public policy, at the global level it is a unregulated network. Its functioning is determined by the (self interested) actions of a large number of economic agents. An individual country, and especially a small or medium size country, has no direct influence on its organization, and there exists no channel by which groups of countries can influence it. Second, the fact that the Internet is simply a layering of different standards provide for a large amount of flexibility in the way in which it is used. A poor connection will still allow for comfortable use of e-mails, whereas very good connections and sophisticated users are required for the use of video conferences.

Is the Internet dead?

Reading the press and listening to the radio would make us believe that the Internet is dying, as the demises of Internet companies – they die at the rate of two per day[1] (although there are still lots of

[1] See "Dot.com shutdowns wane", CNNfn.com, August 30, 2001.

them) – are reported. On the other hand, Internet traffic keeps on increasing rapidly and in some sectors (for instance parts of the academic world) electronic communications have nearly totally replaced paper communications.

Further evidence that the Internet is still alive can be found in the fact that even in markets which one would believe close to saturation, the number of individuals which are connected is increasing. A June 2001 survey by Gartner Dataquest shows that 65 million US households (that is 61% of them) actively use the Internet on a regular basis, an increase of 8.4 million since November 2000. Furthermore, Dataquest estimates that close to 25% of the American homes that are connected are connected via a broadband connection, with DSL and cable modems being the two leading technologies. Furthermore, 20% of dial-up customers expect to upgrade to a broadband connection by mid-2002. Because broadband supports much more intense traffic and more sophisticated services, this will translate in added Internet traffic and use.[2]

If we understand that the Internet is fundamentally only a set of standards for transmitting information and that these standards allow for unprecendented flexibility in the use of information technology, it is clear that we should expect its importance to keep on increasing. Put in other terms: the Internet is the form that the convergence of the different forms of communications is taking, this convergence is irreversible, and so is the Internet's growth. The difficulties of the dotcom sector are important and noteworthy, but they probably simply show that the Internet will not change the structure of industry as fast as some people though two years ago, and that it will develop through its increasing use by established firms. We should also point out that its potential for government and educational services has hardly been tapped.

It would be very unwise to base public policy on the assumption that the Internet was yesterday's fashion.

Old economics and the Internet

In order to understand the consequences of the Internet for public policy, it is convenient to separate the analysis in two parts. We will first look at these changes in the way in which an economist trained in the 1950s would have analyzed them. Later, we will look at what more modern economics has to tell us about these changes.

The development of the Internet, and as a matter of fact the decrease in the cost of all forms of telecommunications, lowers the barriers to trade between countries. Because distance matters less, a French firm that used to find it cheaper to buy some inputs from a French supplier might well decide to turn to a South African supplier. The fact that the Internet can open new markets for national firms is often quoted as a benefit of the Internet in public policy documents. It is also sometimes forgotten that a natural consequence of this analysis is that markets can be taken away from these firms. In economic terms, these phenomena can be analyzed in the same way that

[2] Corey Grice, "People still signing up for broadband", CNET News.com, read at http://news.cnet.com/news/0-1004-202-7003895.html on 4 September 2001.

international trade economists have for a long time analyzed the consequences of a decrease in the cost of transportation.

If we use this analogy of a decrease in the cost of transportation, we immediately see that the firms and the industries that will gain are those whose comparative advantage lie either in greater quality or in a lower cost of production. Those industries that were protected by the high cost that outsiders were facing in serving their national markets could be put at risk. To take an extreme example, a seller of imported specialized books whose main contribution was to help with billing and ordering will find its business endangered.

On the other hand, it is quite difficult to predict the way in which the Internet will change the production technology: we know that the “production functions” of firms will change, but it is hard to guess which inputs are going to become less important and which ones are going to become more important. For instance, it seems to be a common sense idea that electronic communications will reduce the need to travel, but reality is more complex. First, there could be an increase in international travel induced by an increase in international trade. Second, for a given quantity of international trade, there are some indications that the Internet makes travelling easier, as managing communications with a home office becomes less difficult. As a consequence some business people actually end up travelling more. Because it is so difficult to predict the consequences of the changes in technology, public policy must be flexible and provide a framework for its development, rather than trying to predict its consequences and control them beforehand.

