# The Global Digital Divide Revisited (2000-2004)

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**Abstract**

This paper examines the determinants of the "digital divide" using a macro panel data set of 188 countries over the period 1990-2004. Prior research shows that the "digital divide" relates to economic development, education, regulatory environment, internet costs, enforcement, personal computers, spoken language, and digital communications infrastructure, this paper also demonstrates that differences in the distribution of income (inequality) within countries can play a vital role when explaining the "digital divide". Moreover, this effect can be so strong that, according to our results, the negative inequality effect may tend to exceed a possible positive direct income effect on Internet and personal computers diffusion processes. As a consequence, a reduction in income disparities can be essential to promote ICTs diffusion. Our results also suggest that an increase in the public investment in human capital as well as an effort in the promotion of markets openness can considerably reduce the "digital divide".

*Keywords*: Digital divide; Internet; Technological diffusion

***JEL classifications***: L50; L96; O30

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## 1. Introduction

Digital divide is a new phenomenon emerging with the development of the information and communication technologies (henceforth, ICTs). The global economy is being driven by greater integration of global markets and the spectacular growth of the ICTs. The widespread use and implementation of ICTs has increased the world's potential for dissemination of knowledge and information. As a result, a positive sense has emerged concerning the uses and potential benefits from the continued growth of the ICTs. ICT sectors have been growing faster than non ICT sectors. Indeed, ICT services have been growing even faster, particularly computers and related services.

The United Nations Development Report (UNDP) warned that the gains in productivity produced by the new technology may widen differences in economic growth between the most affluent nations and those that lack the skills, resources, and infrastructure to invest in the information society (UNDP, 1999). Thus, poorer societies might be marginalized at the periphery of the communication networks (Norris, 2002). Indeed, there are important differences in the degree of diffusion or adoption across countries. The gap between developed and developing countries is increasing over time (Andrés et al., 2007).

Previous formal literature on the diffusion of ICTs has stressed that disparities in ICTs diffusion may have an important role in the diffusion of knowledge, levels of political engagement, as well as on economic growth (Norris, 2001; Steinmueller, 2001; Brynjolfsson & Hitt, 2003; Wallsten, 2005). As a result, governments of developing countries have become aware of how decisive a political strategy to eliminate the above-mentioned effects can be, and have tried to catch up with more developed countries.

A better understanding of all aspects of digital divide is essential in order to be able to implement adequate policy formulations as documented by international organizations (See, for instance, UNCTAD,2005; World Bank, 2004). This paper aims to analyse the permanence of a "digital divide" by considering a cluster of information networks that include personal computers (PCs) and the Internet. The processes involved in diffusion, emerging trends, and their magnitude can be important inputs for the design and implementation of public policies in developing countries.

In 2004, thirty percent of the world's population had 66% of the world's GDP, 64% of the world's PCs, and they represented 58% of the world Internet subscribers and 75% of Broadband users. Despite the high level of these disparities, it is interesting to note that the Internet is experiencing a change in its trend toward inequality. In 1997, 93% of Internet subscribers were concentrated among only a fifth of the world's people (Kiiski & Pohjola, 2002).

In this paper, we focus on the digital divide. In this paper, we make use of a unique dataset to study the determinants of digital divide for a large set of countries for the period 1990-2004. We use a dataset that covers more countries and years that earlier studies. Our analysis includes both developed and developing countries. This paper addresses three main questions:

1. Is there an international "digital divide" in the processes involved in providing access to PCs and the Internet? Is the "digital divide" decreasing or increasing? Is it seriously affected by each country income inequality?
2. Is regulation affecting the diffusion process? Is education a barrier or an enhancer of diffusion?

3. What are the main determinants of the observed disparities? How can governments promote public policies aimed at reversing the expansion lag in information networks?

This study is very much in the same vein as that of Chinn & Fairlie (2007) focusing on PCs, the Internet and international disparities, and uses a similar methodology. However, this analysis go further by taking into account the specific role income inequalities within countries can play in explaining ICTs diffusion disparities across countries. In addition, this research adds new knowledge to the existing empirical studies by assessing whether underdeveloped countries can really catch up with the more developed countries in terms of access to the Internet. In addition, it considers several alternative statistical measurements in order to study disparities in the world's "digital divide"; breaking it down into different components, and identifying the main determinants. To our knowledge, there have been no empirical studies that address the same general question concerning the effects of ICTs on the growth and development of a nation in this way. Further, we conduct our empirical analysis, in a panel data framework, using standard panel data techniques.

