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Structural Adjustment, Debt and Internet Usage:

A Longitudinal Study of Developing Countries

A Dissertation Presented

By

Dianne S. Stalker

to

The Graduate School

in Partial Fulfillment of the

Requirements

for the Degree of

Doctor of Philosophy

in

Sociology

Stony Brook University

December 2014

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2014

Stony Brook University

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Abstract of the Dissertation

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Because cross-national studies have not addressed the question about the effectiveness of International Monetary Fund (IMF), World Bank (WB) structural adjustment loans, and World Bank telecommunications loans on Internet usage in developing countries, I address this gap though analysis of the contending theoretical perspectives of dependency and economic liberalization. My study is based on a longitudinal analysis of 149 World Bank low-and middle-income countries from 2000 through 2008 inclusive using ordinary least squares and a lagged dependent variable model. Relevant explanatory factors in addition to the lagged dependent of Internet usage, include three types of structural adjustment loans (SAL), debt, trade, foreign direct investment (FDI), real interest rates, private investment in telecommunications infrastructure, GNP, gross capital formation, primary and secondary education, urbanization and democracy. To increase the validity and reliability of my findings, I use three techniques for dealing with missing data: pairwise deletion, listwise deletion, and mean substitution.

Findings are similar among the three types of missing data techniques. First, only a country's GNP, secondary education, and prior level of Internet usage in 2000 significantly affect the level of Internet usage in 2008. Second, the results for the WB and IMF structural adjustment loans are mixed, with both positive and negative correlations associated with Internet usage in 2008. Third, for all three types of missing data techniques, the WB telecommunications loan has a negative correlation with Internet usage in 2008, with the WB telecommunications loan reaching negative and statistical significance using mean substitution.

Dedicated to my husband,

and

to the memory of my father.

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Acknowledgments

Having finally completed this dissertation, I would like to express thanks to my husband for his long-standing support and patience.

I would also like to express appreciation to my committee members: Stephen Cole, who encouraged me to stay the course, and whose recommendations were sound; and to John Shandra, Andrea Tyree, and Michael Koenig. My dissertation is the better for your combined contributions.

A special thank-you to Ping-Wu Li of the Social Sciences Lab, where I spent many hours over the course of this project, for answering questions as I transitioned from SPSS to STATA.

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Chapter One

Introduction

Importance of Studying Telecommunications Usage

Information communication technology is considered to have a significant impact on the socio-economic development of a country (*Bridging the Digital Divide* 2006, Mansell and Steinmueller 2000; Mansell and Wehn 1998; Hudson 1997; WB Millennium Goal, target 18 for telecommunications). The combination of the rapid spread of instant access to information and communication services along with access to almost unlimited informational resources is changing societies. As stated by the World Bank, "The knowledge provided through such easy access to information is creating unprecedented opportunities and having a dramatic impact on the way people live and work" (WB 2010b, vii). The UN's International Telecommunications Union (*ITU* 2009:15) has stated, "Today's information society is a global one where individuals must be able to interact and exchange knowledge and know-how globally." Unquestionably, telecommunications is important because of its role in the spread of information and knowledge across the world (Lam and Shiu 2010); (Stiglitz 2007); (Madon 2000).

According to *The Financial Times,* "The economic and technical drivers of integration—information technology, virtually costless communications, the internet as an all-in-one platform for voice, video and data services and the accelerating pace of innovation in service as well as manufacturing industries—are growing stronger." [1] Broadband reduces the cost of international communications by increasing the availability

[1] Philip Stephens, *Financial Times*, Nov. 30, 2007, p. 11.

of information, "enabling companies to access foreign markets more easily and therefore become more competitive" (Clarke and Wallsten 2006). In a relatively short period, the growth of Internet traffic has increased the demand for high-speed bandwidth access, commonly referred to as broadband Internet connections.[2] Broadband telecommunications technologies consist of the merging of telephone, television, and computer networks that make possible interactive communication of voice, data, and video over the Internet (Firth and Mellor 2005); (Cava-Ferreruela and Alabau-Mũnoz 2006); (Qiang and Rossotto 2009); (World Bank 2010b).

Telecommunications Usage in Developing Countries

In line with economic liberalization policy, both the World Bank (WB) and the International Monetary Fund (IMF) have made a modernized telecommunications infrastructure their priority policy (see WB Millennium Goal, target 18, telecommunications; Vreeland 2003; Qiang and Rossotto 2009) arguing that the expansion of telecommunication services contributes to the economic growth of developing countries. Half a decade ago, the International Monetary Fund (2007) [3] had already observed, "the world is in the midst of an all-purpose technological revolution based on information technology," … and the "longer-term benefits for the global economy are likely to continue, or even accelerate in the years to come." Information

[2] Broadband Internet access, often shortened to broadband, refers to a faster rate of data transmission across the internet. Broadband refers to a wide range of frequencies, or bandwidth. Therefore, the wider the bandwidth, then the greater is the information carrying capacity of a transmission. The Internet refers to all transmission frequencies, whereas broadband is currently any transmission greater than 256 kilobits (0.25 megabits) per second.

[3] International Monetary Fund, *World Economic Outlook,* Oct. 2001, p. 105.

technology products and services will continue to increase and diffuse within the economies of developing countries…" The ITU (2009: 5) has acknowledged "limited availability of fixed networks in many developing countries, where wired access is often restricted to major urban centers, makes it difficult to provide people with fixed broadband access. [Therefore], mobile broadband has a major potential to expand the availability of high-speed Internet access, especially given the spread of mobile cellular networks and their wide population coverage."

If Internet and broadband contribute to economic growth in developing countries, then it is important to understand what factors influence telecommunications usage. We have consensus that broadband provides both economic and social benefits (Gunasekaran and Harmantzis 2007). For example, World Bank research suggests that for every ten-percentage point increase in broadband penetration, economic growth in low- and middle-income countries increases by 1.38 percentage points (Kim, Kelly and Raja 2010). As for social benefits, broadband transmission connects people, companies, and government to each other through the flow of information resulting in new business opportunities, increased transparency of government performance, along with public services including financial services and improved health care (Kim, Kelly and Raja 2010). The availability of high-speed broadband in India makes it possible for this country to offer international services in the software industry, data processing, and call centers. In South Africa, the spreading availability of broadband has permitted business-to-business video conferencing, along with an accompanying growth in trade and services offered by multinational companies (*World Economic Forum* 2011; *Bridging the Digital Divide* 2006; *Negotiating the Net in Africa* 2007).

However, unevenness in the worldwide adoption of telecommunication continues to be an ongoing concern (Hudson 1997; Wilson 2004) because a strong tele-

communications infrastructure, so important for a country's national development, requires a stable investment environment (James 1999). The IMF has cautioned, "While immediate benefits are present, especially in developed nations, it will take years for benefits to accrue substantially in developing nations." One of the reasons for the delay is, as Sachs (2005: 244-245) has observed, developing countries in general lack "urgently required infrastructure" and educational training and skills that prevent them from fully participating in the information society (see WB 2008:133-35). Consider that a nation's inability to provide a technologically focused education can lead to a shortage of trained workers in an important area of economic growth (Riddell, 2007; Peet 2003). Stiglitz (2007:70) has argued that for developing countries, quickly acquiring the "knowledge and technology of the advanced countries," are very important issues in determining their pace of economic growth. Because telecommunications usage is so important within this context, my study considers the effect of three types of structural adjustment loans and two types of debt on Internet usage in developing countries over a nine-year period.

IMF and WB Structural Adjustment and Debt Service

Since the 1980s, national debt crises in developing countries have led to World Bank (WB) and International Monetary Fund (IMF) imposition of austerity measures on recipient nations in order for them to rebalance their budgets (Rich 1994). Structural adjustment policies are conditional requirements imposed on the economies of developing countries in exchange for financial aid by the World Bank and International Monetary Fund (Table 1.1). As a requisite for financial assistance and, in order to "ensure a flow of revenue for debt servicing," "specific economic and social reforms along with market liberalization policies are invoked" (*Structural Adjustment* 2000, 34); (Finger and Mecagni 2007:27); (Shandra, Ross, and London 2003). These policies have two goals: to

ensure repayment of the loans provided, and to promote economic stabilization and growth of the indebted countries (Rich 1994).

Whereas the IMF and WB contend that their structural adjustment policies are necessary to promote strong national economies capable of sustaining an improved standard of living (Antonelli 1991, 37-38; Corbo and Fischer (1992:15), Woodward (1992: 1) maintains that,

> Debt problems and macroeconomic adjustments are inextricably linked in the developing countries. Debt is often a major reason for the need for macroeconomic adjustment; a symptom of failure to adjust adequately in the past; an important determinant of the pace and extent of adjustment needed; and the main channel though which debt problems affect the population. Debt problems may also be a sign of the need for some form of structural change in the economy…. (Woodward 1992:1)

Acceptance of structural adjustment programs necessitates that austerity policy measures be undertaken by countries in order to balance their budgets (Clark [1991]:165) and to become more internationally competitive. The question remains though, whether these structural adjustment practices enhance or hinder Internet usage.

Therefore, following economic dependency and liberalization theories, I include the following measures of structural adjustment in my study. They include the number of World Bank and International Monetary Fund structural adjustment loans, the amount of IMF and WB debt service ratios, increased export earnings through trade, and readjustment of interest rates upward to reduce inflation and encourage investment. Increased reliance on exports via foreign direct investment (Woodward 1992; Peet 2003; Rich 1994) brings in investment capital to supplement domestic savings that are inadequate for self-sustaining economic growth (Schmidt-Hebbel and Webb 1992; Clark [1991]). Loans, in the form of aid from the WB and IMF represent one form of foreign investment, while multinational corporations (MNCs), with their access to capital and modern technologies, represent another important form of foreign investment in

developing countries (Coe, Helpman, and Hoffmaister 1997). Accordingly, I also include a measure of foreign direct investment as a percentage of GDP.

Second, I include economic measures affecting telecommunications usage. As direct government spending in a nation's economy is reduced, privatization of goods and services is increased (Clark [1991]). Reduction of public investment in infrastructure projects in favor of increased privatization has consequences. We should understand how investment in telecommunications infrastructure with private participation shapes telecommunications usage. Other economic factors include a country's gross national product and gross capital formation.

Third, I include social and political measures that affect telecommunications usage. It is important to note that economic policies that compel recipient countries of foreign aid to increase their exports as a way to handle their debt burden contribute to reduced economic growth (Shafaeddin 2006; Boli, Loya and Loftin 1999, 240; Dasgupta 1998). Moreover, these policies reduce the ability of a government to spend on social programs because of ongoing interest payments owed on debt (George 1992; McMichael 2004; Peet 2003). The argument is that increasing export earnings, as a way to finance interest and principal payments on loan repayments (McMichael 2004), comes at the expense of a stable domestic currency (Woodward 1992:3). According to Corbo and Fischer of the World Bank (1992:15), macroeconomic stabilization is achieved through debt reduction by means of currency devaluation. As a way to make a developing country's exports more competitive, acceptance of a structural adjustment loan is contingent upon a nation devaluing its currency exchange rate as a way to reduce its

national deficit (Woodward 1992:31).[4] Walton and Ragin's (1990) work has suggested that IMF lending has contributed to political and social destabilization in developing countries because a reduction in public spending reallocates any money saved to debt repayment. For example, servicing large debt loads in a structural adjustment program means national governments have less to spend on public programs such as education (George 1992). The consensus is that the role of education is essential to the diffusion of telecommunications usage. Other important contributory factors to telecommunications usage are urbanization and democracy. Both should contribute to increased telecommunications usage, but it is possible that structural adjustment loans act as a deterrent.

Significance of my Research

Given the potential for telecommunications to bring prosperity to developing countries, understanding the effects of structural adjustment policies on telecommunications usage is an important issue. Up to now, any cross-national research that assesses the impact of debt and structural adjustment on telecommunications usage in developing countries is lacking. This gap is noteworthy because while the goal of structural adjustment lending is to encourage economic growth, it simultaneously encourages reducing governmental expenditures as a way to generate revenue for paying foreign debt obligations. With the lack of agreement about the consequences of International Monetary Fund and World Bank conditionality on developing countries (Easterly 2005:4), including social and political consequences, the competing theoretical perspectives of dependency and economic liberalization can shed light on the continuing

[4] Woodward (1992: 32) notes a country's balance of payments problem occurs when, "a country is not receiving enough foreign exchange through selling its exports and borrowing from abroad to pay for its imports and debt service."

debate. Placed within these two competing theoretical frameworks, I investigate whether IMF and WB structural adjustment and debt policies promote or hinder the level of Internet usage in developing countries.

Goals of my Research

I extend previous research on telecommunications usage in developing countries in three ways. First, I extend sociological research on structural adjustment loans and debt to Internet usage. On the one hand, cross-national sociological studies on Internet usage have found positive correlations (see Appendix, Table 2.2) with democracy, urbanization, foreign direct investment, and privatization (Robison and Crenshaw 2010); (Crenshaw and Robison 2006a, 2006b); (Robison and Crenshaw 2002); (Guillén and Suárez 2005). On the other hand, cross-national studies of structural adjustment loans and debt have found adverse outcomes in a number of areas, including: deforestation (Shandra, Shircliff, and London 2011); (Shandra, Shor, Maynard and London 2008); water pollution: (Shandra, Shor, and London 2008); women's educational enrollment (Buchman 1996); infant mortality (Shandra et al. 2012); human rights: (Abouharb and Cingranelli 2007, 2009), and economic growth: (Przeworski and Vreeland 2000), and (Vreeland 2003); (Bradshaw and Huang 1991); (Bradshaw and Wahl 1991). Only one study by Bradshaw, Fallon, and Viterna (2005) incorporated both structural adjustment and telecommunications usage as explanatory variables on GNP for the year 1999, and their findings were inconclusive. However, they did not examine the effects of structural adjustment loans on telecommunications usage, as I do in my study.

Second, I apply two theoretical perspectives—one sociological and one economic: dependency, and economic liberalization—to increase the robustness of my findings about

Internet usage. Taken together, these two contrasting perspectives can provide insight into the social, political, and economic influences of structural adjustment loan participation on Internet usage in developing countries. A shortcoming of cross-national research in economics is that a wide range of variables have been used in their statistical regressions, but "this approach is data-driven rather than theory-driven: an overall framework that governs and justifies the selection of variables is lacking" (Verspagen 2005: 505).

Third, in order to guide national policy decisions, cross-national research is needed to determine how structural adjustment loan programs affect telecommunications usage. Therefore, my long-term research is intended to evaluate how the Internet, fixed broadband, wireless broadband are affected by structural adjustment loan programs. For example, because wireless broadband does not require as much investment in physical infrastructure expansion, the ITU (2011) anticipates that wireless telecommunications usage in poor countries may expand more rapidly than Internet. For the time, 2000 through 2008, Table 1.1 categorizes the percentage of users per 100 of the internet, fixed broadband, and mobile broadband in developing countries into high, medium, and low levels of telecommunications usage. While most countries categorized as low- and -medium income developing countries experience low levels of telecommunications usage, this table shows that the level of usage is greater for internet over that of fixed broadband, and fixed broadband over mobile broadband. During this period, the ITU's expectation appears premature. Use of the competing predictions offered by dependency and economic liberalization can provide insight into the discrepancy between prediction and actual outcome. Grouped into three categories by level of telecommunications usage—high, medium, and low, Table 1.1 also matches the total number of SALs against high and

medium levels of usage. Additionally, I have included a column matching the World Bank's level of GNP, 2000 for Internet users.

My immediate research in this study focuses on the dependent variable, number of Internet users per 100 people. Prior cross-national studies have focused on the Internet rather than broadband because of the lack of available data from the international organizations. Consequently, prior research findings on broadband are incomplete since developing countries have only recently begun incorporating this telecommunications technology. However, with a recent increase in publicly available data on broadband (Qiang et al., 2009; *ITU* 2009) it will be possible to compare patterns of telecommunications usage of fixed and mobile broadband usage with Internet usage across developing countries in future research.

Organization of my Research

My research goals proceed in the following manner. In chapter one, I explain both the importance of telecommunications usage in developing countries and discuss how debt and structural adjustment may affect the level of usage. Then, in chapter two, I review the two theoretical perspectives—dependency and economic liberalization which inform the basis of my study, indicating how they may be used to make predictions about telecommunications usage. In chapter three, I explain the methodology used in my analysis. I use an Ordinary Least Squares model. In chapter four, I describe the results of my complete analysis for Internet usage. Finally, in chapter five, I discuss how the theoretical and methodological components of my study relate to each other, how they pertain to policy proposals concerning structural adjustment and Internet usage and conclude with potential directions for future research.

Table 1.1

Comparison of Telecommunication Usage by World Bank Developing Countries

descending order by level of Internet usage: High=blue; Medium=red; Low= black.

