COMMENTARY

Measuring the global digital divide at the level of individuals

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According to the conventional measure, the digital divide assigns the same weight to each country regardless of its population size. In this note, by contrast, the divide is conceptualized at the level of individuals as the absolute number of internet users and mobile phone subscribers in developed as against developing countries. On this basis I find that the conventional gap in information technology (IT) use between these countries either shrinks dramatically or is actually reversed. The role of China in these new results is heavily emphasized. The goal of policy should be to provide access to the vast number of individuals who still have no access to IT, even when the digital divide is closed.

Few concepts in recent years have attracted as much attention as the global digital divide (defined broadly as the differential extent to which rich and poor countries benefit from various forms of information technology (IT)). According to the conventional measure, the divide is narrowing though it still remains rather formidable. This measure however is based on unweighted averages of IT adoption and is conducted at the level of countries rather than individuals. Yet, in welfare terms it is often preferable to use individuals as the unit of observation rather than, or, in addition to the countries to which they belong. Much of the policy, for example, is directed at individuals rather than countries and the bulk of welfare economics takes the individual producer or consumer as the unit of analysis. In this note, therefore, the digital divide is conceptualized as the absolute number of IT users in developed as against developing countries (the result of weighting each country by its population size)[1]. On this basis I find that the divide almost disappears in the case of the internet and is actually reversed in the case of mobile phones. This new finding has much to do with the role played by China. First, however, let me describe the conventional measurement of this phenomenon.

Conventional vs weighted measures of the digital divide

Conventional measures of the digital divide are shown in Tables 1 and 2 for the internet and mobile phones respectively.

In both cases the divide between rich and poor countries has been falling[2] over the period between 1998 and 2004. For the internet the decline has been from 28.3 to 8, whereas for mobile phones the comparable figures are 12.9 and 4.1 (the difference between these new technologies is due largely to the greater leapfrogging opportunities presented by the latter). A weakness of these estimates however is that they are based on comparisons between countries rather than individuals, whereas in welfare terms, it is the latter in whom our interest often resides. In particular, we need to know how many individuals in developed and developing countries actually have access to the internet and mobile phones. (It would be even better if the characteristics of these individuals, such as income were known, but in developing countries this information is unavailable and in any case takes us beyond the scope of the present note.) To move beyond country averages to actual individuals requires that weights be used to capture the size variable and as shown in the hypothetical examples in Table 3, weighting may in principle go either way – of increasing or reducing the digital divide measured in conventional terms.

In the initial two-countries case, where size goes unweighted, IT use is taken to be twice as high in the developed than the developing country, and the size of the divide as conventionally measured is 2 to 1. With weighting, I first assume that there are 10 and 20 persons in the two countries respectively, and this eliminates the gap (that is, the absolute number of users in the developed and developing countries is the same). I assume next the opposite distribution of the population, namely 20 persons in the developed country and 10 in the developing country. This has the effect of increasing the divide to a ratio of 4 to 1.

Which of these two directions is the weighted digital divide likely to take in actual practice? In answering this question, it is useful initially to consider the data contained in Table 4. First, how-

Table 1. The digital divide, 1998–2004: the internet

	Internet users per 100 persons (1998)	Internet users per 100 persons (2004)
Developed countries	17.0	53.8
Developing countries	0.6	6.7
Size of the digital divide (relative terms)	28.3	8

Source: ITU[1].

Table 2. The digital divide, 1998–2004: mobile phone subscribers

	Mobile phone subscribers per 100 persons (1998)	Mobile phone subscribers per 100 persons (2004)
Developed countries	24.6	76.8
Developing countries	1.9	18.8
Size of the digital divide (relative terms)	12.9	4.1

Source: ITU[1].

ever, let me re-emphasize that there is no intrinsic reason why weighting should take one direction rather than the other.

