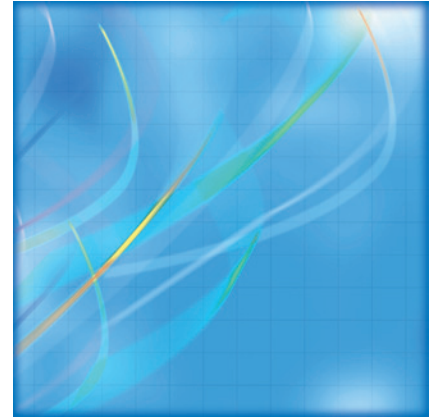**Research Paper**

The Digital Divide in Canada

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THE DIGITAL DIVIDE IN CANADA

The commercial arrival of the Internet and the convergence of information and communications technologies (ICTs) have sparked research interest in new areas. Prominent among those is the Digital Divide. Commonly understood as the gap between ICT 'haves' and 'have-nots', it serves as an umbrella term for many issues, including infrastructure and access to ICTs, use and impediments to use, and the crucial role of ICT literacy and skills to function in an information society. Moreover, it is used to refer both to internal country divides, as well as divides across countries. Today, governments, business, international and non-governmental organizations are in the midst of numerous initiatives to address ICT-related inequities and reap 'digital dividends'. Using mainly the Internet and income, this study places the Digital Divide in perspective, quantifies how big it is and examines how it is evolving.

1. An overview

In reality, many divides exist. They can be identified for any permutation of i) individual ICTs and the timing of their introduction, and; ii) variable of interest. There are old and new ICTs, digital and analogue, with their own attributes and functionality. The diffusion pattern of each ICT depends on its particular characteristics, as well as its actual and perceived uses. A television, for instance, offers different services than a cell phone, which in turn is different from coaxial cable. There is no reason, a priori, to lump different ICTs in one group and expect similar patterns in their penetration either across groups of people or over time. Then, there are many variables of interest: income, education, age, gender, geographical location and many others. Each of these results in the delineation of different groupings of people, with different size and other characteristics. There are serious policy and business reasons why the examination of connectivity among such groups matters, including the success of initiatives such as government online and e-commerce.

Chart 1 shows that household penetration of several ICTs increases by income. The effect of income is more pronounced on new technologies rather than older and established ones. However, the income divide is also present in the case of vehicles (an example of a non-ICT commodity) showing that the effect of income on penetration is not simply an ICT phenomenon.

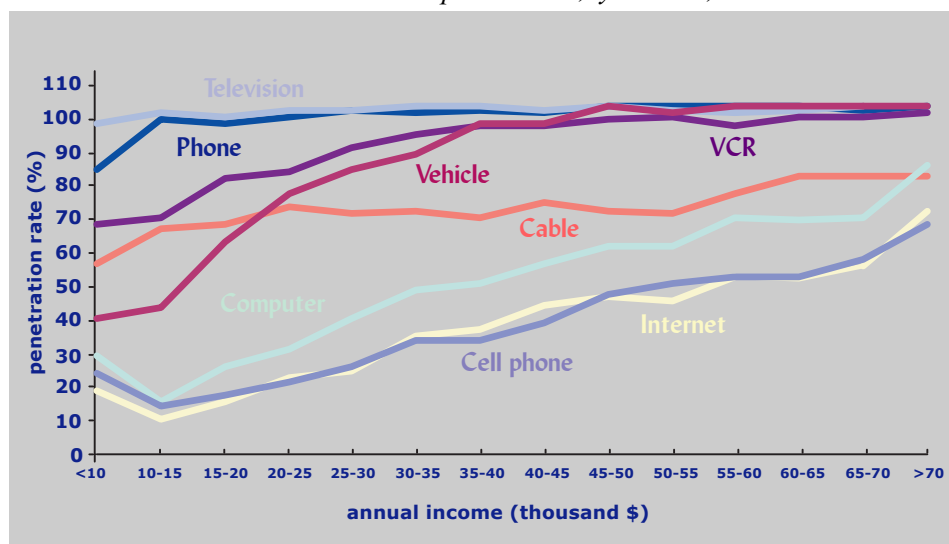**Chart 1.** *Household penetration, by income, 2000*

Table 1 summarizes some divides for the Internet. Clearly, penetration increases across incomes, but it also increases substantially with education, the presence of children and urban areas - within each level of income. This is true whether home-use or use from any location is concerned. (The latter is considerably higher, indicative of the importance of alternative access points, e.g. work, school, library and community resources).