WB GNP, 2000, Internet users	No. Internet Users per 100 population	**2008**	No. Fixed Broadband Subscribers per 100	**2008**	No. Mobile Broadband Subscriptions per 100	**2008**
3	Barbados	73.67	Estonia	23.7	Bulgaria	16.838
3	Estonia	66.24	St. Kitts and Nevis	22.6	Poland	15.862
3	Slovak Republic	65.96	Barbados	19.3	Azerbaijan	13.8725
3	St Vincent Grenadine	60.49	Lithuania	17.6	Trinidad / Tobago	13.793
3	Latvia	60.44	Czech Republic	16.9	Libya	13.44
3	St. Lucia	58.75	Hungary	16.7	Czech Republic	13.255
3	Hungary	58.51	Dominica	14.1	Slovak Republic	10.524
3	Czech Republic	57.82	Croatia	11.8	Georgia	9.385
2	Jamaica	57.31	Poland	11.6	Montenegro	8.679
3	Malaysia	55.8	Romania	11.6	Serbia	7.591
3	Lithuania	54.39	Slovak Republic	11.2	Latvia	6.334
3	Croatia	50.47	Bulgaria	11.1	Oman	5.25
3	Poland	48.99	Montenegro	9.99	South Africa	5.06
2	Montenegro	47.24	Grenada	9.79	Lithuania	4.084
2	Serbia	44.9	St. Lucia	9.11	Estonia	4.074
2	Macedonia	41.54	Macedonia,	8.87	Romania	4.029
3	Uruguay	40.19	Latvia	8.83	Mauritius	4.01
3	Seychelles	38.99	St Vincent Grenad.	8.58	Croatia	3.483
2	Colombia	38.5	Chile	8.49	Indonesia	3.392
3	Dominica	37.57	Argentina	7.99	Hungary	3.149
2	Brazil	37.52	Turkey	7.78	Mongolia	2.992
2	Bulgaria	34.72	Uruguay	7.33	Maldives	2.479
2	Bosnia Herzegovina	34.66	Mauritius	7.23	Sri Lanka	2.433
3	Turkey	34.37	Mexico	7.14	Nigeria	2.42
2	Morocco	33.04	Russian Federation	6.54	Belize	2.158
3	St Kitts & Nevis	32.53	Trinidad and Tobago	6.41	Argentina	1.8675
3	Chile	32.47	China	6.29	Ukraine	1.842
3	Costa Rica	32.31	Serbia	6.14	Ghana	1.82
2	Belarus	32.09	Panama	5.77	Malaysia	1.526
2	Iran	31.96	Brazil	5.26	Brazil	1.451
3	Russian Federation	31.88	Maldives	5.15	Uruguay	1.399
2	Ecuador	28.8	Lebanon	5.03	Chile	1.359
3	Romania	28.79	Bosnia and Herzegovina	5	Philippines	1.282
2	Azerbaijan	28.16	Belarus	4.94	Cambodia	1.024
3	Argentina	28.11	Malaysia	4.93	Jamaica	0.927
3	Panama	27.49	Venezuela	4.76	Cape Verde	0.897
2	Jordan	27.45	Colombia	4.23	Venezuela	0.828
2	Tunisia	27.11	Kazakhstan	4.22	Egypt	0.813
2	Guyana	26.85	Seychelles	3.93	Angola	0.796
3	Venezuela	25.66	Jamaica	3.62	Tajikistan	0.738
2	Peru	24.72	Ukraine	3.46	El Salvador	0.696
1	Vietnam	24.17	Moldova	3.17	Honduras	0.696
2	Thailand	23.89	Dominican Republic	2.69	Uganda	0.671
2	Albania	23.86	West Bank and Gaza	2.54	Guatemala	0.658
2	Georgia	23.78	Peru	2.52	Dominican Republic	0.619
2	Maldives	23.52	Belize	2.39	Russian Federation	0.597
2	Moldova	23.39	Costa Rica	2.38	Morocco	0.586
3	Grenada	23.18	Vietnam	2.38	Thailand	0.543
3	Lebanon	22.53	Jordan	2.36	Macedonia	0.49
2	China	22.5	Georgia	2.23	Tanzania	0.423
3	Mauritius	22.22	Tunisia	2.2	Nicaragua	0.414

3	Mexico	22.16	Albania	2.04	Peru	0.41
2	Dominican Republic	21.58	El Salvador	2.01	Sudan	0.4
2	Cape Verde	20.61	Fiji	1.85	Bhutan	0.35
3	Oman	20	Morocco	1.53	Paraguay	0.316
2	Syria	17.32	Cape Verde	1.48	Mexico	0.302
3	Trinidad and Tobago	17.02	Paraguay	1.43	Kyrgyz Republic	0.3
2	Egypt	16.65	Algeria	1.41	Moldova	0.287
1	Kyrgyz Republic	16.1	Thailand	1.41	Cameroon	0.181
1	Nigeria	15.86	Mongolia	1.37	Belarus	0.1627
1	Sao Tome and Principe	15.48	Philippines	1.16	Afghanistan	0.12588
2	Micronesia, Fed. Sts.	14.49	Oman	1.15	Ecuador	0.1158
2	Paraguay	14.34	Suriname	1.12	Seychelles	0.114
2	Guatemala	14.32	Egypt, Arab Rep.	0.94	Bolivia	0.093
2	Honduras	13.09	South Africa	0.87	Fiji	0.086
2	Cuba	12.94	Tonga	0.7	Mauritania	0.061
1	Mongolia	12.49	Azerbaijan	0.69	Kenya	0.053
2	Fiji	12.2	Bolivia	0.68	Uzbekistan	0.037
2	Algeria	11.93	Nicaragua	0.64	Madagascar	0.021
1	Zimbabwe	11.4	Guatemala	0.58	Rwanda	0.006
1	Pakistan	11.14	Sri Lanka	0.51	Albania	0
2	Kazakhstan	10.89	Palau	0.48	Algeria	0
2	Bolivia	10.83	Sao Tome and Principe	0.47	American Samoa	0
2	El Salvador	10.6	Botswana	0.46	Armenia	0
3	Belize	10.56	India	0.46	Bangladesh	0
2	Ukraine	10.54	Indonesia	0.43	Barbados	0
1	Sudan	10.16	Iran	0.42	Benin	0
1	Haiti	10.13	Senegal	0.39	Bosnia / Herzegovina	0
2	Suriname	9.706	Bhutan	0.3	Botswana	0
2	West Bank and Gaza	9.042	Solomon Islands	0.29	Burkina Faso	0
1	Uzbekistan	9.039	Djibouti	0.29	Burundi	0
1	Tajikistan	8.777	Guyana	0.26	Central African Rep.	0
1	Kenya	8.666	Ecuador	0.26	Chad	0
3	South Africa	8.581	Uzbekistan	0.24	China	0
1	Lao	8.5	Mauritania	0.18	Colombia	0
1	Senegal	8.353	Armenia	0.16	Comoros	0
2	Tonga	8.111	Libya	0.16	Congo, Dem. Rep.	0
2	Indonesia	7.917	Gabon	0.15	Congo, Rep.	0
1	Uganda	7.897	Zimbabwe	0.14	Costa Rica	0
2	Vanuatu	7.269	Cambodia	0.11	Cote d'Ivoire	0
1	Gambia	6.879	Sudan	0.11	Cuba	0
2	Swaziland	6.85	Pakistan	0.1	Djibouti	0
1	Bhutan	6.552	Ghana	0.1	Dominica	0
3	Botswana	6.246	Lao	0.1	Equatorial Guinea	0
2	Philippines	6.218	Micronesia, Fed. Sts.	0.1	Eritrea	0
3	Gabon	6.215	Samoa	0.09	Ethiopia	0
2	Armenia	6.207	Angola	0.09	Gabon	0
2	Sri Lanka	5.772	Vanuatu	0.07	Gambia, The	0
1	Zambia	5.547	Swaziland	0.07	Grenada	0
1	Togo	5.419	Kyrgyz Republic	0.06	Guinea	0
2	Namibia	5.329	Syria	0.05	Guinea-Bissau	0
3	Libya	5.132	Tajikistan	0.05	Guyana	0
2	Samoa	5.032	Turkmenistan	0.05	Haiti	0
1	India	4.54	Cote d'Ivoire	0.05	India	0
2	Congo, Rep.	4.288	Mozambique	0.05	Iran	0
1	Ghana	4.27	Nigeria	0.05	Iraq	0
1	Eritrea	4.059	Zambia	0.05	Jordan	0
2	Cameroon	3.798	Rwanda	0.04	Kazakhstan	0
2	Marshall Islands	3.687	Mali	0.04	Kiribati	0
2	Lesotho	3.577	Bangladesh	0.03	Korea, Dem. Rep.	0
1	Comoros	3.574	Burkina Faso	0.03	Lao	0
2	Nicaragua	3.264	Togo	0.03	Lebanon	0
1	Cote d'Ivoire	3.205	Equatorial Guinea	0.03	Lesotho	0

1	Rwanda	3.086	Myanmar	0.02	Liberia	0
2	Angola	3.052	Cuba	0.02	Malawi	0
1	Guinea-Bissau	2.355	Gambia	0.02	Mali	0
2	Djibouti	2.261	Madagascar	0.02	Marshall Islands	0
1	Malawi	2.129	Malawi	0.02	Mayotte	0
2	Kiribati	2.071	Namibia	0.02	Micronesia, Fed. Sts.	0
1	Solomon Islands	1.958	Tanzania	0.02	Mozambique	0
1	Mauritania	1.866	Uganda	0.02	Myanmar	0
1	Benin	1.847	Kenya	0.01	Namibia	0
1	Papua New Guinea	1.825	Lesotho	0.01	Nepal	0
3	Equatorial Guinea	1.82	Cameroon	0.01	Niger	0
1	Nepal	1.732	Niger	0	Northern Mariana Is.	0
1	Afghanistan	1.723	Afghanistan	0	Pakistan	0
1	Madagascar	1.654	Burundi	0	Palau	0
1	Yemen	1.614	Congo, Dem. Rep.	0	Panama	0
1	Mali	1.574	Ethiopia	0	Papua New Guinea	0
1	Mozambique	1.564	Central African Republic	0	Samoa	0
2	Turkmenistan	1.487	Chad	0	Sao Tome & Principe	0
1	Tanzania	1.224	Comoros	0	Senegal	0
1	Chad	1.191	Congo, Rep.	0	Sierra Leone	0
1	Somalia	1.143	Eritrea	0	Solomon Islands	0
2	Iraq	0.977	Guinea	0	Somalia	0
1	Burkina Faso	0.919	Guinea-Bissau	0	St Kitts and Nevis	0
1	Guinea	0.915	Haiti	0	St Lucia	0
1	Burundi	0.805	Honduras	0	St Vincent Grenadines	0
1	Niger	0.544	Iraq	0	Suriname	0
1	Liberia	0.527	Korea, Dem. Rep.	0	Swaziland	0
1	Cambodia	0.508	Marshall Islands	0	Syria	0
1	Ethiopia	0.446	Northern Mariana Island	0	Timor-Leste	0
1	Central African Republic	0.438	Papua New Guinea	0	Togo	0
1	Bangladesh	0.347	Sierra Leone	0	Tonga	0
1	Sierra Leone	0.25	Somalia	0	Tunisia	0
1	Myanmar	0.22	Yemen, Rep.	0	Turkey	0
1	Korea, Dem. Rep.	0	American Samoa	n/a	Turkmenistan	0
3	American Samoa	n/a	Benin	n/a	Vanuatu	0
1	Congo, Dem. Rep.	n/a	Liberia	n/a	Vietnam	0
3	Mayotte	n/a	Mayotte	n/a	West Bank and Gaza	0
3	Northern Mariana Islands	n/a	Nepal	n/a	Yemen	0
3	Palau	n/a	Timor-Leste	n/a	Zambia	0
1	Timor-Leste	n/a	Liberia	n/a	Zimbabwe	0

WB Country Classifications by Income Group
GNP per capita, based on year 2000

Level

1 Low-income, $755 or lower
2 Lower-middle income, $756- $2,995
3 Upper-middle income, $2966- $9,265

Chapter Two

Theory, Literature Review, and Hypotheses

Dependency and Economic Liberalization

The theoretical perspectives of economic liberalization and dependency provide a justification for the selection of the social, political, and economic factors that influence Internet usage. Two early key studies, representative of the contrasting perspectives of dependency and economic liberalization, are central to contemporary discussion about the importance of technology (and by extension, telecommunications usage) to developing nations. Dos Santos (1970, argued that advanced technological-industrial development reflects an unequal relationship between developed and developing countries. The dependency perspective argues that structural adjustment loans (SALs) should hinder telecommunications usage in developing countries because the economic measures supported by SALs have an effect on social policies and political arrangements because of imposed austerity measures. These include servicing of debt payable to foreign organizations and paying the interest due on the SALs. On the other hand, in his analysis of developing countries, Rostow ([1960], 1990: 9, 46-49) associated technological use with economic growth. He argued that a technologically based "take-off" stage occurs when GDP reaches a level of self-sufficiency. Self-sustainable economic growth requires that a technological stimulus be extended "over the whole front of its economic activity." Technological progress supports efficient use of resources. It is associated with and helps promote trade expansion, foreign direct investment from multinational corporations, urban development, capital investment in physical and social infrastructure from private and

government sources and foreign aid (Reynolds and Krivo 1996: 99; Hudson 1997: 186; Pohjola 2003:90). Multinational corporations, by financing new investment in machinery and equipment, support the production of higher quality technologies in developing countries (WB 2008: 112-116). Of interest then, is whether dependency or economic liberalization better predicts telecommunications usage in developing countries. In particular, within the context of these two perspectives, we need to understand how structural adjustment and debt affect Internet usage. Only then, can useful policies beneficial to these nations be crafted.

DEPENDENCY PERSPECTIVE

Hypothesis 1: Dependency perspective suggests higher levels of IMF/WB structural adjustment loans should correspond with lower levels of Internet usage.

While Rostow ([1960], 1990: 9, 46-49) argued that aid in the form of loans could act as a significant contributory factor in the technological take-off stage in developing countries, recent cross-national research suggests otherwise. When Bradshaw, Fallon, and Viterna (2005) looked at the impact of structural adjustment on GNP per capita for 76 lower and middle-income countries for the year 1999, they found that the presence of Internet hosts increased economic growth. Based only on a single year, their research indicated that structural adjustment lending and debt were not statistically significant factors affecting economic development in developing countries. However, other empirical studies from the early 1990s suggest that IMF lending hindered economic

growth in developing nations. Using a lagged dependent variable for the years 1987 and 1975, Bradshaw and Wahl (1991) found that IMF loans had a strong negative impact on GNP per capita. In a similar study and methodological approach, Bradshaw and Huang (1991), found that IMF loans impeded economic growth because of the need for developing countries to repay their loans with interest. More recently, also using a lagged dependent variable model, Przeworksi, Vreeland (2000) and Vreeland (2003) also found that IMF loans impeded economic growth. The interesting question is whether this pattern holds for telecommunications usage.

Dependency theory hypothesizes that structural adjustment loans (SALs) reduce Internet usage, while economic liberalization theory hypothesizes that SALs increase Internet usage.

Hypothesis 2: Dependency perspective suggests that higher levels of debt should correspond with lower levels of Internet usage.

Dependency theory suggests higher levels of debt should decrease telecommunications usage because developing countries in servicing their debt have less ability to support infrastructure development. Debt is used to assess a country's solvency over time. Because it is a measure of the sustainability of continuing to service its external debt service obligations, a stable debt service ratio is an indication of a manageable national budget. The debt service ratio of a country to its GDP is not necessarily an indication that a country has a structural adjustment loan in place.

Based upon an eight-country survey, the IMF states, "More policy options are

available to countries with a relatively low debt burden and countries that can secure additional concessional financing on a sustained basis, consistent with long-term debt sustainability" (Akitoby 2007: 17; see also Finger and Mecagni 2007). In an attempt to gain parity with developed countries, the World Bank and International Monetary Fund argue that strategic handling of debt by emerging countries may serve to improve the competitiveness of a country's exports, a supply side economics argument [5] (Dasgupta 1998: 85). The dependency perspective has a different interpretation. During the past seventy years, developing countries have had to rely upon a foreign-controlled export sector as a way to purchase modern equipment. Because structural adjustment loans require nations to undertake currency devaluation, the result is import prices increase. Consequently, poorer countries run a continual deficit balance of payments—additional foreign capital and loans are continually needed to pay off their deficit in order to obtain more financing for additional technological purchases.

McMichael (2000: 128, 158) has argued that debt is a new form of dependency, responsible for impeding economic growth in developing countries. Both Evans (1979:164) and Walton and Ragin (1990) argued a nation's debt crisis has been a result of competition for control between external foreign capital investment and internal gross capital formation. For example, because debt owed to external creditors is denominated in foreign currencies, the amount of a developing country's exports must be increased to take into account the difference between a stronger foreign currency and its own devalued national currency.

[5] Supply side economic policies promote a free market philosophy, including liberalization of trade, diminished government interventions, and reform of financial regulations (Fontaine 1996:135), policies advocated by the IMF and the WB.

Przeworksi and Vreeland (2000:390) found that high levels of debt were an important consideration for a country to enter into a structural adjustment program (also see Shandra, Shircliff, and London 2011; Shandra Shor, Maynard, and London 2008; Shandra, Shor and London 2008). Evidence suggests that repayment of debt obligations may deter foreign investment in telecommunications. For example, Bradshaw and Huang (1991) and Bradshaw and Wahl (1991) in their examination of externally imposed interest payments found that high debt obligations, by reducing the ability of developing nations to maintain a stable balance of payments, led to an inflationary and unstable economic environment unattractive to foreign investment.

Dependency theory hypothesizes that higher levels of IMF and WB debt service should correspond with lower levels of Internet usage because government has less money at its disposal to improve the country's standard of living. In contrast, economic liberalization theory hypothesizes that countries with lower levels of debt service have higher levels of Internet usage because this economic setting encourages foreign and domestic capital investment (Corbo 1992: 15).

Hypothesis 3: Dependency perspective suggests higher levels of inward foreign direct investment should be related to lower levels of Internet usage.

During the 1960s and 1970s, classical dependency perspective argued that exploitation of developing countries' unskilled labor and raw materials (Amin 1976 [1973], Frank 1967) amounted to unequal economic exchange. Unfavorable arrangements in trade and foreign direct investment (Dos Santos 1970; Cardoso 1973; Cardoso and Faletto 1979) were due to multinational corporations precluding the growth of indigenous

technology. Multinational corporations were not concerned with the promotion of "locally generated knowledge." In particular, in line with Emmanuel ([1969], 1972:72), exploitation of non-core (peripheral and semi-peripheral) countries' resources is identified as a deficiency of an adequate technological infrastructure. He thought the type of technologies introduced by multinational corporations (MNC) did not necessarily improve a developing country's basic infrastructure because of two related reasons. First, the introduction of capital-intensive technologies was not appropriate to the needs of the low-income host countries, which typically had an excess of low-skilled labor. Second, a gap between traditional and modern technologies could not be easily closed just from the importing of modern machinery by a host country because of a lack of technical skills in the labor force required to make use of more advanced technologies. Castells and Laserna (1994) suggested that the lack of an educated work force prevents self-sufficient industrial development.

On the other hand, Dunning and Lundan (2008, chapter 12, p. 390; see also Moosa, 2002:23), state that government policies, designed to attract inward foreign direct investment, can play an important role in the development of a country's technology infrastructure. Their explanation is that in order to attract foreign investment capital, the IMF and WB encourage governments of developing countries to offer economic concessions to multinational corporations.