Table 4 shows first that the vast majority of the largest 15 countries are drawn from developing rather than developed countries. Perhaps more telling though is the dominance shown by the two largest countries in the world, China and India. Indeed, the rapid recent growth of the former and its weight in total population plays a decisive role in the ongoing debate over convergence, divergence and the world distribution of income. Because it helps to understand how the weighting of countries by population affects the digital divide, I turn next to provide a brief summary of this important debate.

Table 3. How weighting by population alters the digital divide

	Developed country	Developing country
The original divide		
Per capital income	US$ 200	US$ 200
IT users (per 100 persons)	20	10
Size of divide	2	1
The weighted divide		
Case 1		
Population size	10 persons	20 persons
IT users	20 (users per 100)	10 (users per 100)
Absolute number of users	2	2
Size of divide (2 : 2)	2	2
Case 2		
Population size	20 persons	10 persons
IT users	20 (users per 100)	10 (users per 100)
Absolute number of users	4	1
Size of divide	4	1

Table 4. The fifteen largest countries in the world

Country	Population size (millions) 2003	Rank
China	1289	1
India	1069	2
USA	292	3
Indonesia	221	4
Brazil	177	5
Pakistan	149	6
Bangladesh	147	7
Russia	146	8
Nigeria	134	9
Japan	128	10
Mexico	105	11
Germany	83	12
Philippines	82	13
Vietnam	81	14
Egypt	72	15

Source: Todaro[4].

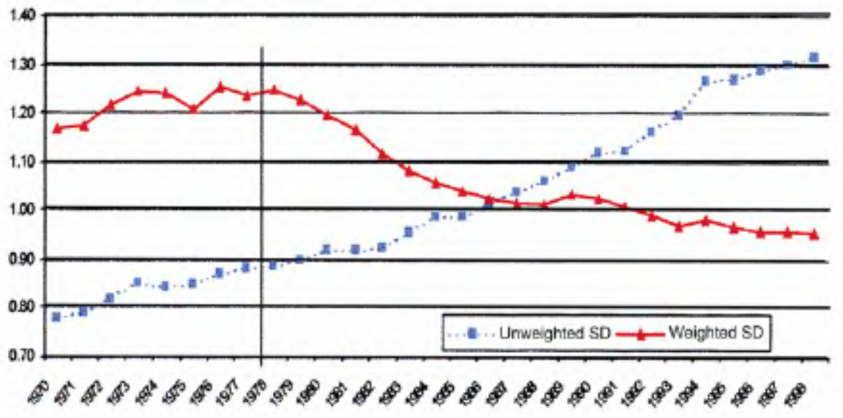

Figure 1. Population-weighted variance of log per capita income: 125 countries. Source: Sala-i-Martin[3].

Weighting by country size and the evolution of global income inequality

When countries are not weighted by their size, the story of global inequality over the past 30-odd years is basically one of rising inequality or divergence (see the rising line in Figure 1, which plots the variance of log GDP per capita across 125 countries over time). But when weighting does take place, the variance in per capita income between countries falls instead, as shown by the declining line in Figure 1. The reason, it seems, has much to do with the performance of the two largest countries, and especially with China. (In any event it is clear that weighting provides us with a radically different take on the evolution of global income inequality.)

In particular, as Sala-i-Martin[3] puts it: 'The reason for the decline in global economic inequality after 1978 is that the most populated country in the world, China, experienced substantial growth rates. Hence, the incomes of a big fraction of the world's population (approximately 20%) started converging towards the rich economies after 1978. The process was later reinforced by the positive growth performance of India (which is another very highly populated poor country: it hosts about 15% of the world's population). Notice that the unweighted inequality measures... treat China and India as simply two data points and give them the same importance as Lesotho (with two million inhabitants) or Luxembourg (with half a million). Thus, the unweighted measures give a Chinese citizen 1/600th of the weight that it gives to a citizen of Lesotho and 1/3000th the weight it gives a citizen of Luxembourg. The global Gini estimated in this section treats each person in the world equally. Thus, the economic progress of China

since 1978 and India after 1991 has resulted in large improvements in the incomes of more than a third of the poorest citizens of the world, and this has implied a substantial reduction in global income inequality[3].' When this type of logic is applied to inequality in information technology, the result, as I now demonstrate, is similar and no less striking.

