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The Digital Inequality in Brazil, 2004 – 2009: Evolution and Effects on Political Engagement

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Abstract: Results show that Brazil has consistently ranked first with respect to Internet connectivity in Latin America and the Caribbean. Analyses of national household surveys show an overall increase in microcomputers and Internet access between 2004 and 2009. Though geographic and socio-economic disparities remained in 2009, the gap in Internet access between people living in urban and rural areas declined, as did the gap between low and high-income households. The study also finds that the intensity of Internet use has a positive effect on the knowledge and attitudes deemed relevant to democratic governance.

Keywords: Brazil, Internet, Governance, Democracy

Introduction

The first Internet domain name was registered in 1985 and, ever since, the network has grown at an exponential rate. By 2016 it is estimated that there will be 3 billion Internet users globally, which is about half of the world's population. If it were a nation state, the Internet economy would rank in the world's top five, behind only the U.S., China, Japan, and India, but ahead of Germany (Dean et al. 2011). Since its inception, the accelerating number of users has been accompanied by a change in the Internet itself, in terms of who uses it, how it is used, and for what purposes.

The revolution in information communication technology (ICT), mainly driven by the widespread ownership of personal computers and the extraordinary increase in people's access to the Internet, has introduced the concept of "digital divide" into the lexicon of studies of social development, political change, and economic growth. The term digital divide can refer to the gap

in Internet access between industrialized and developing societies, referred as the "global divide," or to the gap in Internet access between rich and poor people within a country, referred to as the "social divide" (OECD, 2001). Because the unequal access to the Internet is widely thought to create a new class division between the "information rich" and the "information poor" (Everett, 1998, p.388), both the global and the social forms of the digital divide have caught the attention of researchers and policy makers.

In Brazil, the establishment of the Ministry of Science and Technology in 1992 reaffirmed the government's commitment to promote scientific research, technology, and the development of informatics. Information about digital divide is therefore essential to the development of any public policy that aims to diminish the technology gap and promote the democratization of information.

Perspectives on the Social Consequences of ICT

The Internet is a network of networks that links people and information through computers and other digital devices, allowing person-to-person communication and information retrieval. The Internet is unique because it integrates different modalities of communication (e.g., broadcasting and group discussions) and different kinds of content (e.g., text, images, audio and visual) in a single medium. The Internet can thus be many things at once: a telephone, a library, a discussion hall, a platform for expression, a way to broadcast information to a vast audience, or a conventional mass medium. It is precisely because it can be all of these things simultaneously, and because it allows users the freedom to choose among different modalities, that the advent of the Internet signals a new era in the evolution of ICT (DiMaggio et al., 2001).

The unprecedented versatility of the Internet is what leads analysts to believe that it has the potential to promote many more kinds of social change than radio or television. Manuel Castells (1996) contends that the world is entering an "information age" and goes so far as to argue that the Internet's integration of print, oral, and audiovisual modalities into a single system will have an impact on society comparable to the introduction of the alphabet.

Given that the Internet is relatively new, it is not surprising that there is little agreement about its effects. A summary of the main ideas presented in extensive review essays by DiMaggio et al. (2001) and Ferrell (2012), broadly illustrates the scope and content of current debates.

With respect to the political domain, for example, proponents contend that the Internet, by lowering the access barrier to meaningful public speech, is conducive to a more engaged and deliberative political community, while critics foresee the dominance of large corporate players and invasion of personal privacy. Similarly, because the Internet allows collective activities through much looser forms of coordination compared to activities that once required central coordination and hierarchy, some analysts believe the Internet makes it easier for actors to pursue their goals. Others claim that such decentralization leads to a world with much less social cohesion, as individuals stop consuming mass-produced information from newspapers and televisions and rely, instead, on personalized information sources. Analysts from a Marxist perspective focus on the potential for elite control of both politics and production through enhanced surveillance. Others assert that the Internet empowers ordinary citizens to the point that instant communication can lead to collective action able to unseat traditional elites, as in the case of "los indignados" in Spain and the "Arab Spring" in Egypt. The logic of these connective actions is based on highly personalized content shared among networks of social media (Bennett & Segerberg, 2012).

While some studies in the past have found that there is very little or no correlation between Internet and political engagement (Putman, 1995; Bimber, 1999), recent studies show that the use of Internet is a strong predictor of political knowledge and participation. In a meta-analysis of more than thirty studies related to the issue, Boulianne (2009) found that the effects of the Internet on political and civic engagement have increased overtime. Internet users are more likely to vote (Johnson & Kaye, 2003; Tolbert and McNeal, 2003; Kenski and Stroud, 2006), volunteer or participate in political organizations (Wellman, Quan-Haase, Witte & Hampton, 2001), and engage in political discussion and activism, both online and offline (Gil de Zúniga, Veenstra, Vraga & Shah, 2010; Gil de Zúniga, Jung & Valenzuela, 2012; Shah, Cho, Eveland & Kwak, 2005).

In regards to support for democracy, Bailard (2012) found that Internet penetration influence citizens' satisfaction with their country's democratic performance. In addition to panel survey data, experiments in Bosnia-Herzegovina reveal a causal relationship between Internet use and adherence to democratic norms (Bailard, 2012).

In addition, different types of uses of the Internet are related to different types of political engagement. Gil de Zuniga, Jung and Valenzuela (2012), found that social media use is

associated with social capital, civic engagement and political participation. Similar findings were found regarding the use of blogs (Gil de Zuniga, Puig-i-Abril & Rojas, 2009).