New economics and the Internet

It has been quite remarkable that economists have developed in the last twenty years tools that have turned out to be very well adapted for the study of the Internet, and the induced decrease in the cost of communications. An article in the Boston Globe went so far as to say "Economists now understand the new electronic network industries relatively well. The analytic toolbox that government economists bring to their tasks as architects of competition remains way ahead of business executives intuitions - in even the highest-tech marketplace." This is very well explained in "Information rules", the book by Professors Carl Shapiro and Hal Varian from the University of California at Berkeley, and I will just point out a few points that are relevant for public policy.

The most important development in microeconomic theory over the last twenty years has been the fundamental progress in the economics of information. Economists were therefore very well prepared to study the consequences of decreases in the cost of transmission of information. It may be worthwhile pointing out that even though the decrease in the cost of transmitting information has been important, contrary to what is sometimes written, this cost is still far from negligible. Indeed, even if all telecommunications became free tomorrow, there would still be an important cost of preparing the information so that it is understood by the intended recipient.

Compared to engineers, economists may understand better that some types of information will not be transmitted in larger quantity, even with a large decrease in the cost of transmission: the transmission of information is impeded not only by physical costs, but also by the incentives of the economic agents to transmit this information, and economic agents who have information may not want to release it. Furthermore, information is not a good like others. A buyer can contract with a

seller to provide some good, and the contract is well defined and enforceable, but it is in practice impossible for the recipient to know whether or not the information that he or she has received is the true information that was promised (how do I know that you provided me with all the market data that you have?)

This has important consequences for the analysis of the consequences of new technologies. For instance, it has sometimes been argued that XML, a new standard that is often presented as the successor to html, will make it very easy for buyers to compare the qualities and prices of different good, because sellers will adhere to a common standard for displaying this information. This reasoning forgets that at least some sellers have incentives to trick any such system. There is anecdotal evidence for this: think about the e-seller which added an inventory charge (destined to compensate it for the cost of carrying its inventory!) to its price, in order to defeat the search engines that search for the lower price. There is also more formal evidence. Sarah Fisher and Glenn Ellison have studied an Internet exchange, and shown that sellers of electronic equipment offer very low prices, below cost, on the comparison screens, and then try to veer the buyers towards more expensive and more profitable items once they have connected to their sites. Furthermore, easier access to information can also facilitate collusion (as, for instance, firms can more easily check whether other firms cheat on an explicit or implicit price agreement). As a consequence, it is not clear to which degree the Internet will lead to more competitive markets.

Another important recent development in economics has been the systematic analysis of what has become called "network externalities". There are network externalities when economic agents derive benefits not only from their own consumption of a good, but also from the fact that many other agents consume the same good, or rather belong to the same network. For instance, an individual derives no benefit from the fact that he owns a telephone, if he is the only person to own one. The greater the population of people who own a phone, the greater his utility, as he has more potential interlocutors. Technologies for which network effects exist can exhibit "snowballing" phenomena, where increases in the number of users lead to further increases in that same number, as access to the network becomes more and more valuable. For instance, a senior analyst at Gartner Dataquest, commenting on the study we discussed above explains the increasing number of Americans connected to the Internet as follows: "As more and more of the world get on (the Internet), you want to be on it too. As it gets more accepted, the others come along."

Internet standards provide an important example of network externalities. Indeed, there is no point adhering to a standard if nobody else does, and once one adheres to a standard one derives benefits from the fact that others also adhere to this standard, as the number of people with whom one can communicate increases.

The reverse side of this coin is, of course, that once a standard becomes dominant it is important to be able to use it. I will explain below why I think this has potentially important consequences for public policy.

The Internet and the productivity of firms

The development of communications technology enables fascinating forms of organization. Consider for instance, Topsy Tail which manufactured plastic implement that made it easier to

create fancy pony tails. It reported sales of up to $100 million while employing only three people. The company outsourced all the functions of the firm, including the manufacture, marketing, sales and distribution functions. Some authors have therefore argued that "virtual firms", composed of teams that are physically disjoint, and always reorganizing themselves as new projects appear are the wave of the future.

Why do they believe that this is the case? Sharing information becomes less costly and therefore decentralized decision making becomes more efficient, as individual can coordinate their activities without the help of a hierarchy. In some sense, the new telecommunications technologies would enable us to return to the pre industrial model, with small autonomous firms transacting through markets, and indeed some industries seem to behave in this way. One can think for instance of the movie industry where different teams are always reformed for different movies.