The global diversification of MNCs is increasingly based upon information communications networks (Gholami, Lee, and Heshmati 2006). Structural adjustment policies intended to attract foreign direct investment from multinational corporations are important because MNCs transfer (as imports) technologies into host countries (WB

2008:112); (de Velde 2001: 2, 3, 6). Dasgupta (1998) argues that FDI in some cases may contribute to industry growth, "often based on highly sophisticated technologies" (106). Yet, Dasgupta argues that large oligopolistic firms maintain control of growth through economies of scale rather than through comparative advantage (113). The consequence is that concessions intended to attract inward foreign direct investment can result instead in diminished public programs, for example those focused on providing education to train technologically sophisticated workers. While this outcome is acknowledged, the UN points out that for practical purposes the benefits of various levels of technologies transferred between MNCs and developing countries outweigh any loss UNCTAD *WIR*). [6]

Results from the empirical research are mixed. Dependency perspective argues that stock of inward foreign direct investment (as MNC imports) has a short-term, positive effect on economic growth, but a negative long-term effect in developing countries (Bornschier and Chase-Dunn 1985; Chase-Dunn 1989). In contrast, the IMF (*WEO* 2007) admits that inequality is worsened by this FDI investment because its focus on technology intensive industries increases demand for skilled workers.

Dependency theory hypothesizes that higher levels of multicorporate investment should be associated with lower levels of telecommunications usage because multinational corporations operating in host countries repatriate most of their profits.

Hypothesis 4: Dependency perspective suggests higher levels of trade should correspond with lower levels of Internet usage.

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[6] For example, Firebaugh (1992, 1996) disagrees with the expected outcome proposed by the dependency perspective. On the other hand, Bornschier, Chase-Dunn and Rubinson (1978), Dixon and Boswell (1996), and Kentor and Boswell (2003) continue to find support for this perspective.

Trade deficits run by developing countries are usually a result of buying machinery and other capital goods intended to raise their level of economic development. At the same time, indebted countries need to meet their debt obligations by increasing their earnings. Structural adjustment loans require indebted countries to initiate trade liberalization policies including financial incentives as a way to generate revenue from multinational firms (McMichael 2004; George 1992). Generally, this strategy involves currency devaluation: imports become more expensive while exports become cheaper. Increasing exports to pay ongoing debt obligations may be counterproductive to developing nations (McMichael 2004; Peet 2003; George 1992). In a 2009 study, Howard and Mazaheri examined the impact of FDI, trade, urban population, and literacy on Internet bandwidth, Internet hosts, Internet users, PCs, and mobile phones between the years of 1990 through 2007. Among their findings, trade influenced the amount of Internet bandwidth, but had a negative impact on computer and mobile phone adoption. While Clarke and Wallsten (2006) in a study of 27 developed and 66 developing countries, found that an increased number of Internet users was associated with an increase in exports from low-income to high-income countries, this might indicate an inequitable relationship in trade between developing and developed countries as dependency theory predicts (Frank 1967).

In contrast, free market, or trade openness is considered a key element in economic liberalization, one that plays an important role in technological expansion (Dunning and Lundan (2008, chapter 12; Baliamoune-Lutz 2003; Wunnava and Leiter 2009). As Reynolds and Krivo (1996: 98) observe "indicators of industrial technology should tap the capacity of a society's economy to efficiently transform raw materials into commodities

for consumption or trade." Exports increase GDP because goods sold abroad support a country's domestic production. Crenshaw and Robison (2006a, 2006b), Robison and Crenshaw (2010, 2002), and Guillén and Suárez (2005) have investigated the conditions under which Internet diffusion takes place and found trade openness, economic growth, and education were associated with economic development and telecommunications usage. Between 1993 and 2000, Rouvinen (2006) found, using a lagged dependent variable model, that trade increased the adoption rate of digital mobile phones in developing countries.

Dependency theory hypothesizes that higher levels of trade should be associated with lower levels of Internet usage because multinational corporations operating in host countries repatriate most of their profits. Economic Liberalization suggests that higher levels of trade should correspond with higher levels of Internet usage because the rate of economic growth increases.

Hypothesis 5: Dependency perspective suggests that higher levels of real interest rates should be related to lower levels of Internet usage.

Interest rates are an important consideration for highly indebted countries (Rao and Nallari 2001: 143-148; (Clark 1991). Real interest rates represent inflation-adjusted interest rates. Dependency argues that higher interest rates reflect higher costs for domestic borrowing. As financing becomes more difficult to obtain (Stiglitz 2007:70), domestic investment is reduced. Consequently, rising real interest rates should indicate slower debt repayment to the IMF and WB.

Economic liberalization argues that creating a stabilized, balanced national budget

requires that structural adjustment programs rely on anti-inflationary strategies such as the raising of prices (Fontaine 1996: 134) in a developing country. Consequently, foreign direct investment should be drawn into previously unfunded infrastructure projects because of reduced borrowing costs (Rao and Nallari 20001: 146). This should be beneficial to telecommunications infrastructure investment and telecommunications usage.

Dependency theory hypothesizes that higher levels of real interest rates should be associated with lower levels of Internet usage because of a decrease in lending capital available for domestic investment (Babb 2005:212). Economic Liberalization contends that higher levels of real interest rates should be associated with higher levels of Internet usage because investment and economic growth are encouraged (Corbo 1992: 15)

ECONOMIC LIBERALIZATION PERSPECTIVE

Economic liberalization perspective suggests that structural adjustment should promote telecommunications usage in developing countries. Since the late 1970s, the World Bank and the International Monetary Fund have advocated economic liberalization with both organizations providing loans to recipient countries contingent upon their meeting certain requirements, or conditions (McMichael 2004). Economic liberalization argues that structural adjustment policies promote economic development in low- and middle-income countries (Woodward 1992; Corbo and Fischer 1992) by addressing imbalances in a nation's economy.

Hypothesis 1: Economic liberalization perspective suggests higher levels of gross capital formation as a percentage of GDP should correspond with higher levels of Internet usage.

The Economic liberalization perspective assumes increased prosperity promotes infrastructure and education, and as a result, increases telecommunications usage. Gross capital formation encourages economic growth, which in turn raises a country's standard of living. Higher levels of gross capital formation, according to neo-liberalization theory, should correspond with higher levels of Internet usage. On the other hand, according to dependency theory, lower gross capital formation should decrease telecommunications usage because a government will have less money to spend on infrastructure expansion and education.

According to Andres, Cuberes, Diouf, and Serebrisky (2008), in a study of 199 developed and developing countries between 1990 through 2004, low-income countries had a slower rate of Internet diffusion than developed countries. Their finding support an earlier study conducted in 2003 by Lucas and Sylla, who found that higher levels of infrastructure development were associated with higher levels of Internet hosts in a country. Similarly, in 2006, Chinn and Fairlie found higher Internet usage in 161 developed and developing countries corresponded with higher income per capita. Cava-Ferreruela and Alabau-Munoz (2006) examined the impact of both narrow- and -fixed broadband infrastructure in thirty developed countries and found that each contributed to added growth of telecommunications usage, as did Dasgupta, Lall, and Wheeler (2001) in a study of 44 developing countries. As for wireless broadband, Kauffman and Techatassanasoontorn (2005) found that GDP per capita PPP has a positive influence on the percentage of wireless broadband subscribers. In a study of 100 developed and

developing countries, Wunnava and Leiter (2009) found that GDP per capita PPP had a positive effect on Internet usage, although in a 2008 study, Shchetinin and Massenot found that GDP per capita was associated with a negative effect on developing countries. Stump, Gong, and Li in a 2008 study of 170 developed and developing countries found that higher GDP per capita is associated with the expansion of mobile broadband. In another study by Qiang and Rossotto (2009) using Internet, fixed and mobile broadband penetration in 120 developed and developing countries as independent variables found telecommunications usage supported an increase in GDP per capita between 1980 and 2006.

Economic liberalization hypothesizes that higher levels of gross capital formation should correspond with higher levels of telecommunications usage because increased capital available for domestic investment promotes an improved standard of living.

Hypothesis 2: Economic liberalization perspective suggests higher levels of private investment in telecommunications infrastructure should be related to higher levels of Internet usage.

Policies associated with the economic liberalization perspective advocate increasing reliance upon privatization of government resources, such as public utilities, and financial institutions, combined with reduction of government spending on public services to its citizenry. For example, as a requisite of economic development, national governments have traditionally built, maintained, and rehabilitated their physical infrastructure, including telecommunications. "In fact, investment spending, particularly on infrastructure, used to be one of government's main activities. However, over the past three decades, public spending on infrastructure, as a share of GDP, has been on the

decline worldwide" (Akitoby 2007: iii) with private investment filling in the gap. Cardoso (1973) and Evans (1979) had argued that private investment should be considered another form of dependency. Structural adjustment lending has required developing countries to sell their assets. According to Stiglitz (2007), increased privatization leads to lower revenues through the sale of state-owned enterprises. Cash is raised to pay ongoing debt obligations, but this strategy leaves a developing country unable to generate enough income for current and future growth (Peet 2003).

Yet, private investment is considered an important component of economic liberalization policy according to both the World Bank and International Monetary Fund because it generates revenue and reduces fiscal costs (WB 2008). Government contracting out investment to the private sector—public-private partnerships—are prevalent in developing countries where societal trade-offs in education and infrastructure for instance, must be weighed (see *Bridging the Digital Divide* 2006) against the importing of advanced foreign technologies. Improved access to information communication technologies, especially telecommunications has provided social-economic benefits to developing countries (Madon 2000). According to the World Bank (2008:74), a lack of telecommunications infrastructure has contributed to weak diffusion rates in some low-income countries (see also Oyelaran-Oyeyinka and Lal 2005).

Private-public investment arrangements in South Africa such as Hewlett-Packard's targeted support of libraries, schools, municipal offices has helped to improve telecommunications access and infrastructure (*Bridging the Digital Divide* 2006: 207) but more needs to be accomplished. Since 2000, Thailand has liberalized its trade policy in order to increase imports of information communication technology equipment (*Bridging*

the Digital Divide 2006: 154, 157, 166). Low labor costs through public-private partnerships with multinational firms such as IBM, Seagate Technology, and Hitachi, have turned the country into one of the most important global centers for hard disk drive manufacturing (*Bridging the Digital Divide* 2006:165, 168). In Estonia, public-private partnerships between government, universities, and private telecommunications companies contribute to strong growth in mobile services and support of educational organizations (*WEF* 81-90). On the other hand, due to debt problems, South Africa experienced structural adjustment programs during the 1980s (*Bridging the Digital Divide* 2006:240), and in 1996 and 2004 underwent a further "managed liberalization policy" consisting of partial privatization of telecommunications industry (192). As of 2008 according to the ITU, South Africa had the highest level of mobile broadband subscriptions (5.06 per 100 inhabitants) of African nations.

Between 1997 and 2001, in a study of 118 developed and developing countries, Guillén and Suárez (2005) found that privatization of telecommunications providers increased the level of Internet users. In a 2002 study by Kiiski and Pohjola, they found that telecommunications investment as a share of GDP in both developing and developed countries was associated with growth in the number of Internet hosts. Röller and Waverman (2001) in a study of 21 developed countries between 1970 and 1990 found that private investment in telecommunications infrastructure corresponded with an increase in a country's economic growth.

Economic liberalization hypothesizes that higher levels of investment in telecommunications infrastructure should correspond with higher levels of

Internet usage because of an increase for capital available for investment specifically intended for telecommunications infrastructure, where capital expenditures are a significant cost component.

Hypothesis 3: Economic liberalization perspective suggests higher levels of democracy should be related to higher rates of Internet usage.

According to neo-economic theory, higher levels of democracy should correspond with higher levels of telecommunications usage because the more freedom a country's citizenry has, the more they make use of telecommunications. Norris (2001) contends that increased civic engagement is possible through telecommunications (see also World Bank 2008: 74). Additional empirical support is provided by Milner (2006), who finds that democratic governments promote the diffusion of the Internet.

In examining the connection between democracy and economic development, Lipset (1981) [1963]) found that economic growth is greater in democracies than dictatorships. He contended that important contributing factors to societal equality include higher per capita income, greater urbanization, industrialization, and increased levels of educational enrollment. Along these lines, Huntington (1984) argued that preconditions of democracies include diffusion of economic wealth, free market environment, social structures conducive to cultural diversity, and the establishment of democratic institutions. Democracies differ across the world incorporating a diversity of electoral and party systems, and centralized or decentralized powers carried out by governmental authorities (Norris 2001). Because technical knowledge is considered a form of culture, both at the world and local levels (Lechner and Boli 2005), it is important

to understand how digital communication technologies will operate within a multiplicity of institutions with differing levels of political and civil liberties (see Wei, Qiang and Xu 2005). Information communication technologies that can make "worldwide command and control immeasurably faster and easier than ever before," (Ross and Trachte 1990: 63) suggest a wide range of possible outcomes around the world.

For example, Beilock and Dimitrova (2003) have found that the level of civil liberties play important roles in the expansion of Internet users as did Baliamoune-Lutz (2003) for Internet users, Internet hosts, and mobile broadband subscribers. In three of their longitudinal studies focusing on developing countries (Robison and Crenshaw (2010); Crenshaw and Robison (2006a, 2006b), the level of democracy was found to be important in increasing Internet usage during the years between 1990 and 2004. In their cross-sectional study inclusive of both developing and developed countries, Robison and Crenshaw (2002) had similar findings, as did Guillén and Suarez (2005). Milner (2006) also had similar findings about the impact of democracy on Internet diffusion, including positive benefits of privatization on telecommunications. Her study suggested that democracies rather than autocracies promoted the diffusion of the Internet. However, authoritarian states appear to be interested in the controllability of information communications technologies in order to maintain their regimes (Buchner 1988), suggesting quality of the level of democracy is an important consideration. Corrales and Westhoff's 2006 study suggested that authoritarian governmental regimes had a positive influence on technology adoption. In a more recent study, Rouvinen (2006) found that between 1993 and 2000, higher levels of political freedom were linked with lower mobile broadband adoption rates in developing countries. He posits that the democracy in

developing countries may be either associated with political instability, or, that more authoritarian regimes actively promote telecommunications usage. According to Stiglitz (2007:12), conditionality may undermine domestic political institutions because of foreign intervention.

Economic liberalization hypothesizes that higher levels of democracy should be associated with higher levels of Internet usage because of increased participation in the democratic process.

Hypothesis 4: Economic liberalization perspective suggests higher levels of urban population should correspond to higher levels of Internet usage.

Boserup's 1981 study of technological change took into account conditions necessary for the transmission of technology. Boserup's (1981) thesis contends that demographic density and technological transmission are interrelated. Although she found the correlation between population density and technological level to become less close over modern centuries, nevertheless she argued that since 1950, "rapid increases in world population were accompanied by rapid technological change." She goes on to state that "the process of interrelated demographic and technological change resulted in radical changes in the pattern of international trade and factor proportions (1981:7)." Boserup's (1981) research indicated a difference exists between urban and rural populations adaptation to technological change, with urban population associated with higher telecommunications usage. Boserup (1981:125) considered the effects of population density at two levels, both between and within countries, arguing density improved the quality of communications through such factors as availability of education (77),

infrastructure, and trade encouraged by multinational corporations (199); (See also Chen and Wellman 2004). The World Bank concurs that technological progress has been greater in cities than rural areas of developing countries (WB 2008:151). One of the reasons for this is that providing Internet access to urban dwellers costs less than providing it to rural dwellers because of the lower infrastructure costs.

Recent studies by Robison and Crenshaw (2010) and, Crenshaw and Robison (2006b) have found evidence that cities increase Internet usage. Dewan, Ganley, and Kraemer (2005) in a study of 40 developed and developing countries between 1985 and 2001 also found that urban population size is related to telephone diffusion. In contrast, Howard and Mazaheri (2009) found the percentage of urban population had a small positive impact on mobile phone adoption and a small negative impact on the proportion of Internet users.

The economic liberalization perspective suggests that structural adjustment should increase Internet usage for those countries with high urban populations, while the dependency perspective suggests that structural adjustment should decrease Internet usage for those countries with high urban populations.

Hypothesis 5: Economic liberalization perspective suggests higher levels of GNP should correspond with higher levels of Internet usage.

As London and Ross (1995: 207) comment, a nation's level of economic development should be taken into account as a way to ensure that any effects revealed are independent of a "nation's level of wealth. "

Economic liberalization hypothesizes that higher levels of GNI per capita should

be associated with higher levels of Internet usage because of its contribution to economic stability and higher rates of economic growth through increased amount of capital available for domestic investment.

Summary and Conclusion

My research considers debt and structural adjustment loans along with the influence of economic as well as social and political considerations on Internet usage in developing countries. While contending theoretical perspectives predict opposing outcomes about Internet usage in developing countries, debt and structural adjustment loans should be taken into consideration, as there is little research on this topic. The dependency perspective predicts that debt and participation in IMF and WB structural adjustment loans should be related to lower levels of Internet usage. In addition, multinational corporate investment, levels of trade openness and real interest rates should also correspond with decreased levels of Internet usage. In contrast, the economic liberalization perspective predicts that higher levels of gross capital formation and gross national product should correspond with higher levels of Internet usage. This perspective also suggests that higher levels of telecommunications infrastructure privatization, democracy, and urban population relate to higher levels of Internet usage. Economic liberalization and dependency anticipate that higher levels of both primary and secondary education should correspond with higher levels of Internet usage because a better-educated public is able to make better use of telecommunications technology.

Most of the empirical research on telecommunications technologies, mentioned in this chapter base their modeling on some variation of temporal change in order to handle

the problem of reverse causality with only Stump, Gong, and Li (2008) using a single time point. In general, the research on telecommunications uses telecommunications as a dependent variable. Kiiski and Pohjola (2002) use structural equation modeling (SEM) in conjunction with OLS and Gompertz models (see Menard 2002:21). Of the four studies, which examined telecommunications as an independent variable, only Qiang and Rossotto (2009) used SEM in conjunction with OLS and IVs. However, they note that OLS was an appropriate estimator (Table 2.1 and Appendix, Table 2.2), which I use.