Economists, who endorse decision models that place great emphasis on access to information, predict that the Internet will reduce inequality by lowering the cost of information. This will enable low-income men and women to gain human capital, build social networks, and find and compete for jobs. If economic benefits are associated with access to the Internet, the argument necessarily implies that the lack of access to the Internet will limit people's opportunities, thereby increasing socio-economic inequalities (Anderson et al., 1995).

All these factors help construct the notion of *information inequality* or *digital divide*. According to Selwyn (2002, p.3), "if individuals or groups are excluded from using ICT, it is argued, they will be excluded from many of the benefits that ICT can bring." In Brazil, for example, there is a notion that knowing how to operate a computer is a determinant factor in finding or succeeding on a job (Sorj & Guedes, 2010).

Although people need not own a computer in order to access the Internet, the presumed benefits of the Internet are, to a large degree, influenced by whether people possess a personal computer. Selwyn (2002) makes this point, noting the difference between *accessing* ICT and *owning* ICT as a relevant factor to be taken into account when defining "information inequality":

> Accessing on-line information and resources from a home-based computer or digital television set is not necessarily equitable to accessing the same materials via an open-access work station in a public library or other community-based ICT center. Issues of time, cost, quality of the technology and the environment in which is used, as well as more "qualitative" concerns of privacy, safety, conviviality and "ease of use" are all crucial mediating people's "access" to ICT. (Selwyn, 2002, p.8)

Possessing a computer that is able to access the Internet does not necessarily mean that people know how to use the Internet, however. Digital inclusion can thus be conceptualized not only in terms of access, but also in terms of human capital. In other words, a distinction must be made between "physical access" and "effective access" (Wilson, 2000). Scholars have made the distinction between computer ownership and Internet access as "first digital divide", and disparities in ability and uses as "second digital divide" (Attewell, 2001; Hargitai, 2002). According to Silverstone (in Sewlyn, 2002, p.8), "we should recognize that access to ICT does not denote use of ICT. Similarly, *use of ICT* does not necessarily entail *meaningful use of ICT* or

what could be termed as 'engagement' where the 'user' exerts a degree of control and choice over the technology and its content thus leading to a meaning, significance and utility for the individual concerned."

In addition, Communication scholars fear that the dissemination of new mass media information, such as the Internet, will actually increase socioeconomic disparities if only because higher status individuals already possess greater knowledge and political participation (Bonfadelli, 2002; Prior, 2005). According to the knowledge-gap hypothesis:

> As the infusion of mass media information into a social system increases, segments of the population with a higher socioeconomic status tend to acquire this information at a faster rate than the lower-status segments, so that the gap in knowledge between these segments tends to increase rather than decrease (Tichenor, Donohue & Olien, 1970, p. 159).

Among the possible reasons for the knowledge gap phenomenon is the difference in communication skills between the two groups; the difference on background information; the difference in social contacts and exposure to public affairs; selective exposure; and content actually being geared to those of high socioeconomic status (SES). One of the possible reasons for the knowledge gap is that people with high SES attend more information-oriented content, while people with low SES might not find this information useful or relevant (Severin & Tankard, 2001; Wei, 2009). Because the Internet has a more heterogeneous and user-selected content than traditional mass media, such as television and newspaper, it is expected that the knowledge gap effect is more pervasive online (Bonfadelli, 2002).

More recently, Pearce and Rice (2013) identified four forms of digital inequality: access to the Internet, use of different devices, extent of usage, and engagement in activities online. The effects of the digital inequality among socioeconomic groups are more pervasive for access than for usage frequency, device type, duration, and activities. Hence, quantitative estimates of changes in the prevalence and in the socio-geographic distribution of computers and access to the Internet represent an important step in understanding the state of the phenomenon of digital inequality in Brazil. In addition, the correlation between Internet use and political culture can provide insights with respect to the effect of Internet use on the values and attitudes considered necessary to the deepening of democratic governance.

Research Questions

The competing perspectives regarding the scope and consequences of the global and social divides bring to the fore the three specific research questions (RQ) we address in this study:

- RQ1: Compared to other countries in Latin America and the Caribbean, how does Brazil rank in terms of the proportion of the population that owns a personal computer and in terms of the proportion of computer owners with access to the Internet?
- RQ2: Has the increase in computer ownership and Internet access widened or narrowed the digital gap between geographic regions of the country, and between the rich and the poor subgroups of the population?
- RQ3: Does the Internet explain statistically significant variance in political knowledge, civic participation, and political attitudes after controlling for socio-demographic indicators?

Data and Measures

AmericasBarometer Public Opinion Survey

To estimate Brazil's relative ICT standing in the hemisphere we use the 2010 Americas-Barometer public opinion survey (total N=39,000; Brazil N=2,482), which was carried out in 22 countries in the region by the Latin American Public Opinion Project (see www.vanderbilt.

edu/lapop/). In addition to information about computer ownership and Internet access, the Americasbarometer public opinion survey in 2010 included operational definitions of the frequency of Internet use as well as the four features of political culture considered relevant to democratic governance: political knowledge and participation in community action, and the degree to which respondents approval of legal demonstrations and of the idea that the President can close Congress in the interest of more efficient governance.

Political knowledge was measured using an index composed of responses to three questions: (1) Who is President of the United States? (2) How many states are there in Brazil? (3) How many years is the President's term of office in Brazil? The composite score ranges from 0 (low) to 3 (high).

In addition to political knowledge, the presence of an active and engaged citizenry is considered a key feature of democratic governance (Almond & Verba, 1989). To measure political engagement we used information about participation in community action, operationalized by answers to the following question: In the last twelve months, how many times

did you contribute to a solution to a problem in your community or among your neighbors? Participation in community action is a more valid indicator of political engagement in Brazil compared to voting behavior, which is frequently used in the United States. The question on voting loses validity in Brazil where voting is mandatory and sanctions are attached to noncompliance. Because people who fail to vote are subject to fines and can be denied admission to federal universities, denied a passport and access to military service, voting in an election in Brazil is not in the realm of choice.