The results show that income and educational asymmetries can be important factors affecting diffusion inequalities in the cross-country information clusters studied. In addition, each country's openness to trade can also play an important role explaining the observed disparities. Finally, a crucial element explaining the persistence of the "digital divide" can emerge from the asymmetrical distribution of income within countries.

The remainder of this paper is organized as follows: Section 2 discusses the variables that are included in the baseline specifications. Our model, estimation strategy and empirical results are presented in Section 3. Section 4 presents a series of robustness checks and conclusions are drawn in Section 5. Summary statistics, correlation matrices and regression results are included in the Appendix.

# 2. Variables and discussion

## 2.1 Interest variables

The digital divide is defined as the gap between those with a permanent, effective access to new information and communication technologies (ICTs) and those with none (e.g. Hoffman & Novak, 2000; Fairlie, 2004; Andonova, 2006; Chinn & Fairlie, 2007). According to this definition, this gap can be witnessed both at the national level, between different social groups, and internationally, between different countries. The present study deals with the last one.

In attempting to measure the size and evolution of the international "digital divide" a large set of variables have been tested as determinants of PCs and Internet diffusion. Over the past ten years literature has endeavored to uncover economic, social, and political factors that aided or hindered the divergence of ICTs diffusion rates across countries.

A substancial body of the literature has examined the impact of differences in income, human capital, legal environment, and telecommunications infrastructures on ICTs adoption (e.g. Harggitai, 1999; Quibria et al., 2000; Dasgupta et al., 2001; Oxley & Yeung, 2001; Robison & Crenshaw, 2002; Kiiski & Pohjola, 2002; Bellock and Dimitrova, 2003; Wallsten, 2005; Chinn & Fairlie, 2007). A more limited number of studies have looked at the role of inequality across countries in influencing the international "digital divide" (e.g. Harggitai, 1999; Kiiski & Pohjola, 2002).

The relationship between GDP and ICTs diffusion is well documented in literature. For example, Harggitai (1999), Quibria et al (2000), Kiiski & Pohjola (2002), Bellock & Dimitrova (2003), and Chinn & Fairlie (2007) all have shown that GDP is a large determiner of Internet access. International disparities in per capita income help to explain the gap in computer and Internet use. But this is not the only important factor afecting the global "digital divide".

Bellock & Dimitrova (2003) showed that increasing civil liberties have also a positive and significant effect on the Internet diffusion process. Robison & Crenshaw (2002) that development level, political openness, mass education, and the size of tertiary sector are the most significant determiners of Internet penetration. Also, Kiiski & Pohjola (2002) find that education can be an important factor in Internet diffusion when developing countries are included in the sample.

Oxley & Yeung (2001) demonstrated that Internet hosts penetration is positively related with telecoms infrastructures, rule of law, and credit card use and negatively correlated with telephone service costs. Quibria et al (2000) analysing PCs and Internet use per capita find that GDP, education levels, and infrastructure are the most important drivers of these ICTs diffusion. More recently, Chinn & Fairlie (2007) studied PCs and Internet use per capita and find that GDP, telephone density and regulatory quality (pro-market policies) are important determinants of these technologies.

Following the above mentioned surveyed results, in the present analysis we considered that the process of diffusion of PCs and Internet is affected by: economic indicators, human capital, the institutional and legal environment, and the development level of the existing technological infrastructure.

In our study, the selected economic indicators are: telecommuniactions prices, the level of income per capita (GDP), the Gini index of inequality in the distribution of income for each of the 188 countries in the sample and the degree of international exposure of national markets to international competition. As proxies for telecommunications prices we used both, the price of a three minutes mobile call at peak rate, and the price of a three minutes local call at peak rate (International Telecommunications Union (ITU) database). Income per capita data comes from the Penn World Tables and the source for the Gini index variable is the World Bank's World Development Indicators (WDI) database. Total trade as a percentage GDP is the variable employed to measure the degree of openness of national markets.

The country's educational level is assessed by the level of public expenditures in education as a percentage of the country's gross domestic product. Legal environment is introduced in the model using data from the International country risk guide (PRS group), more specifically from Table 3B: political risk points by component.