Age also causes divides (Chart 2). Internet use declines dramatically with age, from over 90% for teenagers to less than 5% for aged individuals. This reflects a combination of factors, including issues of access opportunities, skills, perceived needs, attitudes and overall lifestyles. Whether the analysis focuses on individuals or households, some variables matter more for some technologies (e.g. age is important for the Internet but not for cable).

The timing of the introduction of individual ICTs is also important in placing digital divides in perspective. For example, a telephone divide today must be seen in the light that the technology, in its basic form, has been around for over a century. This differs from the divide associated with the Internet, which has been around for less than a decade in its commercial incarnation. Historically, the introduction of new commodities has been gradual. Chart 3 presents a collection of recorded penetration histories over a long period of time. Despite perceptions about the meteoric rise of the Internet, fast as it may have been, the penetration of television in people's lives was faster[1]. The penetration of the VCR was also very fast, particularly during its first decade. While the speed of adoption among commodities differs, their penetration is generally characterized by accelerating growth in the initial periods, which eventually gives way to decelerating growth.

The diffusion pattern of ICTs underscores the previous analysis of the peculiarities of each technology. What is important is that all new technologies are subject to a divide in their early penetration. Only when ICTs approach saturation does their diffusion patterns start to resemble the population at large and the distinction between 'haves' and 'have-nots' fades. Thus, at early stages of diffusion there is strong justification to examine groups of people according to characteristics of interest. Our analysis of the digital divide will focus on income.

Table 1.
Internet divides, by income , 2000

Quintiles	bottom	2nd	3rd	4th	top	all
			%			
			Education			
Less than high school	10.9	15.4	32.5	39.7	50.1	22.5
High school/college	32.2	40.9	56.7	63.9	80.1	55.4
University degree +	56.7	62.3	71.1	81.1	91.0	79.3
Total	**23.9**	**34.5**	**54.4**	**63.6**	**80.9**	**51.5**
			Family type			
Single family, children <18	48.0	59.3	67.0	76.6	87.4	71.4
Single family, no children <18	22.0	24.8	43.8	57.3	75.8	46.9
One-person families	13.2	25.4	49.3	58.3	60.2	28.0
Total	**23.9**	**34.5**	**54.4**	**63.7**	**80.9**	**51.5**
			Geographical location			
Urban (CMA)	25.9	36.4	56.2	64.4	82.7	54.0
Rural (non-CMA)	17.6	28.4	47.7	60.8	70.5	41.8
Total	**23.9**	**34.5**	**54.4**	**63.7**	**80.9**	**51.5**