Other features of a liberal democratic political culture include attitudes that endorse the rule of law and reject authoritarian solutions to political problems (Almond & Verba, 1989; Diamond, 1994). In this study we use approval of legal demonstrations and whether respondents believe that the President can close Congress as measures of the attitudinal dispositions that are considered basic to liberal democratic regimes. We recoded the scores on the four independent variables into ordered categories which vary from low, to medium, to high, as described in Table 4.

National Household Surveys, 2004 and 2009

When we turn attention from the "hemispheric digital divide" in the region to the "social divide" within Brazil, we use the National Household Surveys, the *Pesquisa Nacional por Amostra de Domicillios (*PNAD), carried out by the Brazil's census bureau, the *Instituto Brasileiro de Geografia e Estatística (*IBGE). The PNAD annual surveys began in 1967 and have been carried out nearly every year since then, except in those years when the demographic census was in the field (1970, 1980, 1991, and 2000). Whereas the main purpose of the PNADs is to track changes in housing, employment, and migration, the questionnaires used in 2004 and 2009 included two items that are the basis of this study. One asked whether someone in the household possessed a microcomputer. The other asked whether the microcomputer was used to access the Internet. Responses to both questions enable us to estimate the proportion of households with access to information technology, and to estimate variations in access by region, rural-urban residence, and level of per capita household income. The availability of data in 2004 (139,157 households) and in 2009 (153,837 households) is of particular interest because comparable data at two points in time makes it possible to estimate changes that have taken place in both the form and the magnitude of the digital divide in Brazil.

Results

The Digital Divide in the Hemispheric Perspective

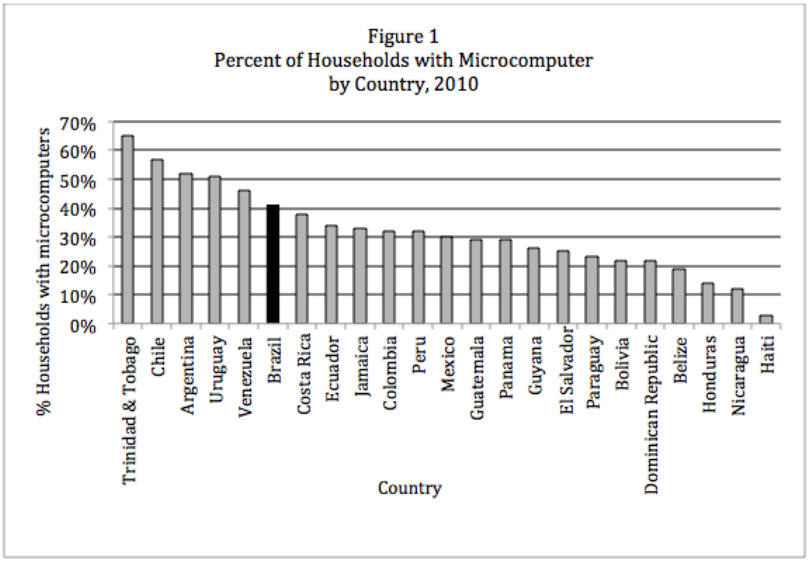
According to the AmericasBarometro data, 41% of people 18 years of age and older in Brazil possessed a microcomputer, as shown in Table 1. Compared to the other 22 countries for which we have data, Brazil is in 6th place with respect to the proportion of people who have a microcomputer (column 1) and is in 1st place with respect to the proportion of computers that are connected to the Internet (column 3). Figures 1 and 2 make it easier to see Brazil's position in relation to other countries in the region with respect to ownership of microcomputers and access to the Internet.

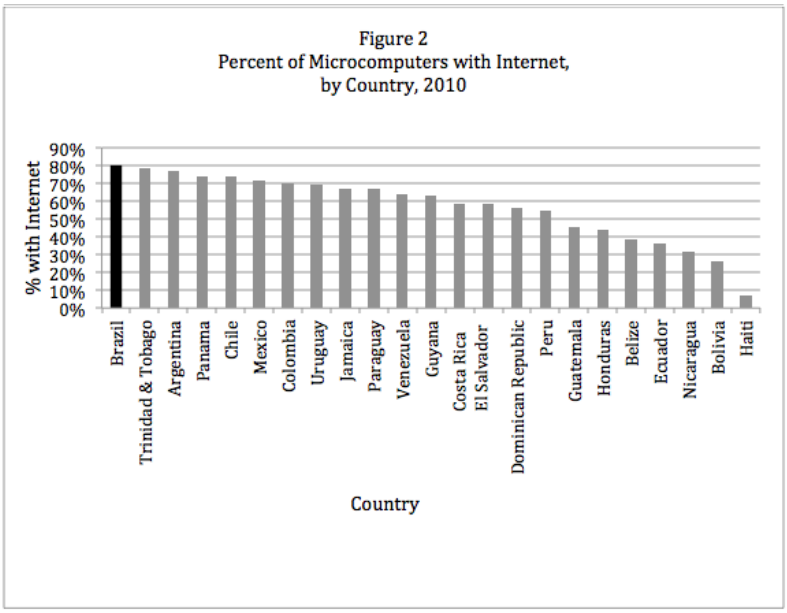
Table 1
Percent with Computer and Internet
Latin America 2010

