Female Literacy Rates, Information Technology and Democracy

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Abstract

The connections between female literacy rates, information technology and democracy are theoretically diverse and obscured by intervening economic and social factors. However, one should not overlook the important role of women's education in the overall economic and political development of a country. This study focuses on the theoretical and statistical connections via a structured literature review and two-stage regression model which validates the thesis that female literacy rates significantly impact the communication technology capabilities of a country, and these technological capabilities then impact the level of democracy within the country's government.

Female Education, Literacy and Technology

The universal right to primary education has been affirmed by United Nations and its member governments time and again over the past fifty years. "However, more than 130 million children who should be attending primary school are not. Two-thirds of these children are girls"[1]. Education makes it possible for women to exercise their rights and meet their aspirations for adequate livelihood, participation in political decision-making, and a fair chance in the modern economy for their families. "Education is an investment that stays with a woman throughout her life, is hers to use as she wishes, and cannot be taken away" [2]. Female education has "well-documented benefits for the broader society". These advantages include increased economic productivity, improved health, lower fertility rates and increased political participation. "While there are many other possible interventions to achieve these social goods, girls' education is the only one which impacts all of them simultaneously"[3].

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[1] Population Council. 1996. Accelerating Girls' Education: A Priority for Governments. n. pag. Accessed: April 30, 2003. http://www.popcouncil.org/gfd/girlseducation.html.
[2] Ibid.
[3] Ibid.

Social benefits also impact the economic sectors of the country. A noticeable impact of the widespread availability of education for women is that of lower fertility and smaller families. Lower fertility rates imply better health for the mothers, as well as more time for income-earning activities. Smaller families allow for fewer expenses and more savings. The education of women also improves their health, and that of their children. It has been proven that higher education leads to improved child nutrition, as well as increased prenatal care, and lower rates of maternal mortality[4].

The benefits of these social indicators for information technology comes with the entrance of women into the formal workforce. Case-level research has also found that education greatly improves a woman's chances of finding stable, paid employment, which is no easy task. As well as providing women with needed income, the employment of women in the formal sector may enhance development through its reduction of high fertility rates. If women are limited to work in the informal (especially at home) or agricultural sectors, the advantages to having more children outweigh the costs. These offspring will offer needed household labor. If moved into employment in the formal sector, it becomes more profitable to remain at work, and not have many children for which to care. Those women who do enter the formal workforce are often forced to leave during their childbearing years due to a lack of child-care options. This leaves them to turn towards "sporadic, short-term, or informal-sector employment (such as street vending or in-home piecework) where they can keep their children with them"[5].

These gender-related constraints on time and mobility lead to a lower degree of economic security for women then men across the world. "Without access to information technology, an understanding of its significance, and the ability to use it for social and

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[4] Buchmann, Claudia. "The Debt Crisis, Structural Adjustment and Women's Education." *International Journal of Comparative Politics* 37 (1996), 5-25.
[5] Ibid.

economic gain, women in the developing world will be further marginalized from the mainstream of their communities, their countries, and the world"[6].

"Government investment in schooling for girls, especially at the primary school level, is particularly justified in that it brings so many benefits"[7]. Even for the poorest country with the overall low enrollment, the argument for governments to focus resources on girls is quite compelling given the documented positive effects of girls' education on development. "With relatively modest modifications in the content and quality of schooling, teachers and materials, a far higher percentage of girls could enroll in and complete primary school, or remain there long enough to acquire basic literacy and numeracy skills"[8].

"Most women in developing countries are in the deepest part of the divide, further removed from the information age than the men whose poverty they share" [9]. The "gender dimension of the digital divide" is exacerbated by "women's lower levels of literacy and education relative to men, as well as negative attitudes towards girls' achievement in science and mathematics" [10].