The existing technological infrastructure is captured by the existing main lines in operation for each country in the sample and the percentage of urban population as this last variable can help us to estimate possible cost differences in building the fixed telecommunications infrastructure. Both variables come from the International Telecommunication Unions (ITU) database.

## 3. EMPIRICAL STRATEGY

Technological innovations such as the ICTs are usually not immediately adopted by all potential consumers. The formal literature has pointed out that individuals have a different timing to innovate (Lefebvre & Lefebvre, 1996). It is possible to classify their behaviour across five different categories: innovators, early adopters, early majority, late majority, and laggards (Rogers, 2003). Based on the concept of rate of adoption, an innovation diffusion process has been viewed as following a pattern over time that seems like an S-shaped or sigmoid curve: first the innovation adoption rate is slow, after that it starts experiencing a phase of rapid growth, after which it stabilizes, and eventually declines. The sigmoid diffusion functions' second derivatives are positive first and then negative after the inflection point. The literature typically uses two kinds of models for ICT diffusion (Griliches, 1957; Dixon, 1980; Pereira & Pernías-Cerrillo, 2005): Gompertz, and logistic. Both represent S shaped diffusion paths.

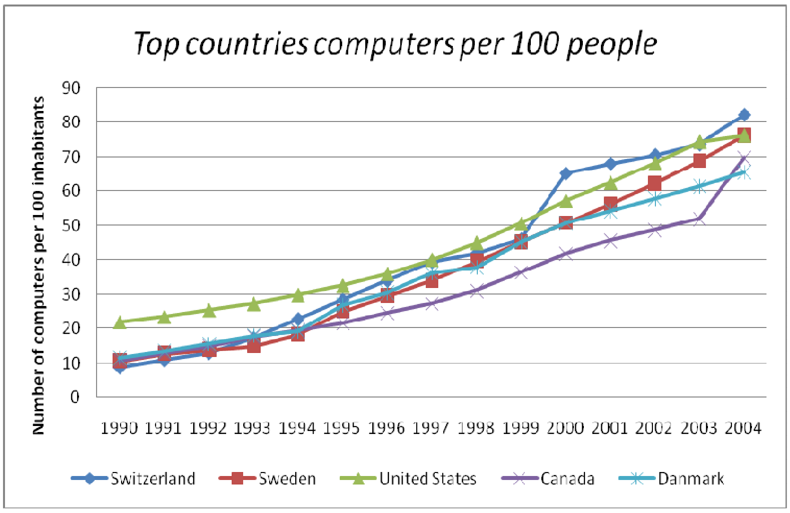


**Figure 1: S-shaped computers diffusion**

Source

The important feature of the Gompertz curve is that the diffusion goes faster at the beginning but becomes slower over time. This leads to a relatively short period of rapid expansion and to a relatively long period of gradual growth up to the maximal level. The logistic curve is more symmetric - the growth rate is initially not as high as in the

Gompertz curve and it declines more gradually (see Jarne, Sanchez-Choliz, & Fatas-Villafranca, 2007).

This S-shaped curves are also designated by "epidemic models" of technology diffusion and they have been the major approach used in the innovations diffusion literature since the middle of the twentieth century. The flow of new adopters of the innovation is related to the stock of existing adopters. When this stock is small the risk of "contagion" is low but as the stocks grows the risk of contagion increases. And as soon as the stock reaches a level close to the total number of potential adopters the flow of new adopters decreases. This approach major drawback is that they do not give an economic explanation for the spread of the innovation, the diffusion process is exogenously given and do not take into account individuals adoption choices.