The size of the digital divide revisited

As noted above, in relation to Table 3, it is entirely possible for weighting by size of the country to reverse the closing digital divide as it is conventionally measured. This could happen, for instance, if the countries that grew fastest in the internet and mobile phones also happened to be relatively large and located in the developed parts of the world. As also noted above, however, weighting in practice is likely to increase the relative influence of developing countries and contribute further to the declining digital divide or eliminate it altogether. And the role of China in this, turns out as it does in relation to the change in global inequality, to be absolutely central.

In fact, whereas the unweighted measure of the divide in the internet was shown above to be 8 to 1, the data contained in Table 5 suggest that the weighted figure might be as low as 1.8 to 1 (China, one should note, comprises 35% of all internet users in developing countries). By December 2007, the number of internet users in China had grown to 210 million (Internet World Statistics), which means that with all other numbers unchanged, the digital divide would barely exist. If one were to draw a map of the world divided into rich and poor countries, the number of internet users per region would be more or less the same. As in the case of global income inequality, the degree of inequality in IT use is much lower than is usually thought.

Thus, the weighted digital divide is

$$\frac{703,760,852}{391,088,874} = \frac{\text{Developed}}{\text{Developing}} = 1.8 .$$

Next, let me turn to the case of mobile phone subscribers between whom the conventionally measured divide as noted above is 4 to 1. The regional distribution of these subscribers is shown in Table 6. Once again, China's share in the developing country total is around 35%. This helped the absolute number of subscribers within the developing countries to exceed those in the developed world even by 2005. There was already then, so to say, a reversal in the digital divide. This should not, however, constitute any grounds for complacency from a policy point of view since there are still vast numbers in developing countries without a mobile subscription and even more without access to the internet. The goal rather should be to increase the size of the digital divide still further in favour of the developing countries. Consider Table 3 from this point of view. In case 1, the digital divide has disappeared, but there are still 18 persons in the developing country (out of 20) who have no access whatever. The policy goal is to provide this group with some form of access to the new technology.

Analysis

In order to gain further insight into the effect of weighting on inequality, it is useful to draw the Gini curves relating to mobile phones and the internet. I have listed countries according to the World Bank definition of low, low middle, high middle and high income. Corresponding to these four categories are data on total usage of these two technologies. A comparison of Tables 7 and 8 suggests that inequality is lower in the case of mobile phones relative to the internet. The share of low and low middle countries for example is 45.2% for the former as against 31.3% for the latter. Schematically, the difference in inequality can be shown by drawing the Gini curves corresponding to the two technologies.

The greater equality in mobile phones reflects the greater accessibility and affordability of this technology compared with the internet where use is largely confined to people with relatively high incomes and levels of education. It is also interesting to evaluate the role of China in these terms. One way of doing so is to take the citizens of this country out of the group to which they belong. The point being that this has a large impact on the pattern of total internet usage

Table 5. World internet usage and the weighted digital divide

Region/country	Internet users (2006)
Africa	33,334,800
Developing Asia	261,368,065 (China 137,000,000)
Developed Asia (Japan, Taiwan, Korea, Singapore)	137,341,000
Europe	314,792,225
North America	233,188,086
Latin America/the Caribbean	96,386,009
Oceania/Australia	18,439,541

Developed includes developed Asia, Europe, North America and Oceania.
Developing includes Africa, Developing Asia, Latin America/the Caribbean.
Source: Internet World Statistics (2007).