Table 2.1

Cited Research on Telecommunications Technologies

Empirical Study	***As Dependent Variable***	**Causality Modeled as:**
Robison and Crenshaw (2010)	Internet users	Time-series
Wunnava and Leiter (2009)	Internet usage	Weighted least squares
Howard and Mazaheri (2009)	Internet bandwidth; Internet hosts; Internet users; PCs; mobile broadband	Lagged dependent variable
Andres, Cuberes, Diouf and Serebrisky (2008)	Internet users	Lagged dependent variable; Gompertz
Shchetinin and Massenot (2008)	Internet users	Gompertz: GMM
Stump, Gong, and Li (2008)	mobile broadband subscriptions	
Crenshaw and Robison (2006b)	Internet hosts	Pooled time-series; lagged variables
Crenshaw and Robison (2006a)	Internet hosts	Gompertz
Chinn and Fairlie (2006)	Internet usage	Fixed and random effects
Milner (2006)	Internet hosts; Internet users	
Cava-Ferreruela and Alabau-Munoz (2006)	Narrow band subscriptions; wired broadband subscriptions	Lagged dependent variable ;bootstrap
Rouvinen (2006)	mobile broadband	Gompertz
Guillén and Suarez (2005)	Internet users	Lagged dependent variable
Kauffman and Techatassanasoontorn (2005)	mobile broadband subscribers	Gompertz
Lucas and Sylla (2003)	Internet hosts	Gompertz
Beilock and Dimitrova (2003)	Internet users	
Baliamoune-Lutz (2003)	Internet hosts; Internet users; PCs; mobile broadband subscriptions	Granger causality
Kiiski and Pohjola (2002)	Internet hosts	OLS; Gompertz; 3SLS
Robison and Crenshaw (2002)	Internet hosts	Time-series
Dasgupta, Lall and Wheeler (2001)	mobile broadband	Gompertz
	As Independent Variable	
Qiang and Rossotto (2009)	fixed broadband; mobile broadband	4SLS; Lagged dependent variable as IV
Bradshaw, Fallon, and Viterna (2005)	Internet users; Internet hosts	2SLS
Dewan, Ganley, and Kraemer (2005)	telephone main line density	
Röller and Waverman (2001)	telephone infrastructure	SEM

Chapter Three

Methodology

Research Design, Estimation, and Regression Diagnostics

In this chapter, I discuss my methodology to examine structural adjustment loan participation. In my analysis, I use a longitudinal design over a nine-year period (2000-2008). The dependent variable is measured in 2008 while the lagged dependent variable and independent variables are measured in 2000 (Table 3.1). This model is commonly used in cross-national research, and has been used by Shandra, Shor and London 2008; see Menard 2002) among others. The use of a lagged dependent variable is regarded as important in making causal inferences with non-experimental data in longitudinal analysis (Finkel 1995) and is appropriate for a short time series with many cases (Menard 2002; Allison 2011). The dependent variable is Internet usage in 2008 and the lagged dependent variable is Internet usage in 2000.

The basic mathematical model for a lagged dependent variable model is:

$$Y_t = B_0 Y_{t-1} + B_1 + B_2 X_{t-1} + E_t$$

This method estimates the effects of change of the independent variables on the dependent variable between two time periods. The dependent variable (Y_t) is theorized to be affected by the lagged dependent variable (Y_{t-1}), the constant (B_1), the lagged value of the independent variable (X_{t-1}), and the error term (E_t). The advantage of using this model is relevant to my analysis because it reduces the possibility of bias estimation introduced by

an omitted explanatory variable prior to the time span under consideration (Menard 2002). As Finkel (1995) states, the time component permits the estimation of the causal effects of prior values of X on future values of Y, controlling for $t\text{-}_1$. Therefore, because time is accounted for, this model reduces concerns about the problem of reciprocal causality. However, analysis based on a conditional change model assigns a maximum explanatory power to the lagged dependent variable as a counter to a generally high correlation between the lagged dependent variable and the dependent variable (Menard 2002). Auto-correlation is a problem associated with the use of a lagged dependent variable because not only are the standard errors underestimated, but also the coefficient of the lagged dependent variable is overestimated relative to the coefficients of the other independent variables in the model. Overall, although a common problem in panel data is the high correlation between the dependent variables and lagged dependent variables, this type of regression does provide a conservative test of the effects of the other independent variables on change in the dependent variables (Hannan 1979).

Multicollinearity

The problem of multicollinearity in cross-national data may result in overestimated standard errors. To detect and correct for this problem, I first examine the bivariate relationship between independent variables by running a correlation matrix as a preliminary check. If the independent variables have a correlation of 0.8, then collinearity may be present. A high R^2 value of about 0.8 or 0.9 (1.0 indicates perfect correlation) signifies high correlation between the two independent variables tested, i.e., variables may appear to be less important than they otherwise would be (Lewis-Beck 1995). Because this procedure does not evaluate the relationship between an independent variable and all

other independent variables, as a second test, I also regress each independent variable on all the other independent variables in the model, to determine if any of the R-squares are higher than the original results (Lewis-Beck 1995). Third, I check whether the mean variance inflation factor (VIF) exceeds a value of six, and the highest VIF score does not exceed a value of ten for each variable in my model (Kennedy 2003). [7]

Heteroskedascity

The problem of heteroskedascity may lead to underestimated values for the standard errors. Consequently, I calculate Breusch-Pagan statistics to identify if heteroskedascity exists (Menard 2002). In the Stata version of listwise and mean substitution models (with the exception of the IMF loan model), the Breusch-Pagan test for the presence of heteroskedascity (*p*-values statistically significant indicate rejection of the null hypothesis of homoskedascity of residuals (Menard 2002), is available. Because heteroskedascity is present, I have adjusted these models using heteroskedascity-robust standard errors, a standard procedure, to deal with this problem of serial correlation. The dependent variable was not transformed. Because SPSS does not provide a readily accessible method for either identifying heteroskedascity or using robust standard error estimation, the pairwise tables present only the standard errors. Because unstandardized and beta coefficients, along with the variance inflation factor (VIF) are unchanged, use of

[7] Variance inflation factors represent the inverse of the square of the correlation matrix and are used in determining if multicollinearity is a problem. It indicates the effect that other independent variables have on the variance of the multiple regression coefficients.

standard errors in lieu of robust standard errors provides a smaller standard error and more conservative p-value estimation.[8]

Outliers and influential cases

Finally, following standard practice with cross-national research, I also test for outliers and influential cases. I test for outliers, observations with large OLS residual errors not representative of the dataset, because they substantially differ from the main body of data, and therefore their presence can distort the regression slopes of a model. First, I identified outliers by a visual examination of the scattergram for each of my independent variables against the dependent variable, Internet usage. Second, I also tested for the presence of influential cases, observations that have an even stronger influence on OLS estimates than outliers do, because they exert a disproportionate influence over the parameters of a statistical model. I visually examined separate stem and leaf plots for leverage and studentized residuals. Third, I also visually examined a leverage vs. squared residual plot. Finally, I ran a Cook's Distance statistic, using a conventional cut-off point of a statistic not larger than an absolute value of one for an influential case, and for a outlier, the cutoff point for a standardized residual statistic of not larger than an absolute value of three. The regression models in cross-national research are known to be very sensitive to the presence of influential observations (Kennedy 2003). After removing four countries (Brazil, Colombia, Morocco, and Ukraine) from my model, I then rechecked for residual normality by graphing both a standardized normal probability plot (P-P) and a

[8] In SPSS, I also ran a separate syntax for White's corrected standard errors. However, I did not include the results because they are not directly comparable with Stata's robust standard error.

variable quantiles vs. quantiles of a normal distribution plot (Q-Q) to detect any departures from multivariate normality. As the results of the slopes between the before and after removal of these countries showed substantially no change, I report only one set of coefficients.

Missing Data

Missing data is a common problem with cross national research studies. Values for variables included in a study may be missing for any number of reasons, particularly with developing countries that may lack adequate resources for establishing and maintaining expensive data collection practices. The World Bank (2010c) notes that statistical systems are still weak in developing countries due to lack of distribution, lack of immediacy in publication, lack of staff, or lack of computer equipment. At the national level, political problems or conflict may interfere with data collection. The problem of missing data values leads to concerns about the validity and reliability of the inferences made about the parameters and statistical tests used (Menard 2002).

Consequently, incomplete data sets are handled in the following manner. In order to estimate the Internet usage model, I run pairwise deletion, listwise deletion and mean substitution to generate the descriptive statistics (Tables 3.2, 3.3, 3.4) and bivariate correlation matrixes for Internet usage (Tables 4.1, 4.2, 4.3). While these are common methods to deal with missing data, these methods have different advantages and disadvantages. First, pairwise deletion does not drop any cases due to missing data. An appropriate sample size should be based on a ratio of cases to independent variables of at

least five to one (Tabachnick and Fidell 2007: 123-124). However, pairwise deletion is a more problematic method when encountering missing data (Allison 2002). Because the pairwise method attempts to use all available data, it can also result in some correlations being based on cases not included in other correlations (Graham 2009). Models may not be based on the same sampling of countries. Second, listwise deletion is a more conservative approach resulting in a smaller panel size because if data if missing on any of the variables included in the model, the method drops the case. However, the available sample size, while representing countries with complete records, also provides a much smaller sample size than the original, and may not include the poorest countries. Consequently, the standard error will be larger because there is less available information. On the other hand, there is another reason to consider listwise deletion as an acceptable way to handle missing data. As Allison (2002:6-7) points out, with listwise deletion, if the data is missing at random (MAR), then this method will yield biased regression coefficients estimates. However, Allison states that this method is more robust against violations of MAR among independent variables under the following condition. If the missing data on the explanatory variable does not depend on the dependent variable, then the regression estimates are unbiased, although it is possible that the intercept will be biased. MAR occurs when the pattern of missing data on the dependent variable can be predicted from the independent variables in the dataset, but these explanatory variables have no relationship to the dependent variable. For example, in my dataset, missing data on GNP, an explanatory variable does not depend on the dependent variable, Internet usage. Because of possible estimation bias with the first two methods, as a third check, I use mean substitution, in which missing values for a variable are replaced with the

variables' mean. If some of the variables have missing data, then the mean substitution estimate is based only on the non-missing values. [9] Mean substitution has the opposite problem of listwise deletion in that the resulting standard error and p-values are underestimated. While this process treats the assigned values as actual observations, they are still estimates themselves with random error corresponding to the original mean.

Data Analysis Procedures

I use the software package, *Stata*, release 13, for both listwise and mean substitution deletion; SPSS, version 22 is used to handle pairwise deletion of missing data. Stat/Transfer version 12 was used to convert my dataset from Stata to SPSS.

[9] Countries included in my analysis after listwise deletion for *Internet users*: Afghanistan, Albania, Algeria, American Samoa, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Barbados, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina Botswana, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verge, Central African Republic, Chad, Chile, China, Comoros, Congo, Dem. Republic, Congo, Republic, Costa Rica, Cote d'Ivoire, Croatia, Cuba, Czech Republic, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary India, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Korea, Dem Republic, Kyrgyz Republic, Lao, Latvia, Lebanon, Lesotho, Liberia, Libya, Lithuania, Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Mayotte, Mexico, Micronesia Fed. States, Moldova, Mongolia, Montenegro, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Northern Mariana Islands, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Romania, Russian Federation, Rwanda, Samoa, Sao Tome and Principe, Senegal, Serbia, Seychelles, Sierra Leone, Slovak Republic, Solomon Islands, Somalia, South Africa, Sri Lanka, St. Kitts and Nevis, St. Lucia, St Vincent and Grenadines, Sudan, Suriname, Swaziland, Syria, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, West Bank and Gaza, Yemen, Zambia, Zimbabwe (Four countries were deleted: Brazil, Colombia, Morocco, and Ukraine.)

Sample Size and Country classification by income group

In my research, only developing countries listed by the World Bank are included. Subsequently, only 153 are initially considered in this study before missing data deletion. I follow the World Bank's four-category country classification system based on low-, lower middle-, upper middle- and high-income economies to distinguish between developing and developed countries. The main criterion for the WB's country classification system is gross national income (GNI), previously referred to as gross national product (GNP). As of the year 2000, the baseline of my study, the World Bank categorized the world's countries by GNI per capita in the following manner: 1) low income economies are in the range of $755 and less; 2) lower middle economies between $756- $2995; 3) upper middle economies in the range between $2996- $9,265; and 4) high income economies are in the range of $9,266 and higher. My research focuses on Internet usage in developing countries. Included in my study are countries from the year 2000 classified as low, lower-middle, and upper-middle countries by the World Bank. Therefore, any countries classified as high income are excluded.

Datasets

My selected variables are drawn from five datasets: (1) *World Bank World Development Indicators*; (2) *United Nations Conference on Trade & Development (UNCTAD), World Investment Report*; (3) *International Monetary Fund (4) Polity IV*. (See Table 3.1).

MEASUREMENT OF VARIABLES

Cross-country data is available on Internet users per 100 people, [10] measured in 2008 while its lagged dependent variable is measured in 2000. All of the independent variables are measured in the year 2000 except for the three structural adjustment loans which are measured as total number of loans between 2000 and 2008 inclusive. I include two pairs of alternative independent indicators: (1) structural adjustment loans, including IMF, WB and WB telecommunications and, (2) debt, including IMF and WB (See Table 3.1). I analyze each pair alternatively. These pairs, "cognate" but "distinct" indicators (London and Ross 1995), are used to protect against potential measurement error. Comparisons of these indicators serve on the one hand, to "guard against," the potential problem of using a single imperfect measure" and, on the other hand, the possibility of incorporating the same measurement error (Paxton 2002) into my model. If the dual indicators in my study show similar effects on telecommunications usage, then confidence in the generalization of my study is increased.

Dependent Telecommunications Variable

Number of Internet Users per 100 People

Internet users are the number of people with access to the worldwide network. This variable represents the level of actual Internet usage achieved by a country. Included are subscribers who pay for Internet access via dial-up, leased line and fixed broadband,

[10] All data on users are based upon *ITU's* World Telecommunications Development Report database. Nationally reported data is drawn either from household surveys or when not available, estimates based on the number of subscriptions. This method may underreport the actual number of people involved (World Development Indicators/International Telecommunications Union definitions of telecommunications indicators, 2010).

and people who also have Internet access without paying directly. While in developing countries, other common types of usage include free and shared access, whether through household, work, school, or cybercafes, this information is not collected by any of the international organizations. Several cross-national research studies have examined the ratio of Internet users (Bradshaw, Fallon and Viterna 2005); (Guillén and Suarez 2005); (Robison and Crenshaw 2010, 2002); (Crenshaw and Robison 2006a, 2006b); (Milner 2006); (Beilock and Dimitrova 2003); (Andres, Cuberes, Diouf and Serebrisky 2008); (Baliamoune-Lutz 2003); (Dasgupta, Lall and Wheeler 2001). Data is from the World Bank. This variable is transformed by square root to correct for a strong positive skew.

Independent Variables

Structural Adjustment Indicators

The IMF and WB provide data on the amount they originally agree to lend to a developing country; however, some problems exist in making full use of the available data. While it is recognized that IMF/WB funding may not be completely spent by a country during a given year (Przeworksi and Vreeland 2000; Vreeland 2003; Abouharb and Cingranelli, 2007, 2009; Shandra, Shircliff and London 2011), omissions in the available data create problems. Although in the case of the IMF, the data shows a wide divergence of loan amounts provided between countries, it is not always possible to compute the yearly amount spent by an individual country because the three columns (total amount agreed, undrawn balance, and IMF credit outstanding at each year's end) in many cases do not add up (IMF lending arrangement database). As for the WB telecommunications lending program, funding amounts are not provided. For these

reasons, the total number of loans is counted for all three types of loan arrangements thereby providing a consistent approach for comparison purposes across countries.

International Monetary Fund Loans

The focus of the IMF is to promote international monetary cooperation, to stabilize nations' currencies, and to expand international trade. This variable indicates whether a nation has received a structural adjustment loan from the International Monetary Fund as of December 31st of each year between 2000 through 2008 inclusive. It is coded to reflect the total number of loans received and used, from 2000 through 2008 inclusive. Interim calculations reflecting a country participating but not actually using a loan for a particular year were coded as zero. Raw data was accessed from the IMF's, "Lending Arrangements, calculated as of December 31" of each year, 2010 online database.

World Bank Loans

The focus of the WB is on worldwide poverty reduction through financing, private investment and private capital. This variable indicates whether a structural adjustment loan for telecommunications has been made by the World Bank (IBRD and IDA) as of December 31st on a yearly basis between 2000 through 2008 inclusive. It is coded to reflect the total number of loans received and used, from 2000 through 2008 inclusive. Interim calculations reflecting a country participating but not actually using a loan for a particular year were coded as zero. Raw data was accessed from the WBs "External Projects, Structural Adjustment Loans, calculated as of December 31" of each year, 2010 online database.

World Bank Telecommunications Loans

This variable indicates whether a structural adjustment loan for telecommunications has been made by the World Bank (IBRD and IDA) as of December 31st on a yearly basis between 2000 through 2008 inclusive. It is coded to reflect the total number of loans received and used, from 2000 through 2008 inclusive. Interim calculations reflecting a country participating but not actually using a loan for a particular year were coded as zero. Raw data was accessed from the WBs "External Projects, Telecommunications, calculated as of December 31" of each year, 2010 online database.

Debt Service ratio, IMF

Indebted nations are under pressure to continually service their foreign debts. Debt service is the average sum of principal repayments and interest in foreign currency, goods, or services actually paid on long-term public and publicly guaranteed debt and repayments (repayments and charges) to the International Monetary Fund (IMF) (Dasgupta 1998: 85). Debt service ratio is expressed as a percentage of a country's exports of goods, services, and income but excludes workers' remittances. Data is from the World Bank. This variable is transformed by square root to correct for a strong positive skew.

Multilateral Debt Service Ratio (as % of public and publicly guaranteed debt service, WB)

Indebted nations are under pressure to continually service their foreign debts. Multilateral debt service is the repayment of principal and interest to the World Bank (WB), regional development banks, and other multilateral and intergovernmental

agencies.[11] Public and publicly guaranteed debt service is the sum of principal repayments and interest actually paid in foreign currency, goods, or services on long-term obligations of public debtors and long-term private obligations guaranteed by a public entity. This independent variable is measured in 2000. Data is from the World Bank. This variable is transformed by square root to correct for a strong positive skew.

Economic Indicators

Trade as a percentage of GDP

Trade openness is the total of exports and imports of goods and services measured as a share of gross domestic product. Trade dependency measures the exposure of a country's economy to the international economy. As a ratio, the greater the level of domestic consumption of exports, the worse a country's trade deficit is. Data is from the World Bank. This variable is transformed by square root to correct for a strong positive skew.

Inward Foreign Direct investment (FDI) stock as percentage of GDP [12]

[11] The multilateral debt service indicator does not include the IMF. (Personal e-mail communication from the Development Data Group of the World Bank, dated October 10, 2011.