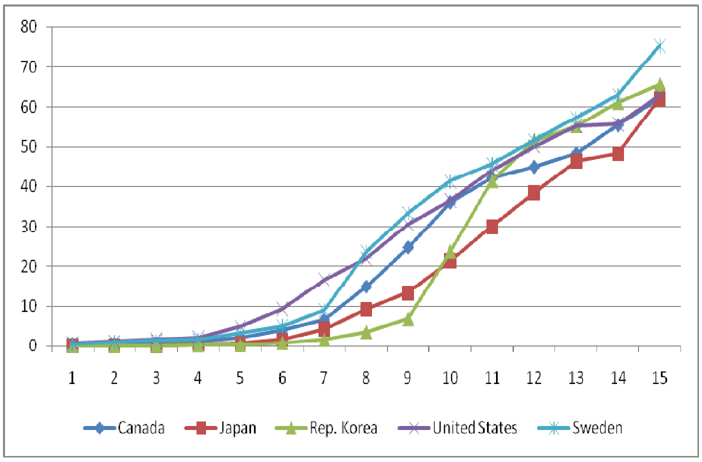


**Figure 2: S-shaped Internet diffusion process**

Source

In the curent study, we follow a well known literature alternative approach (e.g. Kiiski & Pohjola, 2002; Madden et al., 2004; Gruber, 2005) that combines the constant parameters of the diffusion model with other variables that introduce more flexibility into the innovation diffusion process. The diffusion process is affected by both the location variables and the growth variables. These variables depend on country specific effects as well as on a set of continuous explicative varibles. Any particular observation for country *i* and period *t* of the diffusion process can be modelled by the equation:

$$y_{i\,t}= y_i^{*}/(1+exp(-a_{it}-b_{it}t)) \qquad (1)$$

where Y* is the number of potential adopters, and *a* and *b* are the above mentioned location and growth parameters. According to this model

$$dy_t/d\,t= by_t\,(1-y_t/y^{*}) \qquad (2)$$

and $d^2y_t/dt^2$ is positive until the inflection point after which it turns to be negative.

Following Kiiski & Pohjola (2002), and Chinn & Fairlie (2007), we use a Gompertz model of technology diffusion to test the role of the Internet and PCs cross-country diffusion, with the aim of assessing the evolution of the digital divide in more recent years. This models start from equation (2) and assume that the number of potential adopters is a linear function of variables such as per capita income (*GDP*), citizens educational level, openness of the countries markets, prices of the technologies being analysed, the size of telecommunications infrastrucure, and regulatory environment. To identify the main determinants of internet adoption, we follow Estache et al. (2002), and Caselli and Coleman (2001), and estimate the following reduced form:

$$ln(Y_{it}/Y_{it-1}) = \beta_0 + \beta_1 * P_{it} + \beta_2 * GDP_{it} + \beta_3 * N_{it-1} + \beta_4 * I_{it} + \beta_5 * Z_{it} + u_{it} \qquad (3)$$

where *Y* is the penetration rate in country *i* at period *t*, the $\beta$s are parameters to be estimated and $u_{it}$ is a zero-mean stochastic error structure. The explanatory variables include a constant term, *P* is a price vector, the real GDP per capita (*GDP*), the lagged value of the network size ($N_{t-1}$ ), an inequality measure (*I*), and a vector of socio-economic variables (*Z*) that are expected to help to characterize each country location and growth variables.

As economic inequality and income are related to each other, in this paper, we also test the classical Kuznets hypothesis (Kuznets, 1955; Lewis, 1954). According to this hypothesis, inequality rises with income at low levels but falls once income reaches a critical level. Thus, the second derivate is negative, by regressing the following equation:

$$I_{it} = \mu_0 + \mu_1 GDP_{it} + \mu_2 GDP^2_{it} + \eta_{it} \qquad (4)$$

We validate the Kuznets hypothesis if the coefficient of the linear term of this equation has a positive sign ($\mu_1$), while the coefficient estimate of the quadratic term has a negative value ($\mu_2$). If we substitute $I_{it}$ as defined in equation (4) into equation (3) we obtain:

$$ln(Y_{it}/Y_{it-1}) = \pi_0 + \beta_1 P_{it} + \pi_1 GDP_{it} + \pi_3 GDP^2_{it} + \beta_3 N_{it-1} + \beta_5 Z_{it} + u_{it} \qquad (5)$$

where $\pi_0 = \alpha + \beta_4\mu_0$, $\pi_1 = \beta_2 + \beta_4\mu_1$ and $\pi_3 = \beta_4\mu_2$. We fit this model to a panel data set for 188 countries for the period 1990 through 2004.

## 4. THE DATA AND EMPIRICAL RESULTS

Data are gatherered from several sources. Complete data were available for countries for the years 1990 through 2004. The countries included in the full sample are listed in the Appendix. Descriptive statistics of the full sample are reported in Table 2. For the full sample, the average number of computers…… (etc).