Country	Rank (1)	% Computer (2)	Rank (3)	% Internet (4)
Argentina	3	52%	3	77%
Belize	20	19%	19	38%
Bolivia	19	22%	22	26%
Brazil	**6**	**41%**	**1**	**80%**
Chile	2	57%	5	73%
Colombia	10	32%	7	70%
Costa Rica	7	38%	13	58%
Dominican Republic	18	22%	15	56%
Ecuador	8	34%	20	36%
El Salvador	16	25%	14	58%
Guatemala	14	29%	17	46%
Guyana	15	26%	12	63%
Haiti	23	3%	23	7%
Honduras	21	14%	18	44%
Jamaica	9	33%	9	67%
Mexico	12	30%	6	72%
Nicaragua	22	12%	21	32%
Panama	13	29%	4	74%
Paraguay	17	23%	10	67%
Peru	11	32%	16	54%
Trinidad & Tobago	1	65%	2	78%
Uruguay	4	51%	8	69%
Venezuela	5	46%	11	64%

Total	33%	62%

Source: AmericasBarometro
2010
Individuals 18 years of age and older





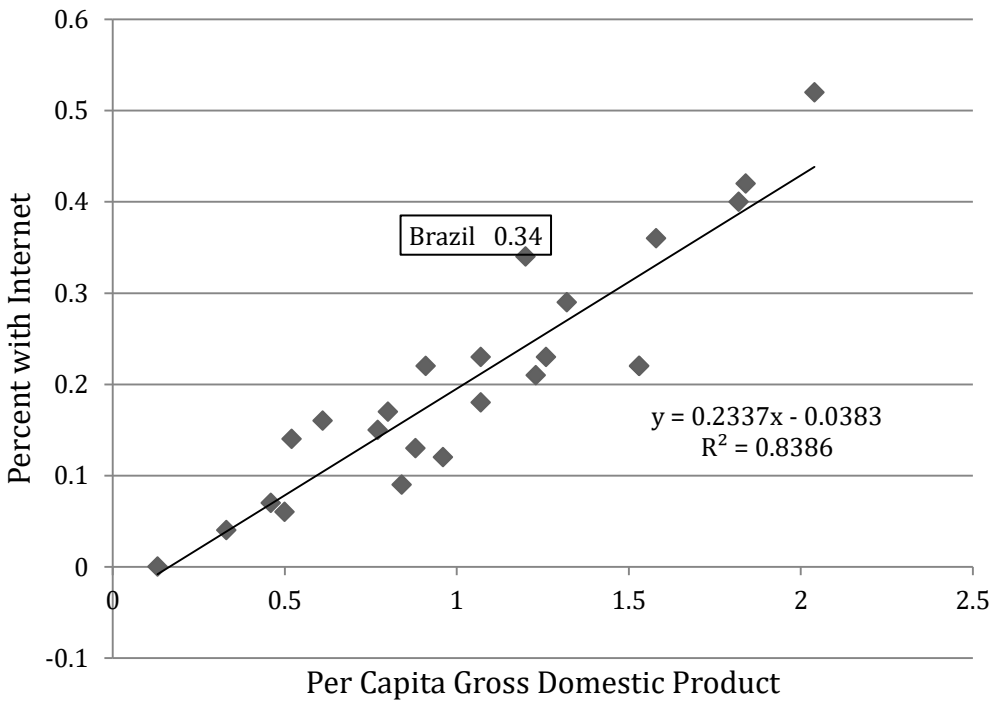
The estimate for Brazil generated using the AmericasBarometro survey is 6.3 percentage points higher than the value generated from PNAD 2009 survey, presented in Table 2 (41% compared to 34.7%, respectively). However, it should be noted that the AmericasBarometer survey is the estimated number of *individuals* who possess a microcomputers whereas the PNAD 2009 data measures the number of *households* in which a computer is present. We therefore expect the AmericasBarometer estimate to be higher compared to the PNAD 2009 estimate. The

two values are more similar when we base the analysis of the PNAD 2009 survey on individuals rather than households. Once the PNAD 2009 sample refers to individuals 18 years of age and older, thereby making it comparable to AmericasBarometer, the estimate of the proportion of people in Brazil who possess a microcomputer is 38.1%, a value that is 2.9 percentage points lower than the AmericasBarometer estimate yet within the 95 percent confidence interval.

We can generate further insight into Brazil's ranking within the hemisphere by regressing the percent of households with Internet connectivity on per capita gross domestic product (GDP). As shown in Figure 3, there is a strong positive association between the two variables. Per capita GDP explains 84 percent of the variance in the percent of Internet households.

Overall the model does quite well in predicting the Internet availability across countries yet the departures from the regression line are also revealing. In the case of Brazil (highlighted in the figure), we see that the actual value (35 percent) is 10 percentage points higher than the predicted value (25 percent). We conclude that Brazil's hemispheric ranking is partly due to factors other than the country's per capita GDP.

Figure 3
Percent of Households with Internect Connectivity
by Per Capita Gross Domestic Product (in 0000s)



The estimates of the magnitude of the digital divide among countries in Latin America presented in Table 1 tell us nothing about internal differences in computer ownership and access to the Internet. Variations by region, place of residence and household income are of special relevance in Brazil, a country known for its large geographic disparities and high concentration of income (Wood & Carvalho, 1988). For the purposes of a more detailed analysis of computer ownership and Internet access we turn to the PNAD surveys in 2004 and 2009.

Microcomputers and the Internet: 2004 - 2009

The estimates for Brazil, presented in Table 2, show the dramatic changes that occurred in only five years' time. In 2009, 34.7% of all households owned a computer (Table 2, A.1), a proportion that was double the 16.3% observed in 2004. The estimates shown in the lower panel of Table 1 (B.1) indicate that proportion of microcomputers connected to the Internet rose from 74.8% in 2004 to 79% in 2009, an increase of 4.2 percentage points.