Notes: The top 18 Census Metropolitain Areas are used as a proxy for urban areas.
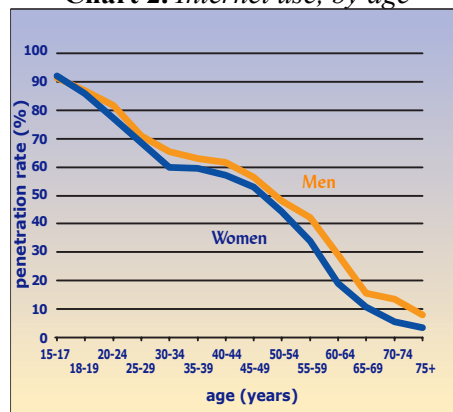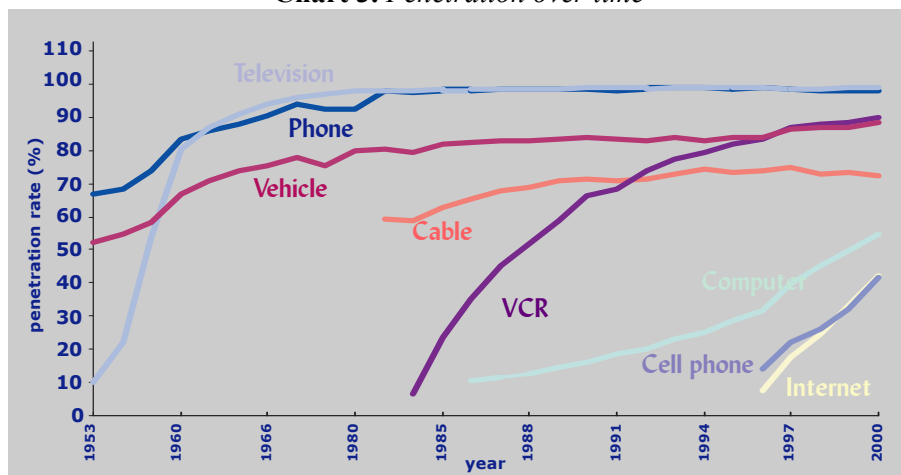
Chart 2. *Internet use, by age*

Chart 3. *Penetration over time*

[1] *From almost nothing in 1952, it reached 10% in 1953 (the first year for which data exist) and within a decade of its introduction it exceeded 80% (1960). Then, it achieved near-complete penetration even before the telephone, which had been around much earlier.*

2. How big is the Digital Divide?

From one year to the next, as more people use the Internet, there are more 'haves' and fewer 'have-nots'. When groups of people are delineated by income (or any other variable), though, each one has its own penetration rate. The divide then becomes a relative concept whose measurement involves comparisons of the 'haves' between 'have-more' and 'have-less' groups. (The absence of such a divide would imply the same penetration rates across all income groups). Its size can be approximated with the difference in the penetration rates between high- and low-income groups.

Such differences were computed for households in the top and bottom income deciles for selected years (Table 2). The findings indicate that the relative divide is very big for newer technologies and drops for saturated technologies. In 2000, it was bigger in computers and the Internet, with 65.2 and 62.5 percentage points separating households in the two extreme deciles, followed by cell phones. Considering that the penetration rate of computers was higher than the penetration rates of the Internet and cell phones, it is evident that their concentration among higher incomes is heavier. The divide in telephones, where almost 12 percentage points in penetration separate households in the top and the bottom income deciles, is high for such an established technology[2]. The fact that it widened sharply in the last year of data serves as an example that closing divides should not be taken for granted, but they can regress.

Another measure used for the divide - although with much less theoretical justification - involves the ratios of the penetration rates among high- and low-income groups. The measure is then interpreted as the 'likelihood' of being connected. In the case of no divide the ratio would be 1; the greater the number, the greater the divide. Such ratios were computed for 1996 and 2000 and are shown in Chart 4. The basic findings are the same as before; the divide is greater for newer technologies, especially the Internet, whereas it barely registers for saturated technologies.

