Quantitative Evidence for the Digital Divide

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The unequal access to and utilization of Information and Communications Technologies (ICTs) has emerged as one of the predominant issues of our times. It assumed additional importance when the link between ICTs and development started to be made. There is a widely held belief, and increasingly evidence, that the diffusion and appropriate utilization of ICTs not only present enormous opportunities for economic and social development, but that their absence seriously threatens to accentuate already existing and sizeable gaps between haves and have-nots. Thus, the *Digital Divide* represents the newest addition to the enormous chasms in the stage of development and the standard of living among people in different countries around the world.

Moreover, the issue of the Digital Divide occupies the area of overlap between economic, social and cultural matters, and is rooted in the heart of the Information Society. Unquestionably, it was the principal driving force behind the twin World Summits on the Information Society (WSIS, Geneva 2003 and Tunis 2005). From early on it became evident that our understanding of what it involves and how to react to it from a policy perspective was in dire need of quantification. Many voices were raised and pleas were heard for the reliable measurement and analysis of the Digital Divide.

Clearly, the issue is applicable wherever masses of people live. It attracted early attention in connection with internal country divides, where research in the U.S.A. (Falling Through the Net series 1995, 1998, 1999, 2000), Canada (Dickinson and Sciadas 1996, 1997, 1999, Sciadas 2000, 2002) and elsewhere addressed its key dimensions, provided measurements and contributed to our understanding of the problem. Given the nature of ICTs and the transformations they induce everywhere, across all walks of life, the interest soon encompassed the international dimension of the divide, involving comparisons across countries. More than ever, it became evident that the international community needs a tool that will help assess the *magnitude* of the Digital Divide, as well as monitor its *evolution*, something indispensable in guiding informed decision making.

Such efforts have been challenged by the dearth of sufficient statistical information on the diffusion and use of ICTs, comparable across a large number of countries and at the desired level of detail. They have also been hindered by the lack of a quality instrument capable of systematically quantifying the Digital Divide over a large number of countries, as well as monitoring its evolution over time.

With respect to the data gaps, several efforts have been undertaken in recent years to make the case for the need, particularly among developing nations, as well as to demonstrate the linkages between ICTs and MDGs (UN 2003). Many of these efforts have now culminated in a promising international partnership underway, involving most UN bodies, as well as other international, regional and national organizations (UNCTAD 2004). The list of expected outputs includes an agreement on a set of core indicators, subject-matter training, and the eventual creation of an international database. Clearly, this represents a forward-looking exercise. To the extent that it will be supported widely and succeed, it will go a long way towards providing valuable information in the longer term that will greatly facilitate the required coverage of the measurements and enhance their international comparability.

With regards to an instrument, significant progress has also been made through a number of approaches that have been advanced to quantify aspects of the Information Society (for a review see Sciadas 2004). Specific to the Digital Divide, a well-known initiative is the Monitoring the Digital Divide project, which is being led by Orbicom in collaboration with development agencies and a growing number of international organizations. Based on the development of a conceptual framework and an operational model conducive to empirical application, it makes maximum sense out of existing data sources to illuminate the issue at hand. A synopsis of the project is provided below.

Orbicom's Infostate Project

The overall objective of the project has been to quantify the Digital Divide and monitor its evolution both:

- across countries at a given point in time, and;
- within countries over time.

Its design was guided by the following terms of reference:

- place emphasis on developing countries;
- rely on a modeling approach that yields policy-relevant results;
- focus on ICTs, but be broader in scope than pure connectivity measures.

The conceptual framework

The nature of ICTs is dual; they are both productive assets, as well as consumables. In that setting, the framework developed the notions of a country's *Infodensity* and *Info-use.* Infodensity refers to the slice of a country's overall capital and labour stocks, that is, ICT capital and ICT labour stocks and indicative of productive capacity. Info-use refers to the consumption flows of ICTs. The aggregation of the two results in a country's degree of 'ICT-ization', or *Infostate.* The Digital Divide is then defined as the relative difference in Infostates among countries.