Table 2
Percent of Household with Computer and Internet
by Area, Region, and Percapita Household Income
Brazil, 2004 and 2009

	Computer		
	2004 (1)	2009 (2)	(2) - (1) (3)
A. Computer			
1 Brazil	16.3	34.7	+18.3
Urban	18.9	39.3	+20.4
Rural	20.1	8.3	+6.2
2 Region			
North	6.9	20.3	+13.4
Northeast	6.8	18.5	+11.7
Southeast	22.0	43.7	+21.7
South	20.3	42.6	+22.3
Center-West	14.9	35.7	+20.8
3 Household Income			
Less than ¼ minimum salary	0.5	4.0	+3.5
More than ¼ to ½	1.2	11.0	+9.8
More than ½ to 1	4.7	23.1	+18.4
More than 1 to 2	14.2	42.0	+27.8
More than 2 to 3	32.7	59.8	+27.1
More than 3 to 5	46.9	70.4	+23.5
More than 5 minimum salaries	64.4	82.4	+18.0
B. Internet			
1 Brazil	74.8	79.0	+4.2
Urban	75.5	80.0	+4.5
Rural	39.7	49.6	+9.9
2 Region			
North	61.0	65.2	+4.2
Northeast	72.2	77.9	+5.7
Southeast	76.2	81.0	+4.8
South	73.9	76.9	+3.0
Center-West	74.7	79.0	+4.3
3 Household Income			
Less than ¼ minimum salary	32.5	46.2	+13.7
More than ¼ to ½	34.0	53.9	+19.9
More than ½ to 1	50.1	65.2	+15.1
More than 1 to 2	62.3	77.3	+15.0
More than 2 to 3	72.7	85.0	+12.3
More than 3 to 5	81.0	90.2	+9.2
More than 5 minimum salaries	89.6	93.9	+4.3
N of Households	139,157	153,837	

Two considerations are pertinent to the proper interpretation of these estimates. It is important to note that some households, especially higher income households, may have more than one microcomputer on the premises. Because the question only asks whether there is a computer present in household, the estimates are likely to underestimate the number of personal microcomputers in actual use. Similarly, the question regarding access to the Internet may also be an underestimate because responses do not account for Internet access through other media (such as mobile phones, smart TVs, or videogame consoles) or when a person asks another to perform a task online for him/her.

Given that the potential biases lead to underestimates rather than overestimates, we can assume that the increases between 2004 and 2009 in computers ownership and access to the Internet are likely to be even higher than the increases observed in the data. The estimates for 2004 and 2009 leave little doubt that access to digital technology significantly increased during the five-year period. The issue to which we now turn is the effect of the observed increase in ICT on the distribution of computers and Internet by geographic location and socioeconomic status.

The Digital Divide within Brazil

It is not surprising that the increase from 2004 to 2009 in the proportion of households with a computer was primarily an urban phenomenon (Table 2, A.1). The percentage of households in urban areas rose 20.4 percentage points to 39.3% in 2009, compared to the increase of 6.2 percentage points observed among households in rural places. However, the urban-rural differences were lower with respect to access to the Internet. As shown in panel B.1 of Table 2, the proportion of urban and rural households connected to the Internet in 2009 was 80.0% and 49.6%, respectively. The comparison over time further shows that the gap between urban and rural places has declined somewhat, evidenced by the 9.9 percentage point increase in connectivity in rural areas compared to the 4.5 percentage point increase in urban areas.

Regional differences also follow the expected pattern (Table 2, A.2). In 2009, the percentages of households with computers in the less developed North (20.3%) and Northeast (18.5%) regions were about half that observed in more developed Southeast (43.7%) and South (42.6) regions. From 2004 to 2009, the number of computers increased in all regions of the country, but the largest increases took place in the Southeast and South regions (+21.7 and +22.3 percentage points, respectively), thereby increasing the regional differences.

The values presented in panel A.3 show the relationship between ownership of a computer and per capita household income for seven categories of minimum salaries. The proportion of households that own a computer is substantially greater in the higher income categories in both 2004 and 2009. The five-year period witnessed an increase in all income categories. The increase was comparatively low in the poorer income categories (up to ¼ and more than ¼ and up to ½ minimum salaries), and high in the categories above ½ a minimum salary. A different pattern of change is observed with respect to connectivity with the Internet. As shown in panel B.3, large increases between 2004 and 2009 occurred across all income categories, but especially in the category more than ¼ and up to ½, which saw an increase of 19.9 percentage points.

When the estimates are presented for the country as a whole, the income effects on ownership of computers and on the access to the Internet (observed in Table 2) are affected by the distribution of the population in rural and urban places, and also by the distribution of people across the five regions. To remove the effects of rural/urban residence and regional location we can control for these variables in a multivariate statistical analysis. Because the two dependent variables are both dichotomies, the appropriate statistical technique is Logistic Regression. Table 3 presents the results.