Table 2.
Differences in penetration rates, top vs. bottom income deciles

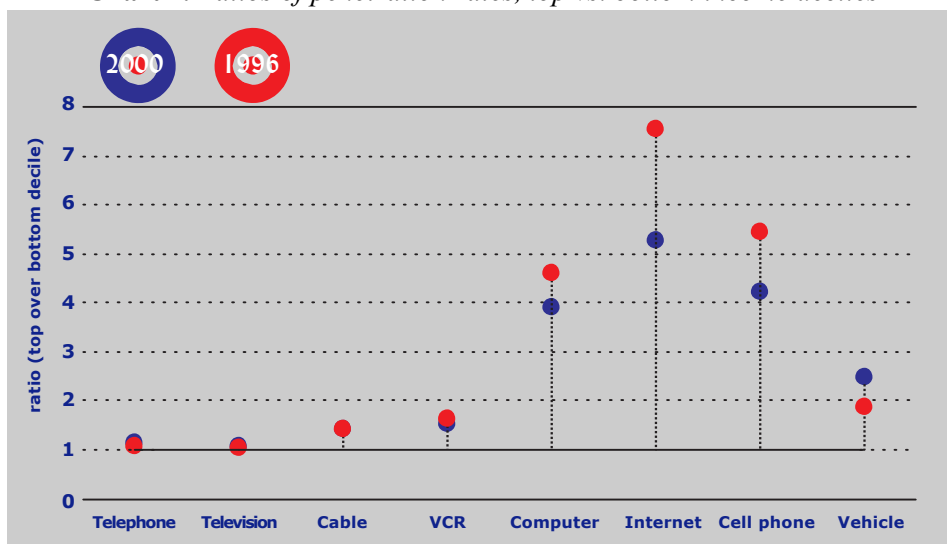|	1982	1986	1990	1996	2000
		percentage points			
Telephone	7.4	7.5	4.6	5.2	11.9
Television	3.9	2.9	2.2	1.5	3.8
Cable	-	-	-	24.6	23.2
VCR	-	47.1	54.3	36.4	33.4
Computer	-	18.8	31.8	48.2	65.2
Internet	-	-	-	18.2	62.5
Cell phone	-	-	-	24.8	55.9
Vehicle	56.5	56.4	51.3	47.1	58.8

Table 2 would imply a growing divide, but the approximations there cannot be generalized outside the two extreme income deciles, as they are subject to several caveats. On the other hand, Chart 2 would imply a closing divide; households in the top income decile were 7.6 times more likely than households in the bottom decile to use the Internet in 1996, but only 5.3 times more likely in 2000. However, ratios are *not* true measures of the divide. Decreasing ratios

Chart 4. *Ratios of penetration rates, top vs. bottom income deciles*

will always be obtained as long as the rate of growth of penetration among the low-income group exceeds that of the high-income group – however small the margin may be[3].

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[2] *Part of this may be explained by possible substitution of cell phones for fixed lines recently.*

[3] *In the case of the Internet, higher income groups have higher penetration rates and, while penetration increase across all income groups, the rate of growth of low-income households exceeds that of high-income households. However, this is not enough for the divide to close. The rate of penetration growth of the low-income group would have to be higher by as many times as the ratio of the high- to low-income penetration in the initial period.*

3. How is the Digital Divide evolving?

Regardless of the size of the digital divide, a more pertinent question is whether it is growing or closing. While inequalities of this type are difficult to prove conclusively with any single measure, insights can be obtained by a well-known analytical technique used in income inequality studies - the Lorenz curve. It was adapted and utilized here for the penetration of the Internet across income deciles (Chart 5).

Chart 5. *Evolution of the relative Internet divide, home use.*

A curve entirely inside the other indicates a closing divide. Crossing curves lead to inconclusive results, something that necessitates the calculation of Gini coefficients. A lower Gini indicates a closing divide.
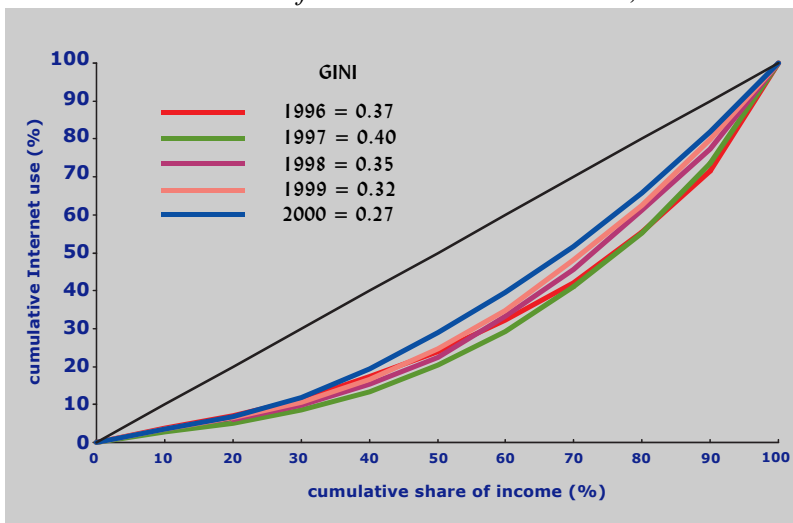
With the exception of 1996, curves for each successive year are cleanly enveloped by those of the previous year, indicating a closing relative divide. The 1996 curve crosses other curves, something that renders the comparisons between 1996 and 1997 inconclusive. Gini coefficients (also in Chart 5) indicate that the divide actually increased between 1996 and 1997, while it keeps closing from 1997 onwards. Thus, in an overall sense the digital divide is closing. This analysis, however, camouflages important movements at more detailed levels and is less suitable for comparisons involving specific income groups, especially those far from each other. For this more detailed analysis was performed.