Infodensity

The productive capacity of a country is determined by the quantity and quality of its factors of production. At any given point in time, the productive capacity is fixed because the factor stocks and the technology with which they are combined in production are fixed, but over time they are all expandable. Factor growth, technological improvements and productivity gains are instrumental and ICTs affect them all. ICT and non-ICT factor inputs are combined to produce ICT and non-ICT goods and services, without a one-to-one correspondence. The same holds true for labour skills, produced and consumed. Attrition, obsolescence, training, movements in and out of the labour force, brain drain, all affect the skills stock. All these are measurable.

ICT capital comprises all kinds of material goods, from wires and cables, to keyboards, printers, sophisticated routers and switches. They combine to form machinery, equipment and *networks*. ICT labour is perceived not so much as a collection of individuals, but as the set of ICT *skills* of those in the labour force. In this formulation, produced output will be an increasing function of these ICT stocks, as it is for all other forms of capital and labour.

Info-use

Clearly, uptake of ICT goods is indispensable for the consumption of ICT services that would satisfy ultimate needs. In fact, ICT consumption involves the use of both ICT capital and skills, both of which are becoming increasingly complex as consumption expands from staples to complex technological goods and services. Thus, building 'consumptive capacity' is a prerequisite to generating consumption flows. In that vein, a distinction is made between ICT *uptake* and ICT *intensity of use***.** The figure below provides a schematic of the conceptual framework.

What really matters for economic development is the utilization of the productive stocks rather than their availability. Having underutilized roads, abandoned factories and rusted telecommunications networks does not increase productive capacity. The same holds true for unemployed or underutilized labour and its skills. The supply-side refers clearly to the productive capacity of the country, but it is differentiated from actual production both because of capacity underutilization and trade.

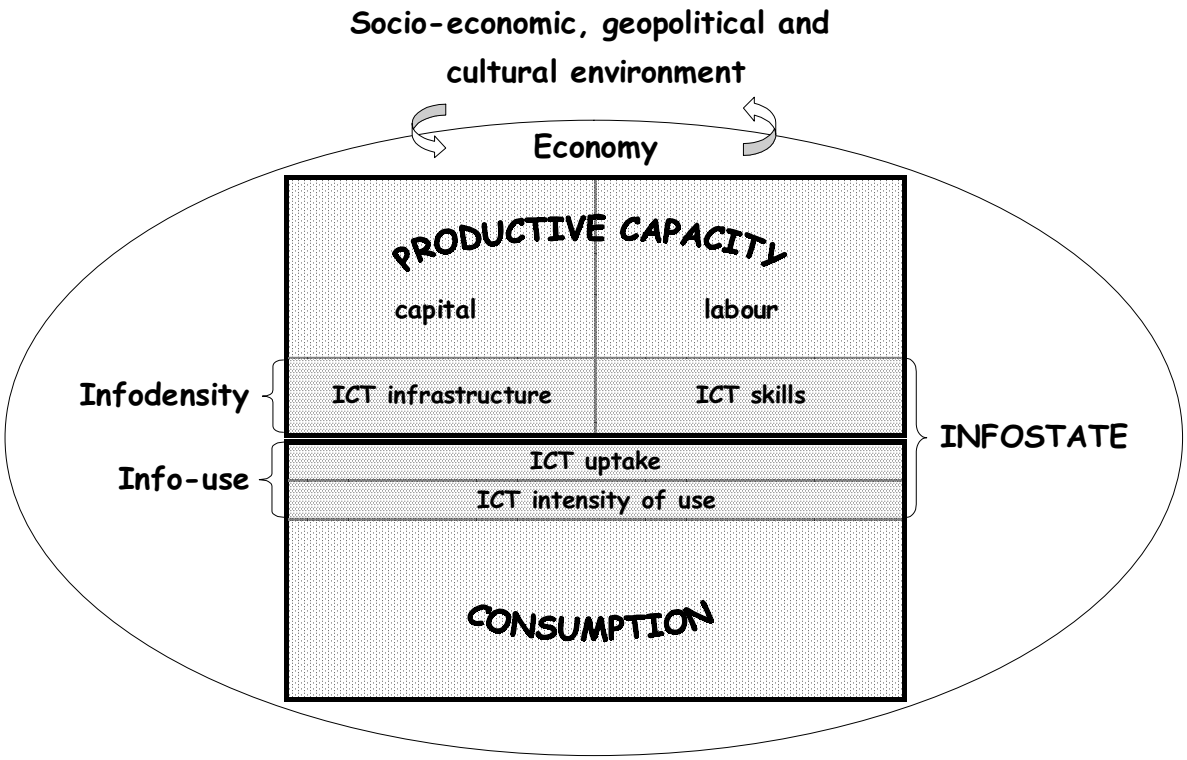
Considering the intuitive and inextricable link of ICTs with the overall factor stocks and the continuous introduction of new ICTs in consumption, ICTs are clearly not bounded upwards but instead are expandable over time. Even as consumables, achieving complete uptake today means nothing for tomorrow. For instance, if every available ICT had achieved 100% penetration and use rates prior to the arrival of the Internet, the ceiling would have moved upwards immediately after. The same holds true for skills, with obvious implications for productivity. Consequently, there is no pre-set, absolute upper limit for Infostates that can be achieved over time.