Communication Technology and Democracy

"Coincident revolutions at the end of the 1980's-breakouts of democracy around the globe and breakthroughs in the communication and information technologies-have inspired the notion that democratic freedom and electronic interconnectivity might be positively correlated"[11]. This interconnectivity is the result of communications

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[6] Hafkin, Nancy and Nancy Taggert. 2001. "Gender, Information Technology and Developing Countries: An Analytical Study". p. 6. Accessed April 30, 2003. http://learnlink.aed.org/Publications/Gender_Book/pdf/Exec_Sum.pdf
[7] Population Council, 1996.
[8] Ibid.
[9] Hafkin, Nancy and Nancy Taggert, 2001.
[10] Ibid.
[11] Kedzie, Christopher R. 1995. "Democracy and Interconnectivity". n. pag. Accessed: April 30, 2003. http://www.isoc.org/HMP/PAPER/134/html/paper.html

technology research and infrastructure. Positive correlation is the first step towards establishing the existence of a significant relationship between communication technology and democratic governments.

"While governments can and have tried to control such [communications and information] technologies for their own ends, the liberating effects have ultimately proved to be the more powerful and, where unfettered, have led to more competitive and adaptive societies"[12]. Countries that allow the free flow of information, in the form of commerce or research, find themselves in better economic, political and social circumstances than those who strictly restrict and regulate the passage of technology over its borders.

It is well understood that information and communication technologies are critical for market success. "[T]elecommunication is an engine-probably *the* engine-for economic and social development"[13]. Economic and social development are important indicators for political development, and especially democracy.

Information technology has been accused of being "inherently de-humanising, centralist and authoritarian". Roger Clarke (1994) believes that "technology is essentially morally 'ambivalent'". Information technology is a tool used by politicians and government executives to achieve political ends.

The democratic ideal derives from the assumption that no class of people has the right to dominate other classes. "It reflects the renaissance conception of mankind, whereby each individual should have the opportunity to access and interpret for themselves the ideas of other people and of Gods; and, in more modern terms, should

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[12] Builder, Carl H. and Steven C. Bankes. The Etiology of European Change, P-7693, RAND, Santa Monica, Calif., December 1990.
[13] Wright, David. "Mobile Satellite Communications in Developing Countries: The role of Inmarsat." *Telecommunications Policy* January/February (1994), pp 5-11.

have the scope for self-determination and self-fulfillment"[14]. Information technology provides this opportunity to citizens of every nation, regardless of size or wealth.

Societies and government structures based on closely-held information are no longer entirely possible when information is free-flowing and relatively inexpensive. "Democracy and decentralization rise, and hierarchical organizations flatten. Travel, work, and consumption patterns change as electronic networks replace stores, factories, and workplaces that exist largely to facilitate information exchanges"[15]. Therefore, the connection between communication information technology and democracy is based on information as much as economic factors.

Overall, there is far more literature on social indicators than on forces of democracy. This may in part be due to the fact that the attention of multilateral banks and developed nations' governments is focused on the economic aspects of capitalism as a driving force for democracy. However, I believe that the literature makes clear that there is theoretical grounds for connections between female literacy rates and information technology, and then between information technology and democracy.

Data, Measurement and the Overview of Analysis

Data

The dataset used in this study was created using data from the World Bank and the United States Central Intelligence Agency. Data was collected for 149 countries in the year 2000.[16]

Dependent Variables

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[14] Clarke, Roger. 1994. Information Technology: Weapon of Authoritarianism or Tool of Democracy? n. pag. Accessed: April 30, 2003. http://www.virtualschool.edu/mon/Economics/ClarkITForAuthorOrFree.html.

[15] World Bank. 1993. "Harnessing Information for Development: A Proposal for the World Bank Group Strategy". n.pag. Accessed: April 30, 2003. http://www.worldbank.org/html/fpd/harnessing/

[16] See Appendix A.

One possible explanation for "a characteristically strong statistical correlation" between democracy and economic growth could be access to information which fuels growth in both elements[17]. In this study, I wish to examine the specific impact of communications technology on the occurrence of democracy. Therefore, it is necessary to utilize a variable to measure communication technology capabilities for each country. The communications index variable is an index of several communications-related variables taken from the World Bank. The index consists of the number of computers per 1000 persons, the number of telephone lines per 1000 persons and the percentage of gross domestic product accounted for by high technology products. These variables were added together and divided by three for each country. For the purpose of this study, this variable measures the communications capabilities for the countries.