The distribution of Internet users was computed by income decile, for the 1996-2000 period (Table 3). It is clear that the proportion of users from the top income decile is less than it was - accounted for 18.2% of all Internet users in 2000, down from 28.4% in 1996. This, however, is not typical of the pattern of other high-income groups. Only the share of the 9th decile was somewhat smaller in 2000 compared to 1996 - and this after it had increased. The relative loss of the importance of the two highest income deciles notwithstanding, the lot of the lowest two deciles did not improve at all over the 1996-2000 period – indicative of a less than generalized closing of the divide. It is thus the middle incomes that picked up share, and accounted for proportionately more of the Internet users in 2000 than in 1996.

Similar findings hold true when the income deciles from which newcomers came from are explicitly identified. Table 4 shows that while over the entire period there is a clear, positive relationship between income and Internet newcomers (last column), from year-to-year the relative contribution of the higher-income groups declined (7th to top decile) and that of the others increased. The gains, once again, were more pronounced among the middle incomes than the lowest deciles. For example, the top decile accounted for one-quarter of all new users between 1996 and 1997, but the 5th decile topped the list from 1999 to 2000. In the same period, the four middle deciles (4th to 7th), contributed almost half (48%) of all new users.

Table 3.

Distribution of Internet users, by income

Decile	1996	1997	1998	1999	2000
			%		
bottom	3.8	2.9	3.6	3.6	3.5
2nd	3.3	2.3	2.4	2.9	3.3
3rd	4.4	3.3	3.8	4.2	5.1
4th	6.0	4.9	5.5	6.0	7.4
5th	6.5	7.1	7.0	8.1	9.7
6th	8.3	8.7	10.9	10.0	10.5
7th	9.7	11.9	12.2	13.2	12.1
8th	13.4	14.1	15.6	14.4	14.2
9th	16.3	18.4	16.2	17.3	15.9
top	28.4	26.5	22.6	20.3	18.2
all	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4.

New Internet users, by income

Decile	1996-1997	1997-1998	1998-1999	1999-2000	1996-2000
			%		
bottom	2.2	5.2	3.8	2.9	**3.4**
2nd	1.5	2.6	4.3	4.7	**3.3**
3rd	2.5	5.0	5.2	8.4	**5.3**
4th	4.1	7.0	7.4	12.2	**7.7**
5th	7.5	6.9	11.0	15.1	**10.3**
6th	8.9	16.0	7.6	12.3	**11.0**
7th	13.5	13.1	16.0	8.3	**12.6**
8th	14.6	19.2	10.9	13.7	**14.4**
9th	20.1	11.2	20.2	11.2	**15.8**
top	25.0	13.9	13.7	11.3	**16.1**
all	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Finally, the differences in Internet penetration were computed for many pairs of income deciles and for every year of available data. Then, the changes in these differences were computed, annually and for longer periods (and an adjustment was made for the growing income gap between high and low incomes[4]). In this specification, a positive number indicates a growing divide (the bigger the number, the bigger the growth) and a negative number indicates a closing divide. The results are shown in Table 5. Generally, the divide is smaller, the smaller the income difference between the groups examined. As well, the pattern of its evolution is mixed. While it is increasing between several income pairs, it is closing among others, especially over the last year of data. For instance, the divide closes between several adjacent deciles as early as 1997-1998 (e.g. 8th and top, 8th and 9th), and even among non-adjacent income pairs (e.g. 4th and 7th deciles in 1999-2000, 4th and 6th deciles in the last two years - two deciles still separated by more than $18,000 in 2000). Dropping 1996 from the calculations, closing divides between high-income deciles can be detected even over a longer period (2000-1997 column). Even when the divide increases, it generally increases less over time.