[12] A prior study by Firebaugh (1992; 109) relied upon stock data as a proxy for degree of MNC penetration, drawn from Ballmer-Cao and Scheidegger (1979: 128), supplemented by data in Bornschier and Chase-Dunn (1985). Several studies from this period used this same source; See Bornschier, Chase-Dunn and Rubinson (1978), "Cross-National Evidence of the Effects of Foreign Investment and Aid on Economic Growth and Inequality: A Survey of Findings and a Reanalysis. *American Journal of Sociology* 84.3 (Nov): 651-683. (See Ballmer-Cao, and Scheidegger, Juerg, *Compendium of Data for World-Systems Analysis*. Soziologisches Institut der Universitat, Zurich.

The UNCTAD *World Investment Report* (WIR) (2006: 294) defines FDI stock as "the value of the share of their capital and reserves (including retained profits) attributable

FDI is a balance of payments concept representing cross-border transfer of funds and is composed of capital investment, reinvestment of profits, and multinational corporation (MNC) internal loans (UNCTAD *WIR*). Following Kentor and Boswell (2003:306), foreign capital penetration, as represented by multinational corporate investment in a host country is measured as inward foreign direct investment (FDI) stock as a percentage of each country's total GDP. This measure reveals the degree to which a host country is dependent on foreign direct investment. This measure has also been used by Dixon and Boswell (1996), Firebaugh (1996), and Kentor (1998) and Robison and Crenshaw (2002). Narula (1996:54) and, Kentor and Boswell (2003) use the available data from the United Nations Commission on Trade and Development (UNCTAD) as I do here. A negative sign before inward FDI represents disinvestment. This variable is transformed by natural log to correct for a positive skew.

Real Interest Rates as percentage of GDP

The real interest rate is the lending interest rate (rate charged by banks on loans to prime customers) adjusted for inflation as measured by the GDP deflator (Corbo and Fischer 1992; Woodward 1992: 37). [13] It represents a balance between savings (supply)

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to the parent enterprise, plus the net indebtedness of affiliates of the parent enterprise." FDI stock is a measure of the total accumulated amount value of foreign-owned capital in a host country. Inward FDI flows represent an annual amount over the course of a year. For a discussion about FDI and MNCs, see Cohen 2007.

[13] See also Sunanda Sen 1996: 14 "On Financial Fragility and its Global Implications," pp. 35-59 in *Financial Fragility, Debt and Economic Reforms*. Edited by Sunanda Sen. NY: St. Martin's.

and investment (demand). The GDP deflator measures the average annual rate of changes in prices for total GDP. Data is from the World Bank.

Investment in telecommunications infrastructure with private participation as percentage of GDP

This variable represents investment in telecommunications infrastructure projects with private participation and refers to those projects that have reached financial closure that directly or indirectly serve the public. Technological improvements are dependent on financial resources. To standardize this variable, private investment, measured in current US dollars is divided by GDP, which is measured in US dollars is divided by GDP, which is measured in $ US millions. Data is from the World Bank. This variable is transformed by its square root to correct for a strong positive skew.

Gross Capital Formation as % GDP

Local capital formation is gross domestic investment measured as a percentage of GDP. This variable corresponds to the level of domestic infrastructure expansion (see Woodward 1992:274 and, World Bank 2008:116) and is included in order to evaluate a country's infrastructure capacity, or intensity to provide basic support for telecommunications usage. Sustainable growth requires new capital formation, but many developing countries have low rates of capital formation. Gross capital formation consists of outlays to fixed assets of the economy plus net changes in the level of inventories, which are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and "work in progress." Infrastructure consisting of fixed assets includes land improvements (fences, ditches, drains, &c.), plant, machinery and

equipment purchases; the construction of roads, railways, bridges, public buildings, including schools, offices, hospitals; private residential dwellings, commercial and industrial buildings; and power and communication systems. Data is from the World Bank. This variable is transformed by its square root to correct for a strong positive skew.

GNI per capita PPP (current international dollars)

Therefore, following London and Ross (1995) and London and Williams (1988), the measure I use to control for the amount of variation of aggregate wealth levels among nations is Gross National Product (GNP, or as it is now known as GNI per capita PPP by the World Bank) per capita converted to international dollars using purchasing power parity for 2000. GNI represents the sum of value added by all resident producers plus any product taxes, less subsidies, not included in the valuation of output, plus net receipts of primary income (employment and property) abroad on a per capita basis. Purchasing power parity (PPP) acts as a weight to control for population size. Data is from the World Bank. This variable is transformed by its square root to correct for its strong positive skewed distribution.

Social-Political Indicators

Primary education, gross enrollment ratio, percentage of relevant age group

Primary education provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music. Primary education is used instead of literacy because of the availability of more data. Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of a corresponding appropriate age

group. Gross enrollment ratio indicates the capacity of each level of the education system. Data is from the World Bank.

Empirical research findings suggest that education has a positive effect upon the adoption of information communication technologies in developing countries (Buchmann 1996); (Madon 2000); (Qiang and Rossotto 2009); (Massenot and Shchetinin 2008); (Dewan, Ganley and Kramer 2005); (Kiiski and Pohjola 2002); (Lucas and Sylla 2003; (WB 2008). Bradshaw, Fallon, and Viterna (2005) have found that the influence of primary education is statistically significant on telecommunications usage. This variable is transformed by its square to correct for a negative skew.

Secondary education, gross enrollment ratio, percentage of relevant age group

Secondary education completes the basic education training that began at the primary level and its goal is to provide the groundwork for lifelong learning and human development by offering more subject- or skill- oriented instruction by more specialized teachers. Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the corresponding age group. Gross enrollment ratio indicates the capacity of each level of the education system. Data is available from the World Bank. This variable is transformed by its cubic to correct for its strong negative skew.

Urban population, percentage of total population [14]

[14] Total population of an economy includes all residents of legal status or citizenship—except for refugees, not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin.

Urban population is the midyear population of areas defined as urban in each country and reported to the United Nations. This figure is stable from year to year with the exception of war and drought. Data is from the World Bank. This variable is transformed by natural log to correct for a positive skew.

Polity IV Index

The reliability and validity of the democracy ratings of Polity IV have been evaluated and accepted over the years. I use only this index in my analysis for two reasons. First, the Polity IV index is more complete than the Freedom House Index, and second, the correlation between Polity IV and Freedom House is 0.88. Bollen and Paxton's (2000: 59-60), working definition of liberal democracy "is the degree to which a political system allows *democratic rule* and *political liberties*" (italics in the original). Their explanation focuses on two measurable dimensions. The first dimension encompasses national governmental responsibility, along with individual participation, either directly or representationally. The second dimension addresses the capacity of a country's citizenry to express a variety of political opinions in any form of media along with the ability to participate freely in any type of political activity.

Separate measures of a country's level of democracy and autocracy are measured on a 21 point scale of plus or minus 1 to 10 (zero is neutral) ranging from 10 indicative of consolidated democratic representation to minus 10 as representative of consolidated autocracy. As recommended by this organization, Polity scores are converted to a three-part regime categorization: autocracies (-10 to -6); anocracies (-5 to +5), and democracies (+6 to +10). Democratic characteristics include open and fair elections whereas autocratic

characteristics comprise unrestricted executive authority.[15] Data is from the Polity IV online database, 2010. This variable is transformed by its cubic to correct for a strong negative skew.

Discussion of Descriptive Statistics

Transformations of variables

All of the continuous independent variables were checked for the presence of skewness and kurtosis, by calculating the Shapiro-Wilk and Kolmogorov-Smirnov tests for normal distribution. I followed the conventional standard of statistical range: an absolute value of no more than three for skewness and for kurtosis, an absolute range of two to no more than ten. Variable transformations are based upon a triple examination of results from Stata's power commands: p-value for Chi-square, and visual inspection of histograms, and quintile-normal plots (Table 3.1).

The dependent variable, Internet usage has not been transformed; nor have the three types of structural adjustment loans. The variable, real interest rates, did not require transformation. In my analysis, I have transformed the lagged dependent variable as a square root in order to reduce the amount of positive skew. I do so because in cross-national data analysis, a problem commonly occurs that the dependent variable contains measurement errors, with the amount of error varying with the independent variable. The descriptive statistics are based upon various transformations of the independent variables (Table 3.1).

Descriptive Statistics

Measures of central tendency (mean, standard deviation, and range) are presented in Tables 3.2, 3.3, and 3.4. The results of the descriptive statistics for the three missing

[15] In line with Polity IV recommendations, cases of foreign dominated countries coded as -66 are treated as missing values, interregnum cases coded as -77 are assigned values of 0, and, any transition countries coded as -88 are also treated as missing.

data methods, pairwise, listwise, and mean substitution are similar, although as a consequence of imputation, the standard deviation for mean substitution differs more than that of pairwise and listwise from each other. Results for the coefficient of variance (standard deviation divided by its mean) are presented because this statistic allows for comparison of the variability among the different independent variables both across and within models. First, comparing across the three models, we see as expected, that several of the coefficients for pairwise and listwise are higher, with one exception, indicating a greater variability than is found for the mean substitution variables. Second, within each model, variances differ. For example, Internet users and private investment in telecommunications show a greater amount of variance than trade, FDI, GNP, or urbanization. IMF and WB debt have lower variability in comparison to the three IMF and WB structural adjustment loans. This suggests that amount of Internet usage and number of SALs are not uniformly distributed across the developing countries. Real interest rates and Polity IV democracy have the largest variance of all. This should suggest that the IMF and WB are dealing with a wide range of conditions in this category of countries, perhaps more instability than realized. Third, the one exception in which the Coefficient of Variation (standard deviation divided by its mean) is higher in mean substitution than in pairwise and listwise, is gross capital formation (.398 vs. .188). The reason is that for every missing value on gross capital formation in the mean substitution dataset, Stata was dropping cases, because as a transformed variable, the square root was undefined. A visual inspection of the raw data in the three datasets showed that this type of problem did not occur elsewhere. Consequently, I have added a little constant, 0.001 to every missing case. Fourth, secondary education has a greater variability than primary education in each of the three models.

Table 3.1

Variables, Measures, and Data Sources

2000-2008

		source	variable transformations
Dependent			
Internet Usage	*Internet Users per 100 people, 2008	WB	
Independent			
Lagged dependent	*Internet Users per 100 people, 2000	WB	square root
Structural Adjustment	*IMF Structural Adjustment lending, 2000-2008	IMF	
	*WB Structural Adjustment lending, 2000-2008	WB	
	*WB Telecommunications loans, 2000-2008	WB	
	*Debt Service ratio, 2000 (IMF)	UNCTAD	square root
	*Multilateral Debt Service Ratio, 2000 (WB)	WB	square root
Economic	Trade as % of GDP, 2000		
	Inward FDI stock as % of GDP, 2000	WB	square root
	Real Interest Rates as % of GDP, 2000	WB	natural log
	Private investment in telecommunications	WB	
	infrastructure as % GDP, 2000	WB	square root
	Gross capital formation as % GDP, 2000	WB	square root
	Gross national product per capita, 2000	WB	square root
		WB	
Social-Political	*Primary education, gross enrollment ratio, 2000	WB	square
	*Secondary education, gross enrollment ratio, 2000	WB	cubic
	Urban percentage of population, 2000	WB	natural log
	Polity IV Democracy Index, 2000	P IV	cubic

* = alternative indicators

Data Sources

IMF	International Monetary Fund
PIV	Polity IV
UNCTAD	United Nations Conference on Trade and Development
WB	World Bank

Table 3.2

Descriptive Statistics
Pairwise
Internet Users

Internet Users per 100 people	N	Mean	Standard deviation	Range Min	Range Max
1) number of Internet Users per 100 people, 2000	143	17.205	17.644	0	73.667
2) number of Internet Users per 100 people, 2000	137	1.250	.991	0	5.347
3) IMF loans total, 2000-2008	143	3.68	4.112	0	19
4) WB loans total, 2000-2008	143	1.84	2.831	0	17
5) WB Telecommunications loans total, 2000-2008	143	4.27	6.122	0	25
6) IMF Debt Service ratio, 2000	99	.103	.036	.032	.214
7) WB Multilateral Debt Service ratio, 2000	118	.199	.069	0	.316
8) Trade as % of GDP, 2000	135	.280	.072	.032	.469
9) Inward FDI stock as % of GDP, 2000	133	2.999	1.255	-1.609	6.360
10) Real interest rates, 2000	114	6.799	14.688	-60.8	41.77
11) Private Invest telecomm infrastructure, 2000	89	12.024	15.964	0	82.441
12) Gross capital formation as % GDP, 2000	131	.144	.027	.054	.247
13) GNP, 2000	133	1.835	.873	.458	4.024
14) Primary education, gross enrollment ratio, 2000	126	9.851	3.484	.378	19.279
15) Secondary education, gross enrollment ratio, 2000	114	333.300	319.378	.223	1446.885
16) Urban percentage of population, 2000	143	3.710	.524	2.079	4.511
17) Polity IV Democracy Index, 2000	116	149.610	431.471	-1000	1000

	Coefficient of variation
1) number of Internet Users per 100 people, 2008	1.025
2) number of Internet Users per 100 people, 2000	.793
3) IMF loans total, 2000-2008	1.117
4) WB loans total, 2000-2008	1.539
5) WB Telecommunications loans total, 2000-2008	1.434
6) IMF Debt Service ratio, 2000	.349
7) WB Multilateral Debt Service ratio, 2000	.347
8) Trade as % of GDP, 2000	.257
9) Inward FDI stock as % of GDP, 2000	.418
10) Real interest rates, 2000	2.16
11) Private Invest telecomm infrastructure, 2000	1.328
12) Gross capital formation as % GDP, 2000	.188
13) GNP, 2000	.476
14) Primary education, gross enrollment ratio, 2000	.353
15) Secondary education, gross enrollment ratio, 2000	.958
16) Urban percentage of population, 2000	.141
17) Polity IV Democracy Index, 2000	2.883

Table 3.3

Descriptive Statistics
Listwise
Internet Users

Internet Users per 100 people	N*	Mean	Standard deviation	Range Min	Range Max
1) number of Internet Users per 100 people, 2008	143	17.205	17.644	0	73.667
2) number of Internet Users per 100 people, 2000	137	1.250	.991	0	5.347
3) IMF loans total, 2000-2008	149	3.68	4.112	0	19
4) WB loans total, 2000-2008	149	1.84	2.831	0	17
5) WB Telecommunications loans total, 2000-2008	149	4.27	6.122	0	25
6) IMF Debt Service ratio, 2000	99	.103	.035	.032	.214
7) WB Multilateral Debt Service ratio, 2000	118	.199	.069	0	.316
8) Trade as % of GDP, 2000	137	.280	.071	.032	.469
9) Inward FDI stock as % of GDP, 2000	136	2.999	1.254	-1.609	6.360
10) Real interest rates, 2000	115	6.799	14.688	-60.8	41.77
11) Private Invest telecomm infrastructure, 2000	89	12.024	15.964	0	82.441
12) Gross capital formation as % GDP, 2000	133	.144	.027	.054	.247
13) GNP, 2000	136	1.835	.872	.458	4.024
14) Primary education, gross enrollment ratio, 2000	126	9.851	3.484	.378	19.279
15) Secondary education, gross enrollment ratio, 2000	115	333.300	319.378	.223	1446.885
16) Urban percentage of population, 2000	148	3.710	.524	2.079	4.511
17) Polity IV Democracy Index, 2000	116	149.612	431.471	-1000	1000

	Coefficient of variation
1) number of Internet Users per 100 people, 2008	1.025
2) number of Internet Users per 100 people, 2000	.793
3) IMF loans total, 2000-2008	1.117
4) WB loans total, 2000-2008	1.539
5) WB Telecommunications loans total, 2000-2008	1.434
6) IMF Debt Service ratio, 2000	.339
7) WB Multilateral Debt Service ratio, 2000	.347
8) Trade as % of GDP, 2000	.254
9) Inward FDI stock as % of GDP, 2000	.418
10) Real interest rates, 2000	2.16
11) Private Invest telecomm infrastructure, 2000	1.328
12) Gross capital formation as % GDP, 2000	.188
13) GNP, 2000	.475
14) Primary education, gross enrollment ratio, 2000	.353
15) Secondary education, gross enrollment ratio, 2000	.958
16) Urban percentage of population, 2000	.141
17) Polity IV Democracy Index, 2000	2.883

* valid N = 41

Table 3.4

Descriptive Statistics
Mean Substitution
Internet Users

Internet Users per 100 people	N	Mean	Standard deviation	Range Min	Range Max
1) number of Internet Users per 100 people, 2008	149	17.205	17.282	0	73.667
2) number of Internet Users per 100 people, 2000	149	1.250	.949	0	5.347
3) IMF loans total, 2000-2008	149	3.68	4.112	0	19
4) WB loans total, 2000-2008	149	1.84	2.831	0	17
5) WB Telecommunications loans total, 2000-2008	149	4.27	6.122	0	25
6) IMF Debt Service ratio, 2000	149	.103	.028	.032	.214
7) WB Multilateral Debt Service ratio, 2000	149	.199	.061	0	.316
8) Trade as % of GDP, 2000	149	.280	.068	.032	.469
9) Inward FDI stock as % of GDP, 2000	149	2.999	1.198	-1.609	6.360
10) Real interest rates, 2000	149	6.799	12.891	-60.8	41.77
11) Private Invest telecomm infrastructure, 2000	149	12.024	12.309	0	82.441
12) Gross capital formation as % GDP, 2000	149	.128	.051	.001	.247
13) GNP, 2000	149	1.835	.833	.458	4.024
14) Primary education, gross enrollment ratio, 2000	149	9.851	3.202	.378	19.279
15) Secondary education, gross enrollment ratio, 2000	149	333.300	280.302	.223	1446.885
16) Urban percentage of population, 2000	149	3.710	.522	2.079	4.511
17) Polity IV Democracy Index, 2000	149	149.612	380.338	-1000	1000

	Coefficient of variation
1) number of Internet Users per 100 people, 2008	1.004
2) number of Internet Users per 100 people, 2000	.759
3) IMF loans total, 2000-2008	1.117
4) WB loans total, 2000-2008	1.539
5) WB Telecommunications loans total, 2000-2008	1.434
6) IMF Debt Service ratio, 2000	.272
7) WB Multilateral Debt Service ratio, 2000	.306
8) Trade as % of GDP, 2000	.243
9) Inward FDI stock as % of GDP, 2000	.399
10) Real interest rates, 2000	1.896
11) Private Invest telecomm infrastructure, 2000	1.024
12) Gross capital formation as % GDP, 2000	.398
13) GNP, 2000	.454
14) Primary education, gross enrollment ratio, 2000	.325
15) Secondary education, gross enrollment ratio, 2000	.841
16) Urban percentage of population, 2000	.141
17) Polity IV Democracy Index, 2000	2.542

Chapter Four

Analysis and Results

Introduction

In order to evaluate the effectiveness of structural adjustment loans (SAL) on Internet usage in developing countries, I contrast the competing theoretical predictions offered by dependency and economic liberalization, and then analyze three different types of SALs—IMF, WB, and WB telecommunications loans. On the one hand, according to dependency predictions, with an SAL intervention, I should expect to observe lower levels of Internet usage over time. On the other hand, according to predictions made by economic liberalization, with an SAL intervention, I should expect to observe higher levels of Internet usage over time. Internet usage 2008 is analyzed using a lagged dependent model, Internet usage 2000, to show change over time. All other predictors are for the year 2000. My analyses is based on ordinary least squares estimation.