Table 6. Mobile phone subscribers per region, 2005

World	2,171,179,091
Developed countries	996,214,367
Asia	102, 545,000
Europe	649,890,484
North America	221,828,884
Oceania	21,950,000
Developing countries	1,174,964,724
Africa	134,941,820
Asia	799,936,437
China	394,110,000
Latin America and the Caribbean	239,588,382
Oceania	498,085

Here Oceania is split into a developed and developing country component.
Source: UNCTAD[5].

Table 7. Cumulative total internet use, 2006

Country grouping	Population (million)	Per capita internet use, per 100 inhabitants	Total use (multiplication of two previous columns)	Percentage share	Cumulative (%)
Low income	2420	4.2	10,164	8.8	8.8
Low middle	2276	11.4	25,946	22.5	31.3
Upper middle	811	22.4	18,004	15.6	46.9
High income	1031	59.3	61,138	53	100.0
			115,252	100	

Source: UNCTAD[5].

Table 8. Cumulative total mobile phone use, 2006

Country grouping	Population (million)	Per capita phone use (per 100 inhabitants)	Total use (multiplication of two previous columns)	Percentage share	Cumulative (%)
Low income	2420	6.9	16,698	12.9	12.9
Low middle	2276	18.2	41,650	32.3	45.2
Upper middle	811	31.7	25,708	19.9	65.1
High income	1031	43.5	46,848	34.8	100.0
	6538			100	

Source: UNCTAD[5].

as the following numbers indicate. In particular without China the two bottom groups then contain only 21.1% of total internet users as against the 31.3% shown in Table 7.

Conclusion

Conventional measures of the digital divide assign the same weight to each country regardless of its population size. Yet, from a welfare point of view, it makes sense to use size as a device to weigh countries in rich and poor regions of the world. Then one derives for comparison the absolute number of internet users and mobile phone subscribers in these two different parts of the world. This results in either a disappearing divide or a reversal in favour of developing countries. The role of China, the world's largest country, is shown to be central to these results. The relevant policy response, however, should not be one of complacency, but rather of increasing further the size of the digital divide in favour of the developing countries.

The point is that even when the digital divide disappears, there are still vast numbers of individuals in developing countries with no access to the internet or mobile phones. Arguably, the current literature focuses too much on closing the (unweighted) digital divide. For this is only a step in a much longer procedure of providing IT access to the majority of the population in developing countries.

Notes

1. Parts of this paper are based on James[2]; which does not contain the section on analysis provided here.
2. Note that here we measure the relative digital divide, i.e. the ratio of the internet and mobile phones in developed to developing countries. One can also measure an absolute divide, where one amount is subtracted from the other.

1. ITU, World Telecommunication/ICT Development Report, Geneva, 2006.
2. James, J., *Soc. Indic. Res.*, 2007.
3. Sala-i-Martin, X., National Bureau of Economic Research, Working Paper 9804, 2002.
4. Todaro, M., *Economic Development*, Pearson, 2006, 9th edn.
5. UNCTAD, The Information Economy Report, Geneva, 2006.

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Trademarks as keywords used in search engines

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The internet has led to some novel business models. One such is Google's AdWords program begun in October 2000, that is now Google's primary revenue source. Under the AdWords program, advertisers pay Google a fee for linking their advertisements to certain keywords or phrases. When a user types that word or phrase into the search engine, advertisements linked to that keyword appear prominently next to or above the search results. Sometimes, businesses choose their competitor's trademarks as keywords, seeking to juxtapose their own advertisements with those of their competitors. The legal question that has arisen is whether the sale and use of trademarks as keywords constitute trademark infringement, and, if so, who is liable for that infringement. The dichotomy here is that while trademark owners see the practice as trademark infringement because internet users cannot distinguish between a trademark owner's website and a keyword advertiser's website when both appear as a paid-for search engine result, the keyword advertisers see it as a permissible form of comparative advertising[1], such as the practice of erecting a billboard across the street from a competitor's store. In fact, Google has found itself facing litigation from both sides[2].