Table 3
Microcomputers and Internet Access Regressed on
Place of Residence, Region, and Household Income, 2004 and 2009
(logistic regression coefficients and odds ratios)

			2004		2009	
			B (1)	Exp(B) (2)	B (3)	Exp(B) (4)
A. Computer	Place	Urban	1.517	4.56	1.44	4.23
		Rural (ref)	-	-	-	-
	Region	North (ref)	-	-	-	-
		Northeast	0.25	1.28	0.05	1.06
		Southeast	0.74	2.09	0.61	1.84
		South	0.69	1.99	0.64	1.89
		Center West	0.41	1.50	0.40	1.49
	Income	Less than ¼ minimum salary (ref)	-	-	-	-
		More than ¼ to ½	0.68	1.98	0.86	2.37
		More than ½ to 1	1.92	6.79	1.62	5.04

		More than 1 to 2	3.00	20.17	2.39	10.87
		More than 2 to 3	4.00	54.45	3.06	21.32
		More than 3 to 5	4.63	102.13	3.51	33.50
		More than 5 minimum salaries	5.35	210.03	4.18	65.49
	Constant		-4.04	0.02	-1.94	0.14
	Nagelkerke R Square		0.379		0.321	
B. Internet	Place	Urban	1.32	3.75	1.198	3.315
		Rural (ref)	-	-	-	-
	Region	North (ref)	-	-	-	-
		Northeast	0.58	1.79	.726	2.067
		Southeast	0.77	2.16	.717	2.048
		South	0.66	1.93	.490	1.633
		Center West	0.57	1.77	.616	1.851
	Income	Less than ¼ minimum salary (ref)	-	-	-	-
		More than ¼ to ½	0.10	1.10*	.304	1.355
		More than ½ to 1	0.77	2.16	.774	2.167
		More than 1 to 2	1.25	3.48	1.383	3.985
		More than 2 to 3	1.72	5.58	1.873	6.507
		More than 3 to 5	2.18	8.88	2.353	10.515
		More than 5 minimum salaries	2.90	18.11	2.859	17.439
	Constant		-1.45	0.24	-.551	.576
	Nagelkerke R Square		0.148		0.142	

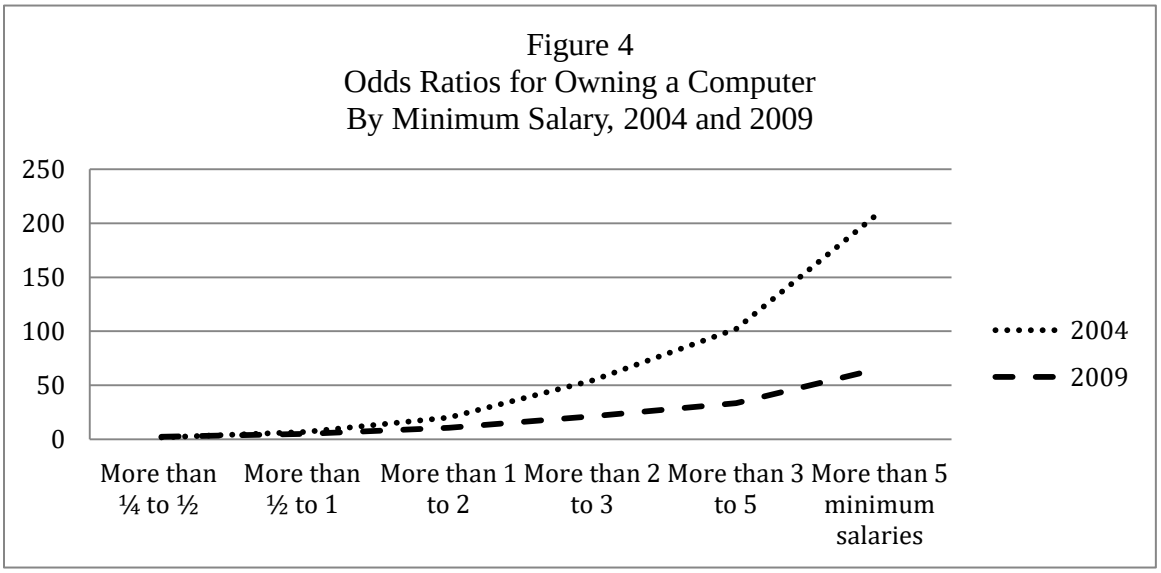
*Not significant

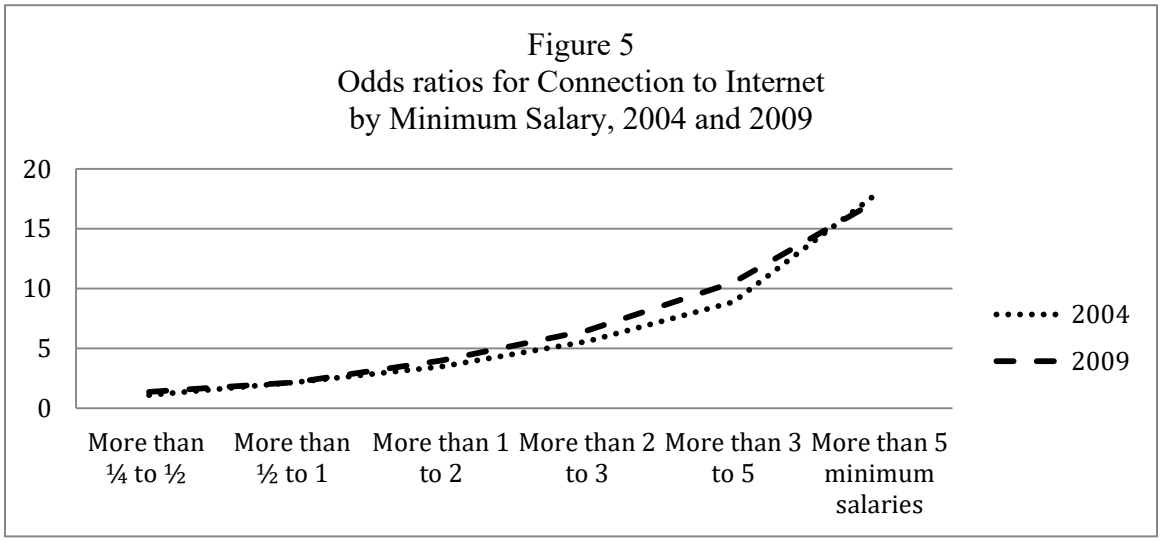
The odds ratios shown in column 2 and 4 are of special interest. If the independent variable had no effect on the likelihood of owning a computer, the odds ratio would be 1.00. This is not the case with respect to place of residence. The results for 2004 and 2009 (A.1, columns 2 and 4) show that, controlling for region and household income, the odds that people living in urban areas own a computer if more than four times greater compared to people living in rural areas, the reference group. The results presented in the lower panel (B.1, column 2 and 4) similarly show that, other things being equal, households in urban areas are more than three times more likely to have Internet access compared to households in rural areas.