OLS Regression Models

Equation for the Dependency perspective:

$$\textit{Internet usage 2008} = \beta_0 + \beta_1 \textit{ Internet usage 2000} + \beta_2 \textit{ trade 2000} + \beta_3 \textit{ FDI 2000} + \beta_4 \textit{ interest rates 2000} + \beta_5 \textit{ education 2000} + \beta_6 \textit{ debt 2000} + \beta_7 \textit{ structural adjustment loan 2000}$$

Equation for the Economic Liberalization perspective:

$$\textit{Internet usage 2008} = \beta_0 + \beta_1 \textit{ Internet usage 2000} + \beta_2 \textit{ GNP 2000} + \beta_3 \textit{ gross capital formation 2000} + \beta_4 \textit{ private telecommunications investment 2000} + \beta_5 \textit{ polity IV 2000} + \beta_6 \textit{ urban population 2000} + \beta_7 \textit{ education 2000} + \beta_8 \textit{ debt} + \beta_9 \textit{ structural adjustment loan 2000}$$

All the tables presented follow the same pattern (see Tables 4.1 through 4.6 located in the Appendix, Tables). First, I examine the effects of structural adjustment loans and debt on Internet users over time with reference to the Dependency perspective. Three different types of SALs are examined: IMF, WB, and WB telecommunications loan, alternating between primary and secondary education (equations 1.1, 1.2, 1.3, 1.4, 1.5, 1.6). I include explanatory variables associated with this perspective: trade, inward FDI stock, and real interest rates, along with primary or secondary education.

Second, I examine the effects of structural adjustment loans and debt on Internet users over time with reference to the Economic Liberalization perspective. Again, three different types of SALs are examined: IMF, WB, and WB telecommunications loan (equations 1.1, 1.2, 1.3, 1.4, 1.5, 1.6). I include explanatory variables associated with this perspective: gross capital formation, GNP, private investment of telecommunications investment, level of urbanization, and democracy, along with primary or secondary education.

For both theoretical perspectives, the level of education (primary and secondary) is included in all regression equations because of their association with the technological development of developing countries. I present both the significant and non-significant findings.

ANALYSES

To deal with missing data, I use pairwise, listwise, and mean substitution deletion. First, the bivariate correlation matrices are examined (Tables 4.1, 4.2, 4.3). Second, findings from the net effects are presented (Tables 4.4, 4.5, 4.6). Third, results of the

OLS regression estimates are presented (Appendix, Tables 4.1 and 4.2; Appendix Tables 4.3 and 4.4; Appendix Tables 4.5 and 4.6). I have the data for any potential violations of OLS regression assumptions. For all models and missing data methods, multicollinearity should not be a problem because the mean and highest VIF do not exceed the standards specified. However, heteroskedascity is a problem, indicated by a Breusch-Pagan test where many of the coefficients reach significance. To deal with this potential problem, I have followed the standard solution of running the models with robust standard errors. Third, I have followed the standard practice of removing any influential and outlier cases through use of Cook's distance statistics and standardized residuals.

Bivariate Correlation Matrices

Bivariate correlation matrices are run for all of the variables in my models in order to determine if multicollinearity is present. Comparing across the three tables, findings are similar. With two exceptions, the bivariate correlations are low to moderate. One, a moderately high correlation (about 0.73-0.76) exists between the lagged dependent (Internet usage 2000) and the dependent variable (Internet usage 2008). The other moderately high correlation (about 0.69-0.76) is between GNP 2000 and the dependent variable. In the first case, the outcome is expected because a lagged dependent variable model allocates maximum explanatory power to the lagged dependent variable (Kennedy 2003). Again, in the second instance, the outcome is anticipated because in prior studies GNP has been shown to have a strong association with economic growth. It is not surprising that GNP has a strong correlation with Internet usage. However, in my research, the largest indicator of Internet usage in 2008 is Internet usage in 2000.

Pairwise bivariate correlation matrix

In Table 4.1, the Pearson correlation coefficients (r) are indicative of a high and positive correlation between Internet users 2008 and Internet users 2000 (.7549, $p < 0.05$); the lagged dependent accounts for 75% of the total model.

Other key findings are: both IMF debt and WB debt have a weak and negative association with Internet usage 2008, although only WB debt reaches a 0.05 level of significance. The three types of structural adjustment loans have a weak and negative association with Internet usage 2008, although only total WB telecommunications loans reach a 0.001 level of significance.

Other variables with positive and statistical levels of significance of 0.001 are: trade, GNP, private investment in telecommunications, urbanization, democracy, primary and secondary education. Gross capital formation and FDI have a positive effect at 0.05 significance level, while real interest rates have a negative, but non-statistical significance effect on Internet usage 2008.

Listwise bivariate correlation matrix

In Table 4.2, the Pearson correlation coefficients (r) are indicative of a high and positive correlation between Internet users 2008 and Internet users 2000 (.7635, $p < 0.05$); the lagged dependent accounts for 76% of the total model.

Other key findings are: both IMF debt and WB debt have a weak, and negative association with Internet usage 2008. These variables do not reach statistical significance. The three types of structural adjustment loans have a weak and negative association with Internet usage 2008, although none reaches statistical significance.

Other variables with positive and statistical levels of 0.01 significance are: gross

capital formation and democracy. Positive and statistical levels of 0.05 levels of significance include GNP, and primary education. Other variables with non-significant findings are: real interest rates with a weak and negative association; those with a positive association include trade, FDI, urbanization, and secondary education.

Mean substitution bivariate correlation matrix

In Table 4.3, the Pearson correlation coefficients (r) are indicative of a high and positive correlation between Internet users 2008 and Internet users 2000 (.7332, $p < 0.05$); the lagged dependent accounts for 73% of the total model.

Other key findings are: both IMF debt and WB debt have a weak, and negative association with Internet usage 2008. These variables do not reach statistical significance. The three types of structural adjustment loans have a weak and negative association with Internet usage 2008. These variables do not reach statistical significance.

Other variables with positive and statistical levels of significance of 0.05 are: GNP, and secondary education. Variables with non-statistical significance and positive associations are: trade and FDI, gross capital formation, private investment in telecommunications, urbanization, democracy, and primary education. Real interest rates have a negative and non-statistical level of significance.

Net Effects

Net effects represent changes in Internet usage associated with each independent

variable. In multiple regression analysis with observational data, net effects approximate the establishment of causal predominance by controlling for all independent variables used in the model. Tables 4.4, 4.5 and 4.6 show effects net of Internet usage 2000 associated with each of the other independent variables.

Comparing across the three tables, we can see the results are similar to each other. Among the key findings are both debt and total structural adjustment loans are negatively associated with Internet usage 2000. World Bank debt reaches 0.001 level of statistical significance, although IMF debt does not. As for the three types of loan, IMF loans and World Bank telecommunications loans reach 0.05 and 0.01 statistical significance respectively, while total World Bank loans are not statistically significant. These findings provide support for the dependency perspective.

Other significant findings provide support for the economic liberalization perspective. These include positive and significant levels for trade, FDI, GNP, level of urbanization, level of democracy, and private investment in telecommunications. Gross capital formation is positive and reaches statistical significance in pairwise and listwise deletion, but only reaches a 0.065 level of significance with mean substitution. Primary and secondary education are positive and significantly associated with Internet usage 2000 at the 0.001 level for all three types of missing data deletion techniques.

A non-significant finding is that real interest rates, showing a positive relationship, do not reach statistical significance in either pairwise, listwise, or mean substitution deletion.

OLS regression models

Dependency (Appendix, Tables, 4.1, 4.3, 4.5)

In line with the dependency perspective, the expectation is that an SAL along with debt would have a negative association with Internet usage 2008. Findings from these three tables however, show that the biggest significant predictor (p-value at .001 levels) of Internet usage in 2008 is Internet usage in 2000, a strong positive effect. In general, these tables also present results that show primary and secondary education have a positive effect on Internet usage 2008, reaching statistical significance. All other coefficients for the predictor variables in this model have non-significant p-values. The only consistent effect lending support for the dependency perspective across all three types of missing data is the negative, but non-significant coefficients of WB telecommunications loans.

Pairwise

The pairwise results (Appendix, Table 4.1) are indefinite about whether debt and SALs have a beneficial or detrimental effect on Internet usage 2008.

The coefficients for IMF debt service (eqns. 1.1 and 1.2) are negative, but non-significant, while WB debt service coefficients are positive and non-significant (eqns. 1.3 thru 1.6). Concerning the three types of structural adjustment loans (SALs), both the IMF loan (eqns. 1.1 and 1.2) and WB loan (eqns. 1.3 and 1.4) have a positive and non-significant effect, while the WB telecommunications loan (eqns. 1.5 and 1.6) has a negative and non-significant effect. GNP has a positive and statistically significant relationship.

Non-significant findings: in all six equations, trade has a positive relationship while FDI and real interest rates have a negative relationship.

Listwise

The listwise results (Appendix Table 4.3) are indefinite about whether debt and SALs have a beneficial or detrimental effect on Internet usage 2008.

The coefficients for IMF debt service (eqns. 1.1 and 1.2) are negative, but non-significant. The coefficient for an IMF loan are positive and non-significant (eqn. 1.1) when primary education is included, but the IMF loan coefficient (eqn. 1.2) is negative when secondary education is included.

World Bank debt service is negative and non-significant when primary education is included in the model (eqn. 1.3), but positive when secondary education is included in the model (eqn. 1.4). The coefficient for a WB loan are positive and non-significant (eqn. 1.3) when primary education is included, but the WB loan coefficient (eqn. 1.4) is negative when secondary education is included.

World Bank debt service is negative and non-significant when primary education is included in the model (eqn. 1.5), but positive when secondary education is included in the model (eqn. 1.6). As for the WB telecommunications loan, both coefficients are negative (eqn. 1.5 and 1.6) but non-significant.

Non-significant findings: in five out of the six tables, trade has a positive effect. In all six tables, FDI has a positive effect and real interest rates have a negative effect on Internet usage 2008.

Mean Substitution

The mean substitution results (Appendix Table 4.3) are ambiguous about whether debt and SALs have a beneficial or detrimental effect on Internet usage 2008. The coefficients for IMF debt service (eqns. 1.1 and 1.2) are negative, but non-significant, while WB debt service coefficients are positive and non-significant (eqns. 1.3 thru 1.6). Concerning the three types of structural adjustment loans (SALs), both the IMF loan (eqns. 1.1 and 1.2) and WB loan (eqns. 1.3 and 1.4) have a positive and non-significant effect, while the WB telecommunications loan (eqns. 1.5 and 1.6) has a negative and non-significant effect. While both primary and secondary education have a positive relationship with Internet usage 2008, only secondary education reaches statistical significance in the three equations (eqns. 1.2, 1.4 and 1.6)

Non-significant findings: In all six tables, coefficients are positive for trade, and negative for both foreign direct investment and real interest rates.

Economic Liberalization (Appendix, Tables 4.2, 4.4, 4.6)

In line with the economic liberalization perspective, the expectation is that an SAL along with debt would have a positive association with Internet usage 2008. Findings from these three tables show that the biggest significant predictor (p-value at .001 levels) of Internet usage in 2008 is Internet usage in 2000, a strong positive effect. In general, these tables present results that show secondary education has a positive effect on Internet usage 2008, reaching statistical significance in two out of the three equations (1.4 and 1.6). As would be expected, GNP has a positive and statistically significant relationship with Internet usage in pairwise and mean substitution models.

The only consistent effect and one *not* supportive of the economic liberalization perspective across all three types of missing data is the negative, but generally non-significant coefficients of WB telecommunications loans. This is a surprising finding, in that economic liberalization is thought to promote Internet usage. Since the pairwise deletion method presents standard errors, instead of robust standard errors, it is possible that pairwise deletion would also present statistically significant coefficients for the SALs.

Pairwise

The pairwise results (Appendix, Table 4.2) are indefinite about whether debt and SALs have a beneficial or detrimental effect on Internet usage 2008. The coefficients for IMF debt service (eqns. 1.1 and 1.2) are negative, but non-significant, while WB debt service coefficients are positive and non-significant (eqns. 1.3 thru 1.6). Concerning the three types of structural adjustment loans (SALs), both the IMF loan (eqns. 1.1 and 1.2) and WB loan (eqns. 1.3 and 1.4) have a positive and non-significant effect, while the WB telecommunications loan (eqns. 1.5 and 1.6) has a negative and non-significant effect.

Non-significant findings: in all six equations, as would be expected private investment and PIV democracy have a positive effect. However, urbanization has an unexpected negative effect in four out of six equations. It appears that Internet usage positively changes rural populations more than urban populations.

Listwise

The listwise results (Appendix Table 4.4) are indefinite about whether debt and SALs have a beneficial or detrimental effect on Internet usage 2008. The coefficients for IMF debt service (eqns. 1.1 and 1.2) are positive, but non-significant, but negative and

non-significant; for WB debt service, are negative when combined with primary education (eqns. 1.3 and 1.5) but positive when combined with secondary education (eqns. 1.4 and 1.6). The coefficient for an IMF loan are positive and non-significant (eqns. 1.1 and 1.2); the coefficient for the WB and WB telecommunications loan are negative and non-significant. As would be expected, gross capital formation has a positive effect, reaching statistical significance when combined with IMF debt and IMF loan.

Non-significant findings: As anticipated, in all six equations, GNP has a positive association, as does urbanization, in five out of six equations. Surprisingly, the results are mixed for private investment in telecommunications; in only three out of six equations are the coefficients are positive.

Mean Substitution

The mean substitution results (Appendix Table 4.4) are indefinite about whether debt and SALs have a beneficial or detrimental effect on Internet usage 2008.
The coefficients for IMF debt service (eqns. 1.1 and 1.2) are negative, and non-significant, while WB debt service coefficients are positive and non-significant (eqns. 1.3 thru 1.6).

Concerning the three types of structural adjustment loans (SALs), both the IMF loan (eqns. 1.1 and 1.2) and WB loan (eqns. 1.3 and 1.4) have a positive and non-significant effect, while the WB telecommunications loan (eqns. 1.5 and 1.6) has a negative and significant effect of $p < 0.50$ and $p = 0.066$, respectively. In all six equations, as would be expected, GNP is positive and statistically significant.

Non-significant findings: As anticipated, the coefficients for the explanatory variables gross capital formation, private investment in telecommunications, urbanization, and PIV democracy are positive, lending support for the economic liberalization perspective.

Summary and Conclusions

OLS regression Models

My research has examined three different ways of dealing with missing data that lead to similar conclusions. Comparing across IMF, WB, and WB telecommunications equations, the main driver of Internet usage in 2008 is Internet usage in 2000, reaching statistical significance of at least 0.05 in all equations; secondary education is statistically significant across both dependency and economic liberalization models, except when in conjunction with IMF debt and IMF loans (eqns 1.2). GNP is positive across all equations; it is statistically significant across both pairwise and mean substitution models. Non-significant findings across the two theoretical perspectives are mixed, although IMF debt has a negative relationship across all models with the exception of the listwise model for economic liberalization.

The only consistent effect found across both theoretical perspective and all three types of missing data is the negative relationship of WB telecommunications loans in 2000 with Internet usage in 2008. However, only in the pairwise model is statistical significance reached. Because the pairwise method used standard errors, it is possible that for the other two types of loans, robust standard errors would have reached 0.05 statistical significance. Overall, I do not find much support for either theoretical model using the additive method for the years 2000 through 2008.

Dependency

With the exception of the WB telecommunication loans, I find little support for the dependency perspective that the three structural adjustment loans (IMF or WB) or both types of debt (IMF and WB) consistently predict a detrimental effect on Internet usage in 2008. Across all three types of missing data models, real interest rates are negatively but non-significantly correlated. Unexpectedly, across the three tables, trade is positively correlated. As for FDI, in the pairwise and mean substitution models, the anticipated negative correlation is found, but an overall positive relationship is found with the listwise model (the exception is eqn. 1.1)

Economic Liberalization

The coefficients for GNP are positive in all three models; in the pairwise and mean substitution models, they reach statistical significance, lending support to the economic liberalization perspective. As would be expected higher levels of GNP correspond with higher levels of Internet usage. In addition, secondary education is statistically significant across all OLS models. This finding too, should be expected since secondary education would provide users with the necessary training to use the Internet as a way to conduct business. Moreover, prior empirical studies have indicated a strong connection between a higher level of GNP and secondary education.

Other non-significant findings: In support of the economic liberalization perspective, as would be anticipated, gross capital formation is positive in all three models, with the exception of the pairwise model (eqns. 1.1 and 1.2). Private investment in telecommunications has a positive relationship with Internet usage 2008 in the pairwise and mean substitution models, but is mixed in the listwise model. For the

urbanization variable, the signs of the beta coefficients are positive in the mean substitution model; positive in five out the six equations in listwise, but mixed in the pairwise model for urbanization. The coefficients for PIV democracy are positive in all equations in the pairwise and mean substitution models, but negative in all six equations of the listwise model. This last finding is of interest for a future investigation, since Buchner (1988) and Rouvinen (2006) both argue that technology has a negative relationship with democracy, a problem at odds with economic liberalization.