The second important dependent variable is that which measure the occurrence and strength of democracy within individual governments. For this variable, the POLITY IV dataset was utilized. The POLITY score is computed (within the dataset) by subtracting the AUTOC score from the DEMOC score; the resulting unified polity scale ranges from +10 (strongly democratic) to -10 (strongly autocratic).

Independent Variables

"The single most important factor for increasing the ability of girls and women to take advantage of IT opportunities is education. This requires interventions at all levels, from literacy through scientific and technological education"[18]. It is for this reason that this study contends that female literacy rates will have a significant impact on the communications technology capabilities of a nation. In order to measure this thesis, female primary school enrollment and female literacy rates are applied as measures of female education throughout the world.

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[17] Kedzie, Christopher R. 1995.
[18] Hafkin, Nancy and Nancy Taggert. 2001.

Economic development is interlinked with communications technology infrastructure and capabilities. Richer countries are more able to afford expensive infrastructure and technological research to attract and conduct business in a global market. Therefore, GDP per capita is utilized to determine the relative wealth of the nations. Specifically, GDP per capita is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output. Growth is calculated from constant price GDP data in local currency. In order to measure this per capita, GDP was divided by the total population for each country.

In many developing countries, agriculture is the primary contributor to the nation's economy[19]. Countries whose GDP is mainly composed of agricultural products tend to be poorer by nature, and therefore, less able to invest large amounts into communication technology infrastructure. Therefore, the percentage of gross domestic product accounted for by agriculture is added to this model as a control variable. The CIA World Factbook defines this variable as the "value added in agriculture as it corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3"[20].

Documented research states that "population concentration in large cities in the developing world contributes to widening poverty"[21]. Council research indicates that rapid population growth and giant size overwhelm the capacity of cities to provide

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[19] Columbia University's Center for Earth Science Information Network (CESIN). 1996. Agriculture and Global Environmental Change. n. pag. Accessed: April 30, 2003. http://www.ciesin.org/TG/AG/AG-home.html

[20] Central Intelligence Agency. *The World Factbook* (Washington, D.C.: The Central Intelligence Press, Inc. 2001).

[21] The Population Council, 1996.

essential goods and services". In addition, larger urban populations indicate a workforce invested in business and commerce rather than agriculture. So not only does urban population affect the relative wealth of the nation, it also has implications for the level of interest in communications technology. Therefore a measure of urban population is used as a control variable in this model**.** Urban population is the midyear population of areas defined as urban in each country as reported to the United Nations. It is measured here as the percentage of the total population.

Aid Per Capita measures the amount of foreign aid (measured in USD) per person in the country. Though private investments and loans flowing to developing countries have surged, tripling from $52 billion in 1990 to $159 billion in 1995, most have gone to a dozen or so emerging economies, including China, Mexico and the Republic of Korea. The poorest countries, particularly in sub-Saharan Africa, have received hardly any private loans or investment. Aid is crucial for these countries in combating poverty, repaying debt, supporting investment and financing social services [22]. Aid has been recently devoted to purchasing and upgrading information technology infrastructure within developing countries, and is therefore an important measure of a country's ability to increase their communication index score.

Model One:

My first hypothesis states that female literacy rates will be a significant factor in the quantity and quality of communications technology in any given country. This hypothesis was tested using an OLS regression model with the communication index as the dependent variable. The independent variable is female literacy rates. In addition, the following variables were used to control outside variables: female primary school enrollment, aid per capita, percentage of gross domestic product accounted for by

[22] United Nations Children's Fund. 1995. "Sharing the Wealth? Aid at Lowest Levels in 45 Years". n. pag. Accessed: April 30, 2003. http://www.unicef.org/pon97/p63a.htm

agriculture, gross domestic product per capita and urban population.

Prior executing the regression command, the variables were tested for multicollinearity utilizing the VIF command in STATA. The results are as follows:

Variable	**VIF**	**1/VIF**
Female Literacy Rate	2.45	0.408366
Percentage of Agriculture in GDP	2.87	0.348299
Primary School Education	1.80	0.554994
Urban Population	2.53	0.395413
Aid Per Capita	1.06	0.942811
GDP Per Capita	1.06	0.945357
Mean VIF	**1.96**	

None of the variables had a 1/VIF less that .10, and therefore, all variables can be used in the regression model.