The individual effects are significant. All models reject the null hypothesis that there is no correlation between individual effects and the explanatory variables, being the prefereed specification the fixed effects model. Inspection of the inequality model regression results enables us to validate the Kuznets hypothesis: the *GDP* coefficients are positive ($\mu_1 > 0$) and statistically significant, documenting a positive impact of a *GDP* increase on the inequality variablel, and the $GDP^2$ estimated coefficient is negative ($\mu_2 < 0$) and statistically significant, stating that the previous effect is decreasing[2].

Therefore, gathering information on the above mentioned results of the inequality model and on the results of the diffusion models helps us explainig the negative sign of the GDP coefficient and the positive sign of $GDP^2$ in the diffusion model results. They both reinforce the importance of the negative effect of inequality ($\beta_4 < 0$) on diffusion processes such as the Internet or personal computers. Moreover, it seems that, according to these results, the negative inequality effect tend to exceed a possible positive direct income effect ($\beta_2 > 0$).

In line with previous studies, we also find evidence that there is a positive and statistically significant impact of the degree of openness of markets on Internet and personal computers diffusion. As we would expect, the degree of international exposure to competition seems to be an important driver of ICTs diffusion.

Similar to the results already surveyed, we also show that education can help ICTs diffusion rates. According to Table 3 and Table 4 results, education has a positive and statistically significant impact on the adoption rate level attained, consistent with the findings of other authors. Less evident is the negative impact of the telecommunications infrastructure, when measured by the number of fixed mainlines, on the diffusion rates being studied. The existing technological infrastructure captured by the existing main lines in operation for each country in the sample seem to play a negative role in adoption rate.

[2] We are here excluding from analysis Model 1 estimates. These are pooled regression results that are valid only on the strong assumption that there are no country specific effects. And as can be viewed in table 5 we reject the null hypothesis of the F-test.

Also, the percentage of urban population seems to have not a significant role in the rate of adoption.

## 5. Conclusions

In this paper, we tried to assess the factors which determine the diffusion of Internet and personal computers across countries placing a particular emphasis on the role of inequality. Our results show that many of the differences observed in the use of information technologies frequently designated by “digital divide” can emerge from differences in the distribution of income within countries (inequality). Consequently, in order to catch up with more advanced countries in ICTs expansion may require less developed countries change public policy towards reducing income inequalities at the national level.

Secondly, education and the degree of openness of the national markets are important determiners of information technologies diffusion. Governments may consider influencing these factors if the ICTs diffusion is one of their priorities.

Testing other factors that can contribute to the observed differences in the level of information technologies diffusion across countries is the next step of this work. New variables will be introduced and tested in order to validate current results. This analysis is our starting point to comprehend the role of inequality and other economic, social and political factors in explaining the global “digital divide”. Further work is needed to verify the validity of the current conclusions.

In this study, there seems to be no clear difference between the results for the Internet penetration rate gaps and those for the computer penetration rate gaps. As a consequence public policies seem to be able to successfully attain a reduction in each of the analysed gaps by promoting an increase in educational achievement, or contributing to the openness of its markets, as well as by making an effort to reduce income disparities among its population.