Table 4.1
Bivariate Correlation Matrix
Pairwise
Internet Users

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1) Internet usage, 2008	1.0000																
2) Internet usage, 2000	0.7549***	1.0000															
3) IMF debt, 2000	-0.1148	-0.0636	1.0000														
4) WB debt, 2000	-0.2613**	-0.3340*	0.1416	1.0000													
5) trade, 2000	0.3336***	0.3525*	-0.3336*	-0.1404	1.0000												
6) FDI, 2000	0.2251**	0.2907*	-0.1897	-0.1079	0.4116*	1.0000											
7) real interest rates, 2000	-0.0261	0.0723	0.1810	0.1740	-0.1938*	-0.0075	1.0000										
8) gross capital formation, 2000	0.2198*	0.2219*	-0.2342*	-0.2538*	0.3877*	0.1872*	0.1311	1.0000									
9) GNP, 2000	0.7602***	0.8018*	-0.1403	-0.4020*	0.3394*	0.2158*	-0.0519	0.2927*	1.0000								
10) private invest. telecom, 2000	0.4239***	0.4163*	0.0785	-0.4181*	-0.2202*	0.0389	-0.1226	0.1269	0.4443*	1.0000							
11) % urbanization, 2000	0.4364***	0.4526*	-0.0380	-0.3066*	0.1408	0.1363	-0.0610	0.1027	0.5712*	0.3419*	1.0000						
12) PIV democracy, 2000	0.4970***	0.6050*	0.1887	-0.0649	0.1170	0.1873*	0.1888	0.0533	0.4717*	0.3109*	0.2324*	1.0000					
13) primary education, 2000	0.2679**	0.2995*	-0.1084	-0.1935*	0.1665	0.2707*	0.0281	0.1929*	0.3510*	0.0894	0.2605*	0.2152*	1.0000				
14) secondary education, 2000	0.6607***	0.6542*	-0.0054	-0.2981*	0.2253*	0.1948*	0.0639	0.1386	0.6808*	0.2848*	0.4772*	0.4361*	0.2832*	1.0000			
15) IMF loan, total	-0.1302	-0.1981*	0.3487*	0.2703*	-0.1660	-0.1507	0.3038*	-0.1423	-0.3341*	-0.1987	-0.1239	0.0710	-0.1630	-0.1057	1.0000		
16) WB loan, total	-0.0791	-0.1360	0.5256*	0.1535	-0.3302*	-0.0988	0.1422	-0.3226*	-0.2463*	0.0339	-0.1128	0.1137	-0.1963*	-0.0585	0.5023*	1.0000	
17) WB telecom loan, total	-0.2861***	-0.2589*	0.1951	0.2155*	-0.3175*	-0.2485*	0.2474*	-0.0423	-0.3386*	-0.0195	-0.1571	0.0473	-0.1627	-0.3246*	0.4146*	0.2045*	1.0

* indicates p <0.05, ** indicates p <0.01, *** indicates p < .001 for a two-tailed test

Table 4.2
Bivariate Correlation Matrix
Listwise
Internet Users
n= 41

	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17
1) Internet usage, 2008	1.0000															
2) Internet usage, 2000	0.7635*	1.0000														
3) IMF debt, 2000	-0.0292	-0.0008	1.0000													
4) WB debt, 2000	-0.4835	-0.4886	0.1408	1.0000												
5) trade, 2000	0.3831	0.3206	-0.5195	-0.0856	1.0000											
6) FDI, 2000	0.3577	0.2902	-0.1754	-0.1443	0.4799	1.0000										
7) real interest rates, 2000	-0.1495	-0.1708	0.2765	0.1716	-0.2273	-0.0766	1.0000									
8) gross capital formation, 2000	0.3969**	0.1866	-0.2848	-0.3364	0.3688	0.0100	-0.1971	1.0000								
9) GNP, 2000	0.6977*	0.8001	-0.0638	-0.5197	0.0700	0.1992	-0.2064	0.1147	1.0000							
10) private investment telecom, 2000	0.2764*	0.4664	0.2624	-0.5508	-0.3215	-0.0027	-0.2810	0.0068	0.6517	1.0000						
11) % urbanization, 2000	0.5852	0.5938	-0.0077	-0.3371	0.0769	0.3618	-0.1041	0.1972	0.7749	0.4757	1.0000					
12) PIV democracy, 2000	0.2056**	0.4608	0.2189	-0.2802	-0.2251	-0.1583	0.0115	0.1164	0.4260	0.3908	0.4460	1.0000				
13) primary education, 2000	0.1522*	0.1190	0.2100	-0.0690	-0.1207	-0.1420	0.1874	-0.1751	0.1123	0.1036	-0.1633	0.2245	1.0000			
14) secondary education, 2000	0.6060	0.5694	0.0964	-0.3621	0.1837	0.3425	0.0903	0.1371	0.5210	0.3430	0.6086	0.3620	0.1021	1.0000		
15) IMF loan, total	-0.1181	-0.2921	0.2975	0.2972	-0.0133	-0.1129	0.3194	-0.1154	-0.4047	-0.5101	-0.1716	-0.1144	-0.0497	0.1128	1.0000	
16) WB loan, total	-0.0676	-0.0299	0.5952	0.0852	-0.3456	0.0076	0.2875	-0.4609	-0.0498	0.0994	-0.0025	0.0773	0.0795	0.0755	0.3262	1.0000
17) WB telecom loan, total	-0.3189	-0.2340	0.2127	0.2835	-0.2223	-0.2077	0.2943	0.0507	-0.2942	-0.1297	-0.1026	0.0270	0.1515	-0.2814	0.0902	0.0636

* indicates p <0.05, ** indicates p <0.01, *** indicates p < .001 for a two-tailed test

Table 4.3

Bivariate Correlation Matrix
Mean Substitution
Internet Users
n= 149

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1) Internet usage, 2008	1.0000																
2) Internet usage, 2000	0.7332*	1.0000															
3) IMF debt, 2000	-0.0797	-0.0488	1.0000														
4) WB debt, 2000	-0.2018	-0.2770	0.1232	1.0000													
5) trade, 2000	0.3206	0.3254	-0.281	-0.1272	1.0000												
6) FDI, 2000	0.2167	0.2771	-0.1299	-0.0825	0.3748	1.0000											
7) real interest rates, 2000	-0.0181	0.0647	0.1177	0.1209	-0.1786	0.0007	1.0000										
8) gross capital formation, 2000	0.1977	0.1513	-0.1261	-0.1549	0.1977	0.0750	0.0461	1.0000									
9) GNP, 2000	0.7273*	0.7568	-0.1023	-0.3160	0.3330	0.1725	-0.0465	0.1486	1.0000								
10) private investment telecom, 2000	0.2825	0.3056	0.0575	-0.2884	-0.1728	0.0275	-0.0791	0.0857	0.3197	1.0000							
11) % urbanization, 2000	0.4260	0.4356	-0.031	-0.2714	0.1352	0.1293	-0.0548	-0.0325	0.5470	0.2650	1.0000						
12) PIV democracy, 2000	0.4348	0.5393	0.1167	-0.0499	0.1011	0.1508	0.1437	0.1143	0.3851	0.2164	0.2095	1.0000					
13) primary education, 2000	0.2577	0.2763	-0.0963	-0.1653	0.1527	0.2408	0.0303	0.1261	0.3222	0.0623	0.2438	0.1825	1.0000				
14) secondary education, 2000	0.5933*	0.6060	0.0037	-0.2293	0.2061	0.1572	0.0519	0.0250	0.6140	0.2155	0.4089	0.3355	0.2520	1.0000			
15) IMF loan, total	-0.1283	-0.193	0.2928	0.2482	-0.1610	-0.1464	0.2708	0.1325	-0.3240	-0.1592	-0.1236	0.0634	-0.1525	-0.0961	1.0000		
16) WB loan, total	-0.0783	-0.1302	0.4700	0.1436	-0.3237	-0.0955	0.1280	-0.0090	-0.2411	0.0294	-0.1127	0.1056	-0.1893	-0.0522	0.5023	1.0000	
17) WB telecom loan, total	-0.2836	-0.2529	0.1739	0.2030	-0.3094	-0.2434	0.2083	0.1247	-0.3298	-0.0167	-0.1568	0.0445	-0.1507	-0.3017	0.4146	0.2045	1.00

* indicates p <0.05, ** indicates p <0.01, *** indicates p < .001 for a two-tailed test

Table 4.4
Net Effects
Pairwise

	Internet users, 2000	**Beta coefficient Net Effects**	***p*-values**	**Sample sizes**
1	Internet users, 2000	.929	.000	136
2	IMF debt, 2000	-.064	.536	96
3	WB debt, 2000	-.334	.000	115
4	Trade, 2000	.353	.000	130
5	FDI, 2000	.291	.001	129
6	Real interest rates, 2000	.072	.449	111
7	Private investment Telecommunications, 2000	.416	.000	84
8	Gross capital formation, 2000	.222	.012	126
9	GNP, 2000	.802	.000	128
10	Primary education, 2000	.300	.001	120
11	Secondary education, 2000	.654	.000	110
12	% urbanization, 2000	.453	.000	136
13	PIV democracy, 2000	.605	.000	109
14	IMF loan, total	-.198	.020	136
15	WB loan, total	-.136	.113	136
16	WB telecommunications Loan, total	-.259	.002	136

Table 4.5
Net Effects
Listwise

	Internet users, 2000	**Beta coefficient Net Effects**	***p*-values**	**Sample Sizes** valid N = 41
1	Internet users, 2000	.929	.000	137
2	IMF debt, 2000	-.064	.536	97
3	WB debt, 2000	-.334	.000	116
4	Trade, 2000	.353	.000	131
5	FDI, 2000	.291	.001	130
6	Real interest rates, 2000	.072	.449	112
7	Private investment Telecommunications, 2000	.416	.000	85
8	Gross capital formation, 2000	.222	.012	127
9	GNP, 2000	.802	.000	129
10	Primary education, 2000	.299	.001	121
11	Secondary education, 2000	.654	.000	111
12	% urbanization, 2000	.452	.000	137
13	PIV democracy, 2000	.605	.000	110
14	IMF loan, total	-.198	.020	137
15	WB loan, total	-.136	.113	137
16	WB telecommunications Loan, total	-.259	.002	137

Table 4.6
Net Effects
Mean Substitution

	Internet users, 2000	**Beta coefficient Net Effects**	***p*-values**	**Sample sizes**
1	Internet users, 2000	.924	.001	149
2	IMF debt, 2000	-.049	.555	149
3	WB debt, 2000	-.277	.001	149
4	Trade, 2000	.325	.000	149
5	FDI, 2000	.277	.001	149
6	Real interest rates, 2000	.065	.433	149
7	Private investment Telecommunications, 2000	.306	.000	149
8	Gross capital formation, 2000	.151	.065	149
9	GNP, 2000	.757	.000	149
10	Primary education, 2000	.277	.001	149
11	Secondary education, 2000	.606	.000	149
12	% urbanization, 2000	.436	.000	149
13	PIV democracy, 2000	.540	.000	149
14	IMF loan, total	-.194	.018	149
15	WB loan, total	-.130	.113	149
16	WB telecommunications Loan, total	-.253	.002	149

Chapter Five

Discussion of Findings and Conclusion

Introduction

In this chapter, I discuss the significance of my findings concerning how Internet usage in developing countries is affected by structural adjustment loans. To do so, I discuss the results from my study in light of theoretical, methodological, and policy implications. First, the theoretical implications are based upon comparing and contrasting the dependency and economic liberalization perspectives as they pertain to Internet usage in developing countries. Second, the methodology used has taken into account the issue of missing data by comparing the results of three types of techniques.

Incorporating the two competing theoretical frameworks of dependency and economic liberalization, I have investigated the effectiveness of three different types of structural adjustment loan programs—IMF, WB, and WB telecommunications loans on Internet usage in developing countries. Finally, I discuss policy implications regarding the effectiveness of SALs.

Theoretical Implications of Research

A review of the literature on telecommunications usage, and in particular, Internet usage in developing countries, (Table 2.1 and Appendix, Table 2.2) shows that most of the empirical studies do not have any theoretical basis, with the exception of a series of studies by Crenshaw and Robison (Crenshaw and Robison 2006a, 2006b, Robison and

Crenshaw 2010, 2002), and Bradshaw, Fallon, and Viterna 2005. All of these studies examined the Internet. Of those studies that examined IMF and World Bank structural adjustment loans, none were concerned with the Internet (Bradshaw and Huang 1991, Bradshaw and Tshandu 1990, Bradshaw and Wahl 1991; Shandra, Shircliff and London 2011, Shandra, Shor, Maynard, and London 2008, Shandra, Shor and London 2008). My study examines how structural adjustment loans affect Internet usage.

For the competing hypotheses of dependency and economic liberalization, I have included variables associated with these perspectives. Variables used in dependency are structural adjustment loans, debt, foreign direct investment, trade, and real interest rates. Variables used in economic liberalization are gross capital formation, private investment in telecommunications infrastructure, urban population, and GNP. Most of these variables are commonly used in cross-national research associated with developing countries. For both perspectives, I find statistically significant support only for GNP, secondary education, and Internet usage in 2000 as a significant factor on Internet usage in 2008. In general, I do not find much support for either theoretical perspective.

For secondary theoretical predictions, I do not find any proof for Rostow who contended that loans would be beneficial to technological growth, at least as far as Internet usage is concerned. The three types of regression analyses suggest structural adjustment loans are negatively associated with Internet usage. Nor is there much support for Boserup, who argued that the level of urbanization would be an important component in the growth of technology, although it may be that Internet usage benefits rural populations more so than urban populations. Overall findings from the three methods indicate the correlation is positive, but statistically non-significant.

Methodological Implications of Research

To deal with the common problem of missing data in cross-national research, I use OLS, using three different methods to deal with missing data: pairwise deletion, listwise deletion, and mean substitution. As a further check on the validity and reliability of my results, two different types of debt (International Monetary Fund and World Bank), three different types of structural adjustment loans (IMF, WB and WB telecommunications loans) and two different levels of education (primary and secondary education) were analyzed. Overall, the results are similar to each other. Surprisingly, debt and structural adjustment loans show both a positive and negative association with Internet usage in the years 2000 through 2008. The only consistently negative finding is the effect of WB telecommunications loans on Internet usage.

Finally, although results are not presented from my earlier analysis evaluating the effectiveness of structural adjustment loans (SAL) on Internet usage in developing countries, I examined whether potential self-selection bias, based on unobservable perceived benefits of participation in a structural adjustment loan program should be taken into consideration (Maddala 1983:186). In the cross-national studies on structural adjustment and developing countries, different assumptions regarding selection into IMF/WB conditionality programs have been studied. One possible choice has been to include use of a fully observed probit model based on the assumption that all factors for accepting conditionality are observable (Abouharb and Cingranelli (2007, 2009), while another choice has been to use a partially observed model based on the assumption that not all factors for accepting conditionality are observable (Przeworksi and Vreeland 2000); (Vreeland 2003).

Przeworksi and Vreeland used a probit model to examine the effectiveness of the IMF program (Przeworski and Vreeland 2000, 2002; Vreeland 2003), based upon partial observability of the factors entering into a country's decision-making process. I also examined the possibility that developing countries might choose to voluntarily participate in WB and IMF structural adjustment loans (SAL) because of the anticipated benefits of increased Internet usage, arguing that a country's underlying reasons for entering these two SAL programs are not explicitly observed and therefore amounted to non-ignorable self-selection bias (Maddala 1986:261-262). The model I used was a variation of the two-stage Heckman binary probit model in which the coefficients of the first stage regression equation showed the impact of the independent variables on Internet usage, net of selection bias. In the second stage of the OLS selection equation, lambda was included as another independent variable intended to control for potential selection bias of the treatment effect (whether or not a country participates in a structural adjustment loan), on Internet usage. In general, the results showed that lambda was not statistically significant, indicating that non-random selection bias of decisions made by developing countries was not a problem.

Policy Implications of Research

Policy decision makers need to be able to assess how effective structural adjustment loans are on Internet usage in particular, and telecommunications usage in general in developing countries. Why do countries decide to enter into a SAL? Given that conditionality is attached to SALs, the decision made by a country to participate based on belief that benefits will ensue, may be problematic (Przeworski and

Vreeland (2000). Consider that countries receiving an SAL intervention treatment are already likely to have experienced macroeconomic and growth problems (i.e., have more debt, have lower gross national income). IMF and WB conditionality programs have demanding financial requirements, so why would developing countries that are not as well off economically choose to participate in structural adjustment loan programs?

A plausible argument is a country's decision to participate in a SAL, despite short-term conditionality requirements, may be in anticipation of accruing long-term benefits in the form of increased capacity for Internet usage in particular, and for telecommunications in general (Koenig 1992). The question then becomes why these participating countries would believe that they have the capacity to benefit more from conditionality policies than would randomly selected countries with the same characteristics. Their motivation to participate might include besides economic weakness, the political pressure to conform with the two international lending organizations, a lack of other viable financial alternatives to conditionality programs, and perhaps social pressure from their citizenry and businesses advocating for improved Internet accessibility.

Table 1.1 shows a correlation between a country's level of GNP and Internet usage. The three tiers represent three categories of Internet usage (high, medium, low). [16] As would be expected, countries with higher GNP have higher Internet usage, tier one, than tier three countries, which both the lowest level of GNP along with the lowest level of Internet usage. Unexpected results include: Over a nine-year time span, total WB

[16] The Excel calculations are based on WB level of Internet usage, arranged in descending order, and then grouped by high, medium, low usage. This was based on the total number of users were summed, and then divided into three tiers. The total sum equaled 2580; the average of each tier was calculated at approximately 860 users (Table 1.1).

telecommunications structural adjustment loans have a consistently negative, although overall non-significant correlation, with Internet usage, lending support to the dependency prediction. Second, private investment in telecommunications, while having a positive correlation, is non-significant. It may be that in both examples more years of data are needed in order to accurately assess the outcome of these factors on Internet usage.

Consider that the findings of IMF and WB structural adjustment loans are mixed: both positive and negative outcomes across both the dependency and economic liberalization models. This should not be too unanticipated, given that neither of these loans is targeted specifically at Internet usage. IMF and WB debt also present mixed, but non-significant results.

Secondary education is positive and statistically significant across all three ways of dealing with missing data in the dependency perspective. Overall, this predictive variable is positive across all tables and methods, reaching statistical significance in six out of nine equations analyzed in the economic liberalization model and in all nine equations in the dependency model. In contrast, results for primary education are mixed across both models: the sign is mostly positive in both theoretical perspectives, but reaches positive and statistical significance only in the listwise method of the dependency perspective. This suggests that secondary education plays a more important role than primary education in the growth of Internet usage in developing countries. This is an important consideration. Clearly, policy decisions at the national level of each country should be made to promote additional schooling, since research literature indicates its close connection to economic growth (Buchmann 1996); secondary education increases

demand for Internet usage. In this study, the three types of structural adjustment loans exert little or no effect on the positive correlation between secondary education and Internet usage in developing countries.