The important finding, though, is that although a closing divide appears between certain income groups, there is still a persistent divide between pairs of very high and very low incomes (e.g. top vs. bottom, 9th vs. 2nd and 8th vs. 3rd deciles), indicative of growing disparities. To demonstrate how much such comparisons depend on the exact cut-offs chosen, the exercise was repeated with only two broad income groupings; the top half and the bottom half. In this case, considering the situation of the bottom 3 deciles, the digital divide is clearly growing (last line of Table 5).

All the above findings collectively conclude that the digital divide is generally closing, but that this is the result of the progress made by middle-income groups (particularly upper-middle) when compared to the highest income group. The lowest income groups (the three bottom deciles here) continue to lose ground vis-à-vis the very high income groups. There is a long way to go before the divide between these groups is eliminated.

Table 5. *Evolution of differences in Internet penetration rates*

Deciles	1997-1996	1998-1997	1999-1998	2000-1999	2000-1996	2000-1997
top-bottom	21.0	4.3	6.9	1.1	32.5	12.3
9th - 2nd	17.1	5.0	11.9	3.7	36.1	20.7
8th - 3rd	11.1	9.6	3.8	3.4	26.9	16.9
7th - 4th	8.9	3.6	7.0	-4.7	14.6	6.0
6th - 5th	1.1	6.6	-3.4	1.8	6.0	5.1
top - 9th	4.4	1.1	-6.2	-1.6	-1.5	-6.7
top - 8th	9.4	-5.2	1.9	-5.0	1.7	-8.3
9th - 8th	4.9	-6.3	7.8	-3.1	3.4	-1.5
8th - 7th	0.8	4.6	-4.7	4.9	5.0	4.7
6th - 4th	4.4	6.1	-0.2	-0.1	9.9	5.7
5th - 4th	3.4	-0.4	3.1	-2.1	3.9	0.6
4th - 3rd	1.5	1.3	1.8	3.1	7.2	6.2
top 5- bottom 5	**12.8**	**6.8**	**6.0**	**2.8**	**28.5**	**15.6**

Closing remarks

As the Internet is becoming the epitome of modern communications, there are many pragmatic reasons why the digital divide matters. This study dealt with the issue and arrived at certain conclusions, within the scope of its investigation. The divide is generally closing, but the gap between the highest and the lowest incomes persists. However, this is quite consistent with many technologies in their early stages of adoption and it remains true that the rate of growth of Internet use at lower incomes is higher that than of the higher incomes. In addition, this should be placed in the perspective that the composition of income groups changes over time. It is not the same individuals or the same group of families that comprise them.

Yet, however important income is, there are plenty of other aspects to this issue. Understanding barriers to access and use of new technologies remains important. While there is ample evidence that affordability is critical, it certainly does not explain the still-sizeable proportion of non-users at the highest income levels. Numerous other factors are at play, many of which change over time due to the evolution of the technologies, falling prices, social norms and much more.

In the end, the issue of the digital divide, like all others, will come down to outcomes and impacts. As Castells put it: "The fundamental digital divide is not measured by the number of connections to the Internet, but by the consequences of both connection and lack of connection" (*The Internet Galaxy*, 2001, p. 269). In examining such consequences, then, it is important to be informed about the degree and the progress of connectivity.

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[4] *This adjustment is necessary, particularly over a period of five years. (It has not been made for the last row of Table 5, as it would be redundant).*