A study by Richard Benson-Armer and Tsun-Yan Hsieh, in the The McKinsey Quarterly of 1997, conclude that this vision is utopian. They come to the conclusion that teams which have not have the opportunity to develop close working relationships will not be as efficient as teams who have had this opportunity. An indeed, it seems that some firms use the Internet to become more centralized. This is specially true of firms that were managed as very loose conglomerates, because they had not put in place, for one reason or the other, the technology that would enable them to coordinate their different activities.

Does that imply that the new technologies of information and the Internet have no positive impact? Not at all: the authors go on to say "But we can also take heart from the fact that teams that couple the use of technology with the discipline needed to build common beliefs, trust, and a shared space in which to work can come a very close second."

Indeed, there is quite a bit of formal statistical evidence that investment in information technology leads to increase in productivity. This is not the place to go into a survey of this literature, but it may be worthwhile pointing out that the evidence suggests that the physical investment in hardware and software is only a small proportion of the total cost of implementation of these technologies. The costs of retraining the labor force and reorganizing the work flows are very large. There is also formal evidence that firms with more collaborative work methods are better able to take advantage of new technologies of information.

Internet and communications between firms

Even if it is not leading to the disappearance of firms as we know them, and even if its consequences are not as radical as the most extreme predictions, it is nonetheless true that the Internet is changing the management of firms. Among other things, it is changing is the relationships between firms, and there is substantial evidence that this will have profound implications. These implications will be an indirect consequence of the cost of transmitting information that is important, through the implied changes in the organization of production.

At a fundamental level, these changes stem from the fact that it is possible to communicate much richer information much faster. Therefore, firms can develop much richer collaboration with their partners. At least with the cost of labor in the developed world, the passage to electronic exchange

as opposed to physical transactions can cut transaction costs, specially those of repetitive purchases, considerably.

In order to take advantage of the possibility of richer communications, firms often reduce the number of their suppliers, concentrating their purchases among a select group of preferred suppliers. For instance, Valeo, a French manufacturer of automobile components, was planning to decrease the number of its suppliers by half in the first year of implementation of its e-commerce strategy. For rather standard materials, they will ask for quotations from a number of them. The benefit of the Internet is in this case to lower the cost and specially to increase the speed of the process. For more sophisticated materials, the Internet allows rich and continuous exchanges between the firms. It allows a better integration of the production processes. For instance, a manufacturer that produces to order can much more easily ask its suppliers to produce components that are individualized to the specific orders.

Some of the benefits from these improved communications could be obtained through proprietary data exchanges, known under the term EDIs, which became fashionable in the 1980s and are widely used. However, firms are more and more turning towards the more open standards of the Internet, which are cheaper to install, easier to modify and especially makes it much easier to offer extended capacities and to link the information flow coming from the outside with the firms' internal management processes. For instance, GE, considered by many as the model of management, is moving many of its management processes away from its very sophisticated and massive EDI to Internet based systems.

Internet and developing economies

My aim in this section is to use the very schematic description of some of the changes induced by the Internet that I presented in the previous pages in order to provide some thoughts on the challenges that developing countries face when they are trying to embrace the Internet and use them for the world's most important challenge of the XXIst century: ending poverty.

E-government

In many ways governments are just like firms. They produce goods and services (services more than goods), and they must ensure that these services are provided efficiently. In that respect, they must think like firms, and make the appropriate cost-benefit analysis when choosing whether to embrace new technology.

Of course, there are some differences between governments and firms, that affect the way in which this cost-benefit analysis is conducted. First, and this is not specific to the use of the Internet, the measure of the performance of government is more difficult than the performance of private firms. For instance, if a firm uses the Internet to deliver a good in a way that is more convenient for its customers, it will be able to raise its price, and the resulting increase in profits measures the contribution of the new technology to its mission. This is not the case for governments, who provide many services without charge, and must take into account not only the decrease in their costs of doing business, but also the increased convenience of the citizens.

A more fundamental difference is the fact that governments are very large and are monopoly providers of a number of services. As a consequence, they can potentially influence the rate of connection to the Internet. One could imagine under certain circumstances that a government could decide a large Internet initiative, where it would provide many services through the Internet, in order to encourage widespread connection. I doubt that such a strategy would be useful in a developing country, except maybe for encouraging connection of a subset of potential users (schools, firms).