It should be noted that this model tested positive for heteroskedascity according to the Cook-Weisburg test conducted in STATA. To control for that, the "robust" feature was used, and the corrected regression results appear in the table below:

Table One: Independent Variables Impact on Communications Index

	Beta (se)	p>[z]
Primary School (% of Female out of Total Attendance)	.2241 (.3013)	.744
Female Literacy Rate	**.9884 (.2632)**	**.000**
Percentage of Agriculture in GDP	**-1.2961 (.4879)**	**.009**
Aid Per Capita	**-.5532 (.1937)**	**.005**
GDP Per Capita	**-3.66e-09 (.3013)**	**.009**
Urban (% of Total Population)	**1.4585 (.3931)**	**.000**
Constant	**-44.2166 (34.1164)**	**.197**
R-Square	**.5201**	
N	**146**	

Source: World Bank Development Indicators and CIA World Factbook.

Results

The results of this model support the hypothesis that female literacy rates do directly impact the communications index score for a country.

For each positive increase of .9884 in the percentage of literate females in a country, there is a positive increase of one unit in the communications index. Therefore, programs which assist women in gaining literacy can thereby increase the knowledge of and participation of these women in communications technology industries, which ultimately benefit their home countries. Depending on conditions in the particular country, literacy programs might be aimed at reaching "a particular age-group, a disadvantaged group such as women, the disabled, rural or semi-urban poor, ethnic minorities or indigenous populations". In this case, "the educational or literacy approaches need to be tailored to specific economic and cultural contexts so as to be relevant and attractive for [women]"[23].

Female primary school enrollment was insignificant in this model. This neither proves nor disproves the proposed hypothesis, but should still be accounted for by programs targeting increases in communications technology. "While the gender disparity is not a serious concern in most of the Latin America/Caribbean and Eastern Asia/Pacific countries, it remains one in many Arab States, sub-Saharan African and Southern Asian countries"[24].

Utilizing Clarify software in addition to STATA clearly demonstrates the statistical influence of increased female literacy rates on a country's communication index score. Table Two indicates that an increase from the below average to average female literacy percentages could lead to a 67 point difference on the communications

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[23] United Nations Educational, Scientific and Cultural Organization. 2001. "Monitoring Report on Education for All". n. pag. Accessed: April 30, 2003. http://www.unesco.org/education/efa/monitoring/monitoring_rep_overview.shtml

[24] Ibid.

index. This is the difference between Algeria and Argentina in communications technology. This increase in female literacy rates adds 150 telephones and 44 computers per 1000 households and increases the percentage of GDP determined by high technology products by three percent.

Table Two: Clarify Expected Values for the Communications Index Score

Simulation	**Expected Value (Comindex)**
Female Literacy Rates (Min)	24.66
Female Literacy Rates (Mean)	91.06
Female Literacy Rates (Max)	116.02

Model Two: My second hypothesis states that the communications index score of a country will then positively impact its polity score (measure of democracy). Countries with higher communications index scores will be more democratic than those with lower scores.

This model was tested with an ordered logistic regression where the polity score is the dependent variable. The communications index was the independent variable used to measure the concept of the hypothesis. In addition, the following variables were used to control outside variables: aid per capita, percentage of gross domestic product accounted for by agriculture, fertility rates, gross domestic product per capita and urban population.

Table Three: Independent Variables Impact on Levels of Democracy Within a Government

	Beta (se)	p>[z]
Communications Index	**.0218 (.0043)**	**.000**
Percentage of Agriculture in GDP	-.0129 (.0131)	.325
Aid Per Capita	.00974 (.0047)	.116
GDP Per Capita	-4.71e-12 (3.45e-11)	.891
Urban (% of Total Population)	-.0174 (.0122)	. 151
Wald chi2 (8)	**39.55**	**.000**
Pseudo R Square	**.1265**	
N	**146**	

Source: World Bank Development Indicators and Polity Four Dataset.