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# Appendix

Table A1. List of countries

| | | | |
|---|---|---|---|
| 01. Afghanistan | 48. Djibouti | 95. Latvia | 142. Samoa |
| 02. Albania | 49. Dominica | 96. Lebanon | 143. Sao Tome Principe |
| 03. Algeria | 50. Dominican Rep. | 97. Lesotho | 144. Saudi Arabia |
| 04. Angola | 51. Ecuador | 98. Liberia | 145. Senegal |
| 05. Antigua and Barbuda | 52. Egypt | 99. Libya | 146. Serbia and Montenegro |
| 06. Argentina | 53. El Salvador | 100. Lithuania | 147. Seychelles |
| 07. Armenia | 54. Eq. Guinea | 101. Luxembourg | 148. Sierra Leone |
| 08. Australia | 55. Eritrea | 102. Macao | 149. Singapore |
| 09. Austria | 56. Estonia | 103. Macedonia | 150. Slovak Republic |
| 10. Azerbaijan | 57. Ethiopia | 104. Madagascar | 151. Slovenia |
| 11. Bahamas | 58. Fiji | 105. Malawi | 152. Solomon Islands |
| 12. Bahrain | 59. Finland | 106. Malaysia | 153. Somalia |
| 13. Bangladesh | 60. France | 107. Maldives | 154. South Africa |
| 14. Barbados | 61. Gabon | 108. Mali | 155. Spain |
| 15. Belarus | 62. Gambia, The | 109. Malta | 156. Sri Lanka |
| 16. Belgium | 63. Georgia | 110. Mauritania | 157. St. Kitts & Nevis |
| 17. Belize | 64. Germany | 111. Mauritius | 158. St. Lucia |
| 18. Benin | 65. Ghana | 112. Mexico | 159. St.Vincent Gren |
| 19. Bermuda | 66. Greece | 113. Micronesia, F. Sts. | 160. Sudan |
| 20. Bhutan | 67. Grenada | 114. Moldova | 161. Suriname |
| 21. Bolivia | 68. Guatemala | 115. Mongolia | 162. Swaziland |
| 22. Bosnia and Herzeg | 69. Guinea | 116. Morocco | 163. Sweden |
| 23. Botswana | 70. Guinea-Bissau | 117. Mozambique | 164. Switzerland |
| 24. Brazil | 71. Guyana | 118. Namibia | 165. Syria |
| 25. Brunei | 72. Haiti | 119. Nepal | 166. Taiwan |
| 26. Bulgaria | 73. Honduras | 120. Netherlands | 167. Tajikistan |
| 27. Burkina Faso | 74. Hong Kong | 121. Netherlands Ants | 168. Tanzania |
| 28. Burundi | 75. Hungary | 122. New Zealand | 169. Thailand |
| 29. Cambodia | 76. Iceland | 123. Nicaragua | 170. Togo |
| 30. Cameroon | 77. India | 124. Niger | 171. Tonga |
| 31. Canada | 78. Indonesia | 125. Nigeria | 172. Trinidad &Tobago |
| 32. Cape Verde | 79. Iran | 126. Norway | 173. Tunisia |
| 33. Central African Rep. | 80. Iraq | 127. Oman | 174. Turkey |
| 34. Chad | 81. Ireland | 128. Pakistan | 175. Turkmenistan |
| 35. Chile | 82. Israel | 129. Palau | 176. Uganda |
| 36. China | 83. Italy | 130. Panama | 177. Ukraine |
| 37. Colombia | 84. Jamaica | 131. Papua New Guinea | 178. United Arab Emirates |
| 38. Comoros | 85. Japan | 132. Paraguay | 179. United Kingdom |
| 39. Congo, Dem. Rep. | 86. Jordan | 133. Peru | 180. United States |
| 40. Congo, Republic of | 87. Kazakhstan | 134. Philippines | 181. Uruguay |
| 41. Costa Rica | 88. Kenya | 135. Poland | 182. Uzbekistan |
| 42. Cote d`Ivoire | 89. Kiribati | 136. Portugal | 183. Vanuatu |
| 43. Croatia | 90. Korea, Dem. Rep. | 137. Puerto Rico | 184. Venezuela |
| 44. Cuba | 91. Korea, Republic of | 138. Qatar | 185. Vietnam |
| 45. Cyprus | 92. Kuwait | 139. Romania | 186. Yemen |
| 46. Czech Republic | 93. Kyrgyzstan | 140. Russia | 187. Zambia |
| 47. Denmark | 94. Laos | 141. Rwanda | 188. Zimbabwe |

Table 1. Descriptive statistics

| Variables | Observations | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Income inequality- Gini index | 201 | 30.956 | 7.687 | 19.6 | 62.5 |
| Real Income (p.c) (in 1,000 $) | 1158 | 8.753 | 1.075 | 6.198 | 10.835 |
| Openness | 1158 | 90.425 | 55.896 | 2.142 | 462.926 |
| Main fixed lines | 1157 | 4 967 698 | 1.66e+07 | 3082 | 3.12e+08 |
| Bureaucracy quality | 785 | 2.560 | 1.0248 | 1 | 4 |
| Urban population (%) | 701 | 56.662 | 22.958 | 5.78 | 100 |
| Education expenditures (%) | 994 | 5.116 | 3.201 | 1.323 | 45.855 |
| Price local calls | 1164 | 1.447 | 13.201 | 0.000 | 230.088 |
| Price mobile calls | 1164 | 169.487 | 2 568.834 | 0.003 | 79 610.340 |
| Personal computers adoption rate | 999 | -10.628 | 1.802 | -16.219 | -4.683 |
| Internet adoption rate | 1004 | -11.092 | 1.784 | -16.337 | -6.365 |