Many commentators have shown great enthusiasm for the role that Internet can play in education. Indeed, it may be important to teach students about the Internet, and it may also be useful to use the Internet to teach traditional subjects. However, the discussion on this subject is often mingled. First, the issue of the role of Internet in education is often presented as part of the debate on universal access. Universal access is described as a non-negotiable issue, and telecommunications firm are made to subsidize school access to the Internet. This is not a good way to think about the issue. Whether or not Internet access is paid by an implicit tax on telecommunications access, it consumes resources. The first policy question one should ask is, given the resources that society is ready to put in education, what should be the role of the Internet? Is it really more important to spend these resources on connection than on more teachers, or better books, or a daily glass of milk in poor areas?

Universal access

Universal access is one of the most used terms in telecommunications, and in the delivery of public services. It is usually defined as the provision of a service at "affordable" prices to all citizens, sometimes with the added requirement that the price be the same for everyone. In the case of the Internet, the call for universal service is often justified by the existence of a "digital divide", which separates the poor from the benefits of the digital revolution.

There are two possible justifications for universal access. One justification, the most often used in the political arena, is in terms of income distribution: “it is not fair that some people do not have access to the benefits of cheap information”. Although this argument is popular, it is, to my mind, a poor argument. Indeed, by definition, poor people do not have access to many goods to which rich people have access, and it is an important, if not the most important, component of public policy to ensure that they have access to more goods. However, justifying a policy of universal access on these grounds require more analysis: one must show that the inequality in the distribution of that good has special status and furthermore that there is some type of "market failure" which implies that it is better to provide the good in question rather than more income to poor people. I do not think that the Internet meets this criterion.

The second possible justification for a policy of universal access relies on the presence of the network externalities. Because economic agents only want to connect to a network if others have also connected, there can be coordination on a bad equilibrium in which no one connects. Implementing a policy of universal access can be a way of kicking the economy out of this bad

equilibrium. This justification is reinforced by the fact that there are some types of communications for which the ability to reach all, or nearly all, the population is crucial.[3]

The presence of network externalities might be a justification for a policy of universal access to the Internet in the United States (although I am not convinced that this is the case), I very much doubt that a full analysis would find that it is the case in a country such as South Africa, where the access to the telephone network (in any case, a necessary preliminary for the Internet) seems to be much more urgent.

This should not be taken to mean that the government has no role to play in the diffusion of the Internet. There are probably some market failures that can be corrected. For instance, some of these market failures could be lack of information about the benefits of installing Internet connectivity for some applications. In this case, the government can either help by diffusing information or by subsidizing demonstration project. It should also support experiments, after the appropriate cost-benefit analysis, that could show new uses for new technologies.

The importance of a modern Internet infrastructure

Traditional economic theory bases its recommendations on well-tested and important insights. A developing countries has at its disposition some resources that are more abundant and cheaper than in developed countries, and it should use this comparative advantage. For most developing country, the most abundant resource is unskilled labor. South Africa is lucky to have some very skilled labor, as well as worthwhile natural resources. The role of economic policy is to identify market failures that prevent entrepreneurs from exploiting this comparative advantage, and to remedy them, as well as to use some of the wealth thus created in order to alleviate poverty. In last year's keynote address at the TIPS forum, Professor Gary Fields used this insight to argue that the best way for a country such as South Africa to solve its unemployment policy was to use an export-led strategy towards economic development, similar to the strategy that was used by the "Asian tigers" in the 1960s, 70s and 80s.

These traditional theories of economics typically use analysis "at the margin". Prices reflect the marginal productivity of factors of production, i.e. the increased production that would come from using one more unit of this factor. Policy makers compare the costs and benefits of transferring one of these units from one use to the other. This implies in particular that the production technologies that are appropriate for a developing country are not the same that are appropriate for a developed country, where the ratio of the price of capital to the price of labor is much lower. Developing countries should use more labor intensive technologies, and specially more technologies that are more unskilled labor intensive.

This theory is the proper guide for economic policy in general. However, it should not be used when discussing standards or more generally sectors of the economy where network externalities are important, and, unless one is very careful, it could provide the wrong type of guidance for an

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[3] See Jacques Crémer, "Network externalities and Universal Service Obligation in the Internet", *European Economic Review*, 2000, vol. 44, 1021-1031.

Internet policy. The fundamental reason for this is that there are much fewer trade-offs with standards than with normal economic resources. A firm can use less capital and more labor and produce the same output. There is no possible substitution for the use of the same standards of communications as its potential clients and suppliers.