Results

The communications index score has a direct impact on the democracy score of a country. For every increase in the communications index, there is an increase of .0218 in the Polity score of a country. This means that for every increase of approximately 50 units in the communications index, there is an increase of one point (on a twenty-point scale) in democracy. These findings support and enhance those of Christopher Kedzie (1995), whose study on democracy and network interconnectivity found that "with greater than 99.9% certainty, one can reject the null hypothesis that there is no relationship between democracy and interconnectivity… [a] single point increase on the interconnectivity scale corresponds to an increase of 5% in the democracy ratings". As this study utilized data from the year 2000, the results more accurately reflect the impact of communications technology.

Utilizing the Clarify software (Table Four), the difference between below average and average communications index score adds three points to a country's democracy score. Three points is the point difference between the Russian Federation and the United

States. In technical terms, this increase in communications technology leads to executive parity or subordination in the constraints on the executive (from substantial constraints) and competitive party competition (from transitional).

Table Four: Clarify Expected Values for the Democracy Score Index

Simulation	**Expected Value (DemGov)**
Comindex (Min)	.2805
Comindex (Mean)	3.213
Comindex (Max)	13.303

Conclusions

The results of the first model indicate that female literacy rates do play a role in the communications index score for a country. Although male education was not considered, it is not implied to be insignificant. Rather, female education is taken into special consideration because of its cultural challenges throughout the developing world. Whereas males are educated in most cultures and countries, women face different challenges and barriers to education, not the least of which are related to family and religious beliefs.

The communications index then plays a role in the overall democracy score of the country. Although the changes may seem small in nature, their theoretical implications should not be overlooked. As development banks and agencies seek to make systemic change towards democracy, they should take into consideration the implications of the educational policies and programs for women.

Communications technology is an important predictor for capitalist and democratic success. Countries looking to expand foreign direct investment and high technology business success should look to increasing their communications technology,

including telephone lines and personal computers. Although these changes seem to be minor, increases in communications technology are in reality movement towards better social, economic and political status for the home nation.

Appendix A

Afghanistan	Denmark	Democratic Republic of Korea	Poland	Vietnam
Albania	Dominican Republic	Republic of Korea	Portugal	Yemen
Algeria	Ecuador	Kuwait	Quatar	Yugoslavia
Angola	Egypt	Kyrgz Republic	Romania	Zambia
Argentina	El Salvador	Lao PDR	Russian Federation	Zimbabwe
Armenia	Equitorial Guinea	Latvia	Rwanda	
Australia	Eritrea	Liberia	S. Africa	
Austria	Estonia	Libya	Saudi Arabia	
Azerbaijan	Ethiopia	Lithuania	Senegal	
Burkina Faso	Finland	Luxembourg	Singapore	
Bahrain	France	Macedonia	Slovak Republic	
Bangladesh	Gabon	Madagascar	Slovenia	
Belarus	Gambia	Malawi	Spain	
Belgium	Georgia	Malaysia	Sri Lanka	
Benin	Germany	Mali	Sudan	
Bhutan	Ghana	Mauritania	Swaziland	
Bolivia	Greece	Mauritius	Sweden	
Botswana	Guatemala	Mexico	Switzerland	
Brazil	Guinea Bissau	Moldova	Syria	
Bulgaria	Guyana	Mongolia	Tajikistan	
Burundi	Haiti	Mozambique	Tanzania	
Cambodia	Honduras	Myanmar	Thailand	
Cameroon	Hungary	Namibia	Togo	
Canada	Iceland	Nepal	Trinidad	
Chad	India	Netherlands	Tunisia	
Chile	Indonesia	New Zealand	Turkey	
China	Iran	Nicaragua	Turkmenistan	
Colombia	Iraq	Niger	UAE	
Comoros	Ireland	Nigeria	Uganda	
Republic of the Congo	Italy	Norway	United Kingdom	
Costa Rica	Jamaica	Oman	Ukraine	
Croatia	Japan	Pakistan	Uruguay	
Cuba	Jordan	Panama	United States	
Cyprus	Kazakhstan	Papua New Guinea	Uzbekistan	
Czech Republic	Kenya	Paraguay	Venezuela	