Table 2. Correlation matrix of variables used in regressions

| | Internet adoption rate | PCs adoption rate | Real Income (p.c) | Education Expenditures (%) | Openness | Main fixed lines per | Bureaucracy quality | Urban population (%) | Price local calls | Price mobile calls | Lag PCs |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Internet adoption rate | 1 | | | | | | | | | | |
| PCs adoption rate | 0.956* | 1 | | | | | | | | | |
| Real Income (p.c) | 0.030* | 0.091* | 1 | | | | | | | | |
| Education expenditures (%) | 0.301* | 0.313* | 0.062* | 1 | | | | | | | |
| Openness | 0.430* | 0.454* | 0.267* | 0.111* | 1 | | | | | | |
| Main fixed lines | -0.436* | -0.419* | 0.191* | -0.098* | -0.176* | 1 | | | | | |
| Bureaucracy quality | 0.026 | 0.077* | 0.774* | 0.163* | 0.197* | 0.2996* | 1 | | | | |
| Urban population (%) | 0.011 | 0.084* | 0.722* | 0.046* | 0.200* | 0.085* | 0.450* | 1 | | | |
| Price local calls | 0.010 | -0.013 | -0.047* | -0.080* | -0.0045 | -0.023* | -0.055* | 0.005 | 1 | | |
| Price mobile calls | 0.010 | -0.013 | -0.036* | -0.064* | 0.0003 | -0.016 | -0.034* | -0.003 | 0.751* | 1 | |

Note: * indicates statistical significance at the 5 percent level.

Table 3. Regression results.
Dependent variable: *Internet adoption rate*

| Explanatory variables | Model (1) | Model (2) | Model (3) |
|---|---|---|---|
| Real Income (p.c) | -10.366*** [1.244] | -3.257*** [1.338] | -22.146*** [7.459] |
| Real Income (p.c) $^2$ | 0.612*** [0.071] | 0.1876*** [0.079] | 1.245*** [0.411] |
| Openness | 0.012*** [0.002] | 0.101*** [0.002] | -0.002 [0.006] |
| Education expenditures (%) | 0.113*** [0.042] | 0.071*** [0.024] | -0.017 [0.011] |
| Main fixed lines | -0.001*** [0.001] | -0.001*** [0.001] | 0.001* [0.001] |
| Urban population (%) | 0.013** [0.006] | 0.006 [0.006] | 0.007 [0.020] |
| Bureaucracy quality | -0.805*** [0.158] | -0.162 [0.141] | 0.096 [0.168] |
| Price local calls | 0.009* [0.005] | 0.001 [0.004] | -0.001 [0.001] |
| Price mobile calls | 0.001 [0.001] | 0.001* [0.004] | 0.001*** [0.001] |
| Lag internet users | 0.001*** [0.001] | 0.001** [0.001] | 0.001 [0.001] |
| Constant | 32.163*** [5.359] | 1.930 [5.673] | 86.566*** [3.057] |
| Observations | 397 | 397 | 397 |
| *Individual effects* | | | |
| F-test | | | |
| (p-value) | | | (0.000) |
| *Individual effects vs Random effects* | | | |
| Hausman test | | | |
| (p-value) | | | (0.000) |
| *No serial correlation* | | | |
| Baltagi-Wu Ibi statistic | | | 2.158 |

Notes: * significant at 10%; ** significant at 5%;
*** significant at 1%. Robust standard errors in brackets
Model (1) Regression with robust standard errors and analytical weights.
Model (2) Prais-Winsten regression, heteroskedastic panels corrected standard errors.
Model (3) Fixed effects with standard errors adjusted for panel clustering.