The effect of urban residence on the likelihood of owning a microcomputer thus appears to remain more or less constant when we compare the results in 2004 to those in 2009. In contrast to urban residence, the effect of income changed significantly over the five-year period. The observed changes have important substantive implications for understanding the changing character of the digital divide in Brazil.

The odds ratios presented in columns 2 and 4 are in relation to the lowest category of income, up to ¼ minimum wages. The poorest group of the population serves as the reference group for estimating the effect of belonging to each subsequent income stratum. We thus observe that, in 2004, the odds of owning a computer among households earning more than 5 minimum salaries are around 200 times more likely to own a computer compared to households with ¼ salaries or less. Figure 4 visually displays the odds ratios associated with each income strata. It is evident that the relationship is not linear. The curve is relatively flat up until the "more than to 2 and less than 3 salaries" category, when the curve becomes much steeper. In other words, the likelihood of owning a computer does not change much from the first through the third income category, but rises with each subsequent income strata, and does so at a higher rate. It is evident that household income is a major determinant of the digital divide in 2004.

Figure 4
Odds Ratios for Owning a Computer
By Minimum Salary, 2004 and 2009





The comparison with the findings in 2009 is revealing. In 2009, the odds ratio of owning a computer among households earning more than 5 minimum salaries is around 65 times higher compared to households with ¼ salaries or less. This value is substantially lower than the comparable odds ratio of 210.03 observed in 2004. As a result, the shape of the curve, shown in Figure 5 is flatter in 2009 compared to five years earlier. We conclude that household income remains a major determinant of probability of owning a computer, but that the income effect is lower in 2009. Put another way, digital divide between the poorest and the richest households declined substantially between 2004 and 2009. It is evident that computers not only became more prevalent in the country in 2009 (Table 2), but also that the probability of owning a microcomputer became more equally distributed.

With respect to the Internet, Figure 5 shows that the relationship between increases in per capita household income and the likelihood of having access to the Internet did not change from 2004 to 2009. Using the lowest income category as the reference, the odds ratio for households in the highest income category was 18.1 and 17.4 in 2004 and 2009, respectively. If the socioeconomic profile of the digital divide with respect to the Internet remained virtually unchanged, the interpretation of this observation should note the estimates shown in Table 3, which show that 80% of microcomputers are connected to the Internet, which is higher than any country in the region.

The estimates obtained from the 2004 and 2009 PNAD surveys illustrate the rapid changes that have taken place in Brazil with respect to the ownership of microcomputers and access to the Internet. To extend the analysis from access to the Internet to assessing the social consequences associated with the frequency of Internet use, we use indicators available in the 2010 AmericasBarometer survey.

Does the Digital Divide matter in Brazil?

We recoded the scores on the four independent variables in the AmericasBarometer survey into ordered categories, which vary from low to high, as described in Table 4. Because the distribution of the dependent variables violates the assumptions of Ordinary Least Squares Regression, we used Ordinal Regression to test the effects of Internet use, controlling for socio-demographic characteristics. Ordinal Regression is similar to Logistic Regression but accounts for variables that have multiple responses that can be ordered in intensity.

Table 4

Description of Dependent Variables, Main Independent Variable, and Control Variables

Dependent variables	
Political knowledge	Who is President of the United States? How many states are there in Brazil? How many years is the President's term of office in Brazil? (Composite index scores: (0) low to (2) high)
Participate in community action	In the last twelve months, how many times did you contribute to a solution to a problem in your community or among your neighbors? (1) never (2) once or twice a year (3) one or twice a month (4) once a week (Scores (1) low to (3) high)
Approve of a legal demonstration	Do you approve of the idea that people have the right to participate in a legal demonstration? From (1) strongly disapprove to (10) strongly approve (Scores (1) low to (3) high)
President can close congress	In light of the country's current situation, to what degree do you agree with the statement "When the Congress gets in the way of the government's work; our presidents should govern without the Congress." From (1) strongly disagree to (7) strongly agree (Scores (1) low (2) high)
Main independent variables	
Internet use	How often do you use the Internet? (1) never (2) rarely (3) several times a month (4) several times a week (5) daily
Control variables	
Media for news	How often do you pay attention to the news, be it on television, the radio, newspapers or the Internet? (1) never (2) rarely (3) one a month (4) several times a week (5) daily
Age	In years

Income	Household income in reais: (1) 0 to 510 (2) >510 to 1,020 (3) >1,010 to 1,530 (4) >1,530 to 2,550 (5) >2,550 to 3,570 (6) >3,570 to 4,080 (7) >4,080 to 6,120 (8) >6,120 to 7,650 (9) >7,650 to 10,200 (10) >10,200 (Minimum salary in 2010= R$510)

The B coefficient for the variable called Frequency of Internet use, shown at the bottom of Table 5, is the ordered log-odds estimate for a one unit increase in the Internet Use score on the expected level of Political Knowledge, when the other variables in the model are held constant. In this case, a one-unit increase in Internet Use would result in a 0.388 unit increase in the ordered log-odds of being in a higher category of Political Knowledge. As shown in column two, this value is equivalent to a 47 percent increase in the odds of achieving a higher score on the scale of Political Knowledge. The Negelkerke Pseudo R-square estimate is relatively high (0.229). We can conclude that, other things being equal, an increase in the frequency of Internet use is associated with a substantial increase in political knowledge.