The empirical model

For measurement purposes the framework serves as a guide for an operational model which approximates pragmatically the purity of the concepts. Such an exercise involves several nuances, including the constraints of existing indicators and their lopsided availability among countries. Statistical manipulation must be combined with, and guided by, subject matter considerations and the project's terms of reference.

While alternative empirical applications are admissible under the framework, the modeling approach relies on *indicators*. Practically, each component of the model is populated by suitable indicators. In total 21 indicators are used; these are converted to indices, a method that makes possible their aggregation across different units of measurement. The exercise is carried out from the bottom up, in order to be able to trace analytically the explanations of the findings back to their origin.

Consistent with the need for policy relevance of the model, as opposed to its business usefulness, Infostates are expressed in *relative terms*. Thus, a small country like



Luxembourg can have a higher Infostate than a much larger one, say, India. In absolute terms something like that is unlikely to happen and this matters for businesses with an eye on market size.

Considering the relative nature of the Digital Divide, due to the continuous evolution of Infostates everywhere, the model calls for a *reference country* and a *reference year*. The reference country facilitates benchmarking, while the reference year makes possible the monitoring of the evolution of each country's Infostate components over time. 2001 was chosen as the reference (base) year due to the availability of additional indicators. Rather than use a real country as a reference, Hypothetica was created, a country that represents the average values of all countries examined. This offers immediate and intuitive initial benchmarking. As an alternative benchmark, Planetia was also created and included in the calculations. In this case, the values are those of the planet as a whole, if viewed as one country. (In this setting, each country could be seen as a region of the planet).

While adhering to the use of existing data from credible sources, a total of 192 countries are included in measurements of *networks*, covering 99% of the population of the planet, 153 countries in *skills* and therefore *Infodensity*, covering 98% of the population, 143 countries in *Info-use* and 139 in overall *Infostate*, covering more than 95% of the global population.

Distinguishing features

While work in this area is full of challenges, this approach contributes to the overall research agenda and offers the following:

- A cohesive framework which provides a perspective, as well as makes possible analytical linkages, economic or otherwise.
- A realistic depiction of the Digital Divide and its decomposition to constituent parts, all of which are unbounded upwards, both in the context of developed and developing countries.
- Time-series data that make possible the monitoring of evolution, not only levels. Therefore, benchmarking and analyses of evolutions are no longer constrained to comparing changed rankings from one period to the next.
- The best existing data available, reliable and available to all, combined with a reproducible, transparent and defensible methodology.

The way forward

The first phase of the project developed the conceptual framework and presented a pilot application (Orbicom 2002). The second phase for Geneva included a full-scale empirical application covering up to 192 countries over a 6-year period, 1996-2001 (Orbicom 2003). The unique features of the approach, such as the logical incorporation of skills, the intuitive micro-macro analytical linkages, the synthesis of the best data available, and its by-design ability to trace each

country's Infostate year-after-year set a higher standard in international benchmarking. The new approach is being received well by the international community, with rave reviews for its vigour and contribution, and is already having a noticeable impact. Today people talk of Infostates as a matter-of-fact and use the new instrument to add value to their own work. This has led to widespread interest to continue and expand this project.