Table 4. Regression results.
Dependent variable: *Personal computers*

| Explanatory variables | Model (1) | Model (2) | Model (3) |
|---|---|---|---|
| Real Income (p.c) | -10.169*** [1.029] | -4.642*** [1.307] | -0.183 [3.861] |
| Real Income (p.c) $^2$ | 0.597*** [0.060] | 0.2811*** [0.078] | 0.010 [0.212] |
| Openness | 0.011*** [0.001] | 0.0078*** [0.001] | -0.0002 [0.002] |
| Education expenditures (%) | 0.124*** [0.032] | 0.0624*** [0.017] | -0.0005 [0.005] |
| Main fixed lines | -0.0001*** [0.001] | -0.0001** [0.001] | 0.0001* [0.001] |
| Urban population (%) | 0.0186*** [0.005] | 0.0070 [0.006] | 0.0030 [0.005] |
| Bureaucracy quality | -0.686*** [0.116] | -0.0977 [0.101] | -0.013 [0.032] |
| Price local calls | 0.010*** [0.002] | 0.0019 [0.001] | -0.0014*** [0.001] |
| Price mobile calls | -0.0001 [0.001] | 0.0001 [0.001] | -0.0001 [0.001] |
| Personal computers -lag | 0.0001 [0.001] | -0.0001** [0.001] | 0.0001*** [0.001] |
| Constant | 29.812 [4.342] | 6.557 [5.434] | -10.864 [17.454] |
| Observations | 315 | 315 | 315 |
| R-squared | | | |
| *Individual effects* | | | |
| F-test | | | (0.000) |
| *Fixed effects vs Random effects* | | | |
| Hausman test | | | (0.000) |
| *No Serial Correlation* | | | |
| Baltagi-Wu Ibi statistic | | | 2.329 |

Notes:
* significant at 10%;
** significant at 5%;
*** significant at 1%
Model (1) Regression with robust standard errors and analytical weights.
Model (2) Prais-Winsten regression, heteroskedastic panels corrected standard errors.
Model (3) Fixed effects with standard errors adjusted for panel clustering.

Table 5. Regression results.
Dependent variable: *Gini inequality index*

| Explanatory variables | Model (1) | Model (2) | Model (3) |
| --- | --- | --- | --- |
| Real Income (pc) | -56.269* [3.0537] | 11.434*** [2.1276] | 53.446*** [2.4009] |
| Real Income (p.c) $^2$ | 2.580 [1.5719] | -0.811*** [0.2145] | -2.592*** [1.2483] |
| Constant | 333.762*** [1.4812] | -2.928*** [0.5901] | -243.131*** [115.7832] |
| Observations | 276 | 276 | 276 |
| R-squared | | | |
| *Individual effects* | | | |
| F-test | | | |
| (p-value) | | | (0.000) |
| *Fixed effects vs Random effects* | | | |
| Hausman test | | | |
| (p-value) | | | (0.000) |
| *No Serial Correlation* | | | |
| Baltagi-Wu Ibi statistic | | | 1.500 |

Notes:
* significant at 10%;
** significant at 5%;
*** significant at 1%
Model (1) Regression with robust standard errors.
Model (2) Fixed effects with ar(1) disturbances.
Model (3) Fixed effects with standard errors adjusted for panel clustering.

Table 6

Variable names, definitions and sources

| Variable | Variable description | Source |
|---|---|---|
| Income | Real GDP per inhabitant (chain index) | Penn World Tables (PWT) 6.2, 2006 |
| Openness | Total trade as a % of GDP | Penn World Tables (PWT) 6.2, 2006 |
| Inequality | Gini index (WIID2.c high quality criteria) | UNU-WIDERWIID2.c high quality criteria |
| Main fixed lines per 1000 people??? | Main fixed telephone lines in operation divided by population | International Telecommunication Union (ITU), 2005 |
| Urban population (%) | Urban population as a percentage of total population | International Telecommunication Union (ITU), 2005 |
| Bureaucracy quality | Quality of bureaucracy | International Country Risk Guide (PRS group)(Table 3B: political risk points by component) |
| Price local calls | Price of a 3-minute fixed telephone local call (peak rate) ppp adjusted | International Telecommunication Union (ITU), 2005 |
| Price mobile calls | Mobile cellular - price of 3-minute local call (peak) ppp adjusted | International Telecommunication Union (ITU), World Telecommunications Report, 2005 |
| Education | Public expenditure on education (%) | UNESCO Education Database |
| Internet adoption rate | | Adapted from ITU world telecommunications indicators database 2005 |
| Personal computers adoption rate | | Adapted from ITU world telecommunications indicators database 2005 |
| Internet users | Description per 100 | International Telecommunication Union (ITU), World Telecommuncations Report, 2005 |
| Personal computers | Description per 100 | International Telecommunication Union, World Telecommunications Report (ITU), 2005 |