Table 5

Internet Use Regressed on Indicators of Political Knowledge, Participation in Community Action Approval of Legal Demonstrations, and President's Right to Close Congress, Brazil 2010 (Ordinal Logistic Regression)

			Political Knowledge			Participate in Community Action			Approve of Legal Demonstrations			President can Close Congress		
			B		Exp(B)	B		Exp(B)			Exp(B)	B		Exp(B)
			1		2	3		4	5		6	7		8
Threshold		0	-0.028			1	1.866	**	1	-3.095	**	1	-0.748	**	
		1	1.733	**		2	2.792	**	2	-0.905	**	2	2.456	**	
		2	3.769	**		3	4.096	**	3	0.456					
Region	North		0.326	**	1.39		-0.043		0.96	-0.447	**	0.64	0.587	**	1.80
	Northeast		-0.309	**	0.73		-0.358	**	0.70	-0.314	**	0.73	0.461	**	1.59
	Center-West		0.441	**	1.55		0.167		1.18	-0.475	**	0.62	0.05		1.05
	Southeast		0.236	*	1.27		-0.171		0.84	-0.254	*	0.78	0.281	*	1.32
	Southeast (ref)														
Place	Urban		0.137		1.15		-0.473	**	0.62	-0.016		0.98	0.682	**	1.98
	Rural (ref)														
Gender	Male		0.511	**	1.67		0.032		1.03	0.013		1.01	-0.014		0.99
	Female (ref)														
Age	In years		0.001		1.00		0.019	**	1.02	-0.009	**	0.99	-0.005		1.00
Education	Years of school		0.026		1.03		0.022		1.02	0.013		1.01	-0.001		1.00
Income	Household		0.119	**	1.13		0.097	**	1.10	0.017		1.02	-0.028		0.97
Media	Turn to media for news		0.274	**	1.32		0.035		1.04	0.081	*	1.08	-0.104	*	0.90
Internet	Frequency of use		0.388	**	1.47		0.08	*	1.08	0.065	*	1.07	-0.105	**	0.90

R-Sqr.	0.229	0.042	0.024	0.036

Source: AmericasBarometer
2010 **p<.01 *p<.05

Compared to the indicator of Political Knowledge, the models that predict the effects of Internet Use on the other dependent variables is less strong, evidenced by the comparatively low R-square values for Participation in Community Action (0.042), Approval of Legal Demonstrations (0.024), and President can Close Congress (0.036). The coefficients for Internet Use are nonetheless statistically significant and offer potentially important insights into the associate between Internet use and key dimensions of political culture. Specifically, every increment in the frequency of use is associated, respectively, with an eight and a seven percent increase in the odds of participating in community action and in the respondents' approval of people's right to participate in a legal demonstration. The results further show that each increase in the frequency of Internet Use is associated with ten percent decline in the odds that respondents approve of the idea that the President can Close Congress.

Although the models have low explanatory power and the coefficients for Internet Use are small, we can conclude that the statistically significant effects of Internet Use nonetheless show a pattern across the three indicators of political culture that is consistent with the hypothesis that Internet use is associated with attitudes considered supportive of democratic governance.

Discussion

In the decades since the military relinquished control of the government in 1985, Brazil has been ruled by a succession of elected presidents in a climate of political stability and economic growth. The socioeconomic and political progress the country has achieved has inspired a kind of "breathless excitement" in the Brazil's future (Sweig, 2010). The optimism is reflected in the "BRIC" acronym, coined by the investment giant, Goldman Sachs, which places Brazil in the company of Russia, India and China as the four leading emerging markets, expected to comprise nearly half of the world's GDP growth by 2020. Whether Brazil is able to live up to its potential in the years ahead will much depend its ability to successfully address the challenges that remain, not least of which include the need to expand and disseminate information technology and promote a political culture that supports the deepening of democratic governance in the country.

The estimates presented in this study leave little doubt that Brazil ranks among the leaders in Latin America in terms of the proportion of households that owns a computer and the

proportion with access to the Internet. The data further show that in the five years between 2004 and 2009 access to computers and to the Internet has increased across the country. Geographic and socio-economic disparities remain in 2009, yet the gap in Internet access between people living in urban and rural areas has declined, as has the gap in Internet access between low and high-income households.

Our analysis additionally shows that, other things being equal, more frequent users of the Internet are more likely to be politically informed and are more likely to endorse attitudes that are consistent with the political culture of liberal democratic governance. Frequency of Internet use is positively associated with Internet user's participation in community action as well as the likelihood that they approve of taking part in legal demonstrations, but is negatively associated with the counter-democratic notion that the President of the country has the right to close Congress.

Because the models predicting politically relevant attitudes are weak and the estimated independent effects of Internet use are small, the findings with respect to the social consequences of the Internet in Brazil are more suggestive than definitive. Nonetheless, when we consider these results in the broader context of the increase in computer ownership and Internet access, we can conclude that the ICT environment in Brazil has expanded significantly, that the digital divide by socioeconomic status has declined, and that the observed changes have potentially positive effects on various aspects of political culture deemed relevant to the prospects of democratic consolidation in Brazil.

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