A trivial example of this last statement would be a language. If two economic agents do not speak the same language, and have no translator, they cannot trade whatever the surplus that could be generated by an exchange. Now, it seems that the set of standards that constitute the Internet are becoming an indispensable communications standard in industry (my statement is very careful, as I know of no formal evidence of this fact, but I do believe that this is indeed the case). Firms use these standards in order to communicate, and, as shown above, in order to change their methods of production. In particular, the cycles of development of new products is being shortened. This evolution is driven by very solid economic reasons: by shortening the time to market firms know the demand better and reduce their investment costs.

If a firm decides three months before putting it on the market the characteristics of a new product, it will need *all* its suppliers to have the information infrastructure that enables them to support this production strategy. If it has installed a system for very intensive communications with its suppliers, *all* of them must be able to communicate in the same way. As a consequence, without access to a modern Internet infrastructure, South African firms will be excluded from a large number of markets.

I therefore believe that a country with any type of export ambitions must ensure that its firms have access to a sufficient Internet, and more generally telecommunications, infrastructure. I realize that, in some sense, I am arguing for universal access for the production sector when I just argued against a universal access policy for households, but this seems to me to be the wise choice, and in the long run the choice that is the most likely to draw more people faster out of poverty.

It should be stressed that electronic transactions also require some important adaptations to the institutional environment: enforcement of electronic signatures, security of payments over the Internet, respect for privacy, etc. The Green paper rightly stresses these aspects, which I will not discuss in detail here.

A short story to end that part of our discussion. Last summer, I discussed with a young Indian entrepreneur, based in Chicago, who was a co-owner of a factory in India, and was in charge of importing (to the US) fantasy jewelry for sale in department stores. In this business, it is very important to follow fashion as rapidly as possible. In order to conduct this business, he had therefore installed a sophisticated telecommunications infrastructure, with in particular, a live two way video connection, linked to sophisticated portable cameras so that, among other things, the discussion of new designs could proceed in real time. The striking aspect which I want to stress, and which illuminates the more theoretical development that precedes, is the fact that in order to manage a firm where workers are paid $1 for long days, the most modern telecommunications equipment is needed.

Links to telecommunications policy

If the thesis that the possibility to connect to a modern Internet infrastructure is accepted, one is left with the problem of choosing the proper policy instruments. There are two components to the use of the Internet: one is the access to software and hardware for firms and individuals; the second is good quality connection. Access to software and hardware is best left to the market, although governmental policy towards education can play an important role.

On the other hand, in all countries in the world, telecommunications is decisively influenced by governmental policy. There is at this point a close to general consensus among the economists who have studied the recent evolution of the markets that the best strategy for achieving a first rate telecommunications infrastructure is to privatize and to introduce or increase competition. For instance, Professor Noll of Stanford University has recently reviewed the experience of a very large sample of developing countries. He finds that "the performance of telecommunications has improved almost everywhere, regardless of whether reforms were undertaken". On the other hand: "Quite a bit of research has focused on the average effects of reform on performance, and has found that improvements have been greater for reformed companies. The case studies reveal that after reform, the investment rates of telephone utilities increase by fifty percent or more, and labor productivity, measured as main lines per employee, typically increases by 25 to fifty percent, and sometimes more." (In this context, reform refers both to the privatization of the previous monopoly, and the introduction of competition.)

In particular, ensuring that the part of the economy that requires good connection to the Internet is indeed given this connection probably requires strong competition, allowing competitors to the large telecommunications firm both to lay fiber where needed, and giving them access to unbundled components of the telecommunications system.

On the other hand, there are some projects that the private sector is probably not equipped to handle. For instance, I would guess that there may be a role for the government in ensuring the connection of South Africa to the overall Internet through sufficient fiber. Furthermore, as discussed above in the discussion of universal service, the government certainly has a role in improving the circulation of information about uses, in subsidizing demonstration projects or research and development, or in ensuring that a properly trained labor force is available.

Conclusion

The development of the Internet provides many opportunities for developing countries that are able to grab the opportunities that it promises. It will enable them to compete internationally in new markets, as well as to provide their citizens with new services. Government policy should carefully choose its targets to ensure that economic agents have the proper information about the cost and benefits of the use of the Internet, and that the telecommunications infrastructure is of sufficient quality.