Therefore, considering the speed of developments, the empirical application and the ensuing basic analysis will be extended to the latest year for which new data become available (2003) to gauge relative progress for Tunis and beyond, in keeping in line with the Action Plan of WSIS. This will be the cornerstone of the new phase and will provide a valuable contribution to the discussions.

With results from the core empirical application consolidated, the analytical potential afforded by the model will be exploited more fully. Detailed policy work will take place at a detailed country level in Latin America, Africa and Asia to investigate the different movements involved. There are reasons behind the movement of the numbers and it will be instructive to dig further into the 'whys'. Many valuable lessons wait to be learned from such detailed analyses that will link the quantitative findings with policies at the country and regional levels. Moreover, quantitative and qualitative work on issues concerning ICTs and gender will be incorporated into the project.

How to read the diagrams and statistical tables

Based on data from the ITU and other sources, a database is constructed for the empirical application of the Infostate model. Data from there are used for the construction of the diagrams and tables that appear in this publication. As explained above, since the Digital Divide is a relative concept, the model calls for a reference country and a reference year. The global average of all countries and 2001 were chosen as the reference country and year, respectively.

The data in the diagrams are expressed in index form in order to make possible visual comparisons across variables with different scales. All indices are based on the global average having values equal to 100 in 2001. Each diagram conveys the following information: the thick line refers to the country's index values in 2003, to show the latest available state; the thin line refers to the country's situation in 1995 and can be compared with the 2003 line to demonstrate the progress made; information is visually maximized with the inclusion of the global average for 2003 in the dotted line, which allows comparisons between the country and the global average. When actual indicators rather than indices are included, this is clearly explained – as is the case in the tables for Afghanistan and Bhutan, as well as the table in the chapter devoted to the island nations.

Indicators are expressed in appropriate units, whether by population or households. Some indicators used in the Infostate model are simple, others are composite. Among those shown in the diagrams, simple indicators are: mobile phone subscribers, literacy, TV-equipped households, residential phone lines, PCs and Internet users. The indicator for fixed telephone lines includes adjustments for waiting lines and digitization of the network; for Internet hosts includes secure servers; enrolment is calculated as a weighted average of gross enrolment in primary, secondary and tertiary education, and; international telephone traffic reflects the average minutes of both outgoing and incoming international calls.

References

Dickinson Paul and Sciadas George (1996) "Access to the Information Highway", Canadian Economic Observer, Cat. No. 11-010, December.

Dickinson Paul and Sciadas George (1999) "Canadians Connected", Canadian Economic Observer, Cat. No. 11-010, February.

Orbicom (2002) "Monitoring the Digital Divide", National Research Council of Canada, www.orbicom.uqam.ca.

Orbicom (2003) "Monitoring the Digital Divide…and Beyond", National Research Council of Canada, www.orbicom.uqam.ca.

Sciadas G. (2000) "Digital Households in Canada" in Information, Innovation and Impacts, eds. John de la Moth and Gilles Paquet, Economics of Science, Technology and Innovation, Kluwer Academic Publishers.

Sciadas George (2002) "Unveiling the Digital Divide", Connectedness Series, No. 7, Statistics Canada, Cat. No. 56F0004MPE, October, *http://www.statcan.ca.*

Sciadas George (2004) "International Benchmarking for the Information Society", presented at the ITU-KADO Digital Bridges Symposium, Busan, S. Korea, September, www.itu.int.

UNCTAD (2004) "Partnership on Measuring ICT for Development", project document.

UN ICT Task Force (2003) "Tools for Development: Using ICT to Achieve the Millennium Development Goals"

U.S. (1995) "Falling through the Net: A Survey of the 'Have-Nots' in Urban and Rural America", Department of Commerce, July.

U.S. (1998) "Falling through the Net II: New Data on the Digital Divide", Department of Commerce, July.

U.S. (1999) Falling through the Net III: Defining the Digital Divide", Department of Commerce, July.

U.S. (2000) "Falling through the Net IV: Toward Digital Inclusion", Department of Commerce, October.

Note

1 This article draws heavily from *Monitoring the Digital Divide…and Beyond* (Orbicom 2003).