Limitations of my study and Future Research

My study examines Internet usage in developing countries for the years, 2000-2008 inclusive. First, in future research, I would like to extend my study through 2013, an additional five years. While it would have been useful to have such information when I began this study, I would like to see if the data omission changes the general findings of my present study. The bivariate correlation matrices show that inclusion of the lagged dependent model (over 70 percent) accounts for most of the model results. In developing countries, since 2000, Internet usage has increased, but it began at a lower level than in developed countries and at a slower level in the earlier years. Inclusion of another five years of data, from 2009 through 2013, might provide an improvement in the statistical results. It is possible that increasing Internet usage would be correlated with an increasing number of structural adjustment loans. In addition, it is customary in cross-national studies of developing countries with limited data-keeping records, to also include significance levels of 0.10 along with the standard 0.05 level.

Second, I would like to expand my research to include fixed and mobile broadband. Although a small number of empirical research studies on broadband have been published (Cava-Ferreruela and Alabau-Mũnoz, 2006), the most recent studies conducted under the aegis of the World Bank admit that the main problem has been the lack of available data on broadband. According to Qiang and Rossotto (2009:36), "a critical mass of broadband penetration—a common feature of network infrastructure—

has been reached in only a small number of countries, and only quite recently." However, this problem is fortunately being resolved as time passes. Third, I would like to compare high-income countries with low-income countries. With the inclusion of additional years and a broader range of countries, I would also like to re-investigate the Heckman sample selection model. Fourth, with additional years of data included in a future study, I would like to examine interaction effects between private investment in telecommunications and urbanization. With the additive method, my research finds positive but statistically non-significant support for Boserup's thesis. This initial finding suggests that the Internet is diffused equally throughout urban and rural areas in developing countries, but a multiplicative method, over a longer period may clarify the issue.

Secondary avenues of future research should be mentioned. A couple of explanatory variables not included in the present study could shed some additional light on future research in telecommunications usage. One of these is explanatory variables that would have a bearing upon telecommunications usage is monthly subscription fees for broadband, but available by private subscription and only to commercial users. This variable provides information about the costs associated with telecommunications usage, an important consideration in developing countries. Another variable of interest would be inclusion of a higher level of education, tertiary education. This would help answer the question whether secondary education is the optimal level in developing countries to promote Internet usage.

A structural equation probit model would provide another way to examine the direction of causality between structural adjustment loan and debt. Although possible, I chose not to use an instrumental variables approach (structural equation model) because

of the difficulty of finding an instrument that would be correlated with the structural adjustment loan intervention and yet independent of the error term in the regression equation (Guo and Fraser 2010: 101; Breen 1996). A related avenue of investigation involves compliance with structural adjustment policies (Vreeland 2003 and, Przeworksi, and Vreeland 2000; also Abouharb and Cingranelli 2007, 2009). This would involve analysis of which countries have accepted structural adjustment loans and not used them.

Two final thoughts regarding the use of a lagged dependent variable model. First, purpose of the lagged dependent is to serve as a control in estimating the effects of the independent variables in the model on the dependent variable. It is commonly known that high correlation exists between the lagged dependent and the dependent variable. Not only does the lagged dependent explain much of the variance between the two, but the lagged dependent also explains much of the change over time between the other independent variables and the dependent variable. One common suggestion is to consider also examining p-values at the 0.10 significance level (Shandra et al. 2005).

Another suggestion, although considered a somewhat controversial technique (Allison 1990), would be to also use a second type of analysis, the change score model with the results serving as a comparison to the lagged dependent variable model. While the two models are commonly thought to provide similar results, Allison argues that, under certain conditions, the change score model might provide improved statistical results.

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APPENDIX

Table 2.2

Quantitative Studies of Telecommunications

Study	Independent variable	Dependent variable	Controls	N	Sample	Time	Findings
Robison and Crenshaw (2010)	GDP; trade % GDP; FDI % GDP; global cities; income; Freedom House; Polity IV index	Internet users per 1000 people	Ave cost 3 minute phone call; percent population 15-24	143	Developing countries	1990-2004	cities increase demand Internet; state repression has weak but positive effect on Internet growth
Wunnava and Leiter (2009)	*Ln* GDP per capita PPP; telephone, PC usage 1000 people; gross tertiary enrollment rate; urban population; trade; Gini Income; English (dummy); level of Freedom House index	Internet usage per 1000 population		100	Developed & developing counties	(N/A)	*Ln* GDP per capita PPP, phone infrastructure,& PCS; English have positive association with Internet usage along with trade, tertiary enrollment, income equality
Qiang and Rossotto (2009)	Ave ratio investment to GDP, 1980-2006; primary school enrollment 1980; average penetration broadband: fixed and mobile phones, Internet	Ave. per capita GDP 1980-2006	GDP; dummy variables for sub-Saharan Africa, Latin America & Caribbean	120	Developing and Developed countries	1980-2006	Ave growth rate slowed by initial GDP; average growth rate increased with average share investment; high income countries growth benefited most from broadband penetration
Howard and Mazaheri (2009)	FDI; trade; population; urban population; literacy; power consumption; telephone mainlines; regime type; privatization (binary); years of privatization; market liberalization (binary); years of market liberalization; regulatory separation; years of regulatory separation; regulatory depoliticization (binary); years of regulatory depoliticization; lagged dependent variables	Internet bandwidth; Internet hosts; Internet users; computers; mobile phones		154	developed and developing counties	1990-2007	Trade influences amount of internet bandwidth; increased trade has negative impact on computer adoption & negative impact on mobile phone adoption (lagged model); ln population size positive impact on mobile phone adoption (lagged model) but not in AR model; urban population has small positive impact on mobile phone adoption (AR) and small negative impact on proportion Internet users; FDI and literacy have no effect in different models

Shchetinin & Massenot (2008)	*Ln* GDP per capita PPP; gross FDI % GDP; literacy rate; *ln* no. PCs per capita; dummies; trade; urban population; telephone lines, fixed and mobile phones subscriptions	No. Internet users per 100		23 66	Developed & developing countries	1991-2003	Internet adoption starts later but goes faster in developing countries; FDI inflows and better education increases Internet diffusion; GDP per capita has negative association with developing countries and positive association with developed countries
Andrés, Cuberes, Diouf, and Serebrisky (2008)	*ln* real cost local phone call; *ln* no. phone lines per capita; *ln* no. computers per capita; *ln* lagged growth no. Internet users per capita; Internet subscribers; country specific (dummy)	*ln* growth no. Internet users per capita	*ln* real GDP per capita	199	Developed and Developing countries	1990-2004	Low income countries have slow catch-up of Internet diffusion; number Internet users in given year in given country associated with number of Internet users in prior year
Stump, Gong And Li (2008)	Median age; education index; GDP per capita; population density	Mobile phone subscriptions	population density; GDP % from agriculture; landlines installed; beginning year for digital mobile use	170	Developed and developing countries	2005-2006	GDP per capita influences mobile phone adoption; education does not; median age has effect on adoption rate if high GDP per capita; population density not significant
Crenshaw and Robison (2006b)	*ln* No. of telephone mainlines per 1000 population percent labor force in general services; population; trade; Polity IV index	*ln* Internet hosts	global cities; tourism; trade, FDI	58	developing countries	1995-2000	teledensity, labor force, political openness, global cities, tourism, trade influence growth of Internet usage
Crenshaw and Robison (2006a)	*ln* No. of telephone mainlines per 1000 population; *ln* liberal democracy index; *ln* tertiary education enrollment; *ln* property rights rank; *ln* cost of 3 minute local phone call	*ln* rate change no. Internet hosts per 10,000 population; lagged *ln* no. Internet hosts per 10,000 population	*ln* Adjusted real gross GDP per capita PPP $; manufacture exports; % total; *ln* sum of annual FDI inflows averaged; *ln* largest city population; /% urban population; *ln* INGOs	80	developing countries	1995-2000	FDI, urbanism, exports, NGOs, democracy, property rights, GDP increase Internet diffusion

Milner (2006)	Telecommunications systems privatization; no. phone lines per capita; % American users; % American Internet hosts; Average no. users; Average no. Internet hosts; privatization; year	No. of Internet hosts/per 10000 population; No. of Internet users per 10,000 population	*ln* Country population per 10000; *ln* GDP per capita; *ln %* urban density; level of democracy/ autocracy Polity IV; level of political liberties	190	Developed and Developing countries	1991-2001	Level of democracy increases Internet diffusion; urbanization has weak but positive effect; privatization has no effect
Cava-Ferreruela and Alabau-Mũnoz (2006)	DSL subscriber prices; no. Internet subscribers; 1 year lagged availability DSL infrastructure; no. unbundled local loops per 100 lines; Internet prices; cable TV networks; % population; tertiary education; local websites; 1 year lagged availability cable infrastructure; % cable TV subscribers per 100 population; 1 year lagged DSL coverage per 100 population; no. dialup Internet subscribers; penetration of PCs per 100 population; ratio rates	DSL subscribers per 100 population; cable modem subscribers per 100 population	GNP per capita	30	OECD countries	2000-2002	Technological competition, low cost fixed broadband infrastructure deployment and technological predisposition contributed to economic growth
Chinn and Fairlie (2006)	Income per capita; years of schooling or illiteracy rate; trade as % GDP; age (young or old), urbanization; telephone; cost subscription charges, cost of 3 minute phone call; electricity consumption; regulatory policies	Internet usage per capita; PC usage per capita		161	Developed & developing countries	1999-2001	Income differences per capita most important; PCs: telephone density, regulatory quality; Internet: regulatory quality, telephone density

Rouvinen (2006)	Population; income; literacy; credit; trade; Freedom House; PCs; mobile users	Digital mobile phones		75 90	Developed, developing countries	1993-2000	No digital divide in adoption rate; income not important; trade increases adoption rate only developing countries; higher level freedom suggests lower adoption rate developing countries
Dewan, Ganley, and Kraemer (2005)	Monthly phone costs, cost of local phone calls, urban population size, education level, telephone main line density, trade	IT diffusion per capita; GDP		40	Developed & developing countries	1985-2001	IT penetration positively associated with per capital GDP; technology costs; urban population size; education level; trade). association stronger for countries with higher levels IT penetration; effects different across counties at different stages of IT adoption
Bradshaw, Fallon, Viterna (2005) *Dependency*	*ln* No. of Internet hosts per 10,000 population; *ln* no. of internet users per 1000 population; *ln* growth in no. of Internet hosts per 10,000 population	*ln* GNP per capita	Total debt service/% GDP; foreign aid per capita; IMF credit; FDI net inflows % GNP; immunization ≤ 1 year; primary education % primary school enrollment	76	lower and middle income countries	1999	Internet diffusion increases economic development (number Internet hosts significant but number Internet users not significant)
Guillén and Suárez (2005)	*ln* level of democracy index; privatization (time-varying dummy); competition local phone service (dummy); time varying trend year (dummy); core & semi-peripheral (dummy)	*ln* no. of Internet users per 100 population; lagged *ln* no. of Internet users per 100 population	*ln* GDP per capita constant US$; *ln* no. phone lines per 100 population; *ln* cost of Internet access US$ as 3 minute phone call; *ln* literacy % adult population; time trend	118	15 core, 22 semi-peripheral; peripheral countries	1997-2001	Unequal power relations increase Internet use; Internet use increased by privatization of telecommunications provider, competition local phone service, level democracy

Kauffman and Techatassanasoontorn (2005)	GDP per capita PPP; no. fixed phone lines per 1000; no. phone operators; 3 minute peak rate phone call, PPP, no. of regulatory standards	% mobile broadband phone subscribers		43	Developed and developing countries	1992-2002	Different subscriber penetration gaps influenced by telecommunications infrastructure, increased competition fewer wireless regulatory standards, costs of services; regional influences increase differences between developed & developing countries
Beilock and Dimitrova (2003)	*ln* per capita income PPP US$; per capita income US$; *ln* no. PCs per 1000 population; *ln* no. telephones per 1000 population	*ln* growth no. Internet users per 10,000 population; no. Internet users per 10,000 population	level of civil liberties (high, low); 6 regions (dummy)	105 16	Developed and developing countries	2000	Per capital income differences has greater impact on lower cross-country Internet usage rates than at higher levels of income
Lucas and Sylla (2003)	No. telephones per 1000 population; *ln* adjusted GDP PPP US$; % est. average income females; literacy rate	*ln* adjusted no. Internet hosts /population * 1 billion, 1998	life expectancy; % paved roads	245	Developed and Developing countries	1998; 2001	Higher levels of GDP, literacy, communications infrastructure predict higher levels of Internet diffusion for those countries having greater median no. Internet hosts; technology gap is greater between developed and developing countries
Baliamoune-Lutz (2003)	Per capita income; *ln* exports + imports/GDP; literacy & education; civil liberties, political rights	*ln* 2000-ln 1998 of ICT diffusion: Internet hosts per 10000; Internet users per 10000, PCs, mobile phone subscribers per 100	ICT stock (dummy)	47	Developing countries	1998-2000	level of ICT diffusion predict number of Internet hosts, mobile phone subscribers, civil liberties, political rights
Robison and Crenshaw (2002)	*ln* Energy consumption per capita (kg oil); *ln* no. phone mainlines per 1000 population; *ln* level of political openness; *ln* lagged secondary education as % age population; *ln* % tertiary labor force service	*ln* no. average Internet hosts per 10,000 population	*ln* net inward FDI stock % GDP; *ln* population density; *ln* GINI inequality; *ln* exports + imports/GDP	74	developed and developing countries	1995-1999	Level of development, political freedom, level of education, FDI increase Internet capacity

Kiiski and Pohjola (2002)	*ln* level of income; *ln* Internet access cost; telecom competition; no. PC per 1000 population; no. phone mainlines per 100 population; share telecom investment/GDP; share telecom revenue/GDP; Gini coefficient net income inequality	ln growth no. of Internet hosts per capita: GDP per capita	GDP per capita; average years schooling over 15 years; English proficiency; 2 dummy regions; university education	23 75	OECD; non-OECD greater 1 million population	1995-2000	GDP per capita and Internet access, level of education, telephone access predict increase in no. Internet hosts per capita
Röller and Waverman (2001)	Nonresidential capital stock net telecommunications US$; penetration rate telephone mainlines per capita; Real gross GDP $ per capita/population; total real telephone service revenue per mainline US $; Real investment telecom infrastructure in US$; government surplus (deficit) in US$; waiting list for main lines per capita	All lagged: Real gross GDP per capita US$; penetration rate mainlines per capita (medium-high dummy); waiting list for main lines per capita; Real US$ investment telecom infrastructure	Total labor force in millions; geographic size; time trend	21	OECD	1970-1990	Near universal telecommunications infrastructure predict increase in economic growth
Dasgupta, Lall and Wheeler (2001)	Income per capita	*ln* growth no. Internet subscribers/no. telephone mainlines; *ln* growth mobile phone subscriptions	*ln* urban population size; index of government competition policy; 4 regions (dummy)	44	Developing countries	1990-1999	Low income countries with high competition policies predict higher Internet subscriptions and telecom access

Appendix Table 4.1 PAIRWISE Dependency

Internet users, 2008	*Eqn 1.1*	*Eqn 1.2*	*Eqn 1.3*	*Eqn 1.4*	*Eqn 1.5*	*Eqn .6*
Internet users, 2000	13.316*** .748 (1.52)	10.073*** .566 (1.760)	13.040*** .732 (1.428)	9.983*** .561 (1.669)	12.885*** .724 (1.439)	9.950*** .559 (1.671)
trade as % of GDP, 2000	11.876 .048 (.597)	11.357 .046 (21.012)	21.748 .088 (20.512)	20.258 .082 (19.872)	13.540 .055 (19.883)	15.775 .064 (19.339)
foreign direct investment stock as %GDP, 2000	-.377 .-.027 (1.189)	-.287 -.020 (1.100)	-.470 -.033 (1.087)	-.313 -.022 (1.033)	-.518 -.037 (1.091)	-.320 -.307 (1.043)
real interest rates, 2000	-.102 -.085 (.097)	-.102 -.085 (.091)	-.090 -.075 (.086)	-.098 -.082 (.084)	-.065 -.054 (.088)	-.089 -.074 (.086)
primary education, enrollment ratio, 2000	.000 .051 .000		.000 .059 (.000)		.000 .045 (.000)	
secondary education, enrollment ratio, 2000		.00001** .297 (.000)		.0000164** .297 (.000)		.00001625** .294 (.000)
IMF debt service ratio, 2000	-31.016 -.063 (41.477)	-37.043 -.075 (39.001)				
IMF loan, 2000	.334 .078 (.364)	.299 .070 (.340)				
WB debt service ratio, 2000			1.581 .006 (19.155)	7.894 .031 (18.629)	4.668 .018 (19.155)	9.516 .037 (18.613)
WB loan, 2000			.422 .068 .458	.289 .046 (.439)		
WB telecommunications loan, 2000					-.212 -.074 (.218)	-.060 -.021 (.217)
constant	-1.533 (8.730)	.254 7.623	-7.216 (7.688)	-6.898 (6.718)	-2.954 (7.590)	-5.124 (6.818)
R-squared	.588	.635	.586	.632	.586	.631
no. of observations	82	82	97	92	97	92
Highest VIF	1.49	2.010	1.396	2.029	1.420	2.027
Mean VIF	1.29	1.466	1.268	1.433	1.274	1.466

Notes: The first number reported is the unstandardized regression coefficient, the second number is the standardized regression coefficient, and the number in parentheses is the standard error.
* indicates p <0.05, ** indicates p <0.01, *** indicates p < .001 for a one-tailed test

Appendix Table 4.2	**PAIRWISE**		**Economic Liberalization**			
Internet users, 2008	***Eqn 1.1***	***Eqn 1.2***	***Eqn 1.3***	***Eqn 1.4***	***Eqn 1.5***	***Eqn 1.6***
Internet users, 2000	6.062** .340 (2.489)	5.122* .288 (2.470)	6.491** .365 (2.403)	5.550* .312 (2.416)	6.221** .349 (2.413)	5.380* .302 (2.422)
gross capital formation, 2000	-4.960 -.008 (52.416)	-.087 .000 (50.704)	24.368 .038 (51.698)	29.061 .045 (50.870)	18.846 .029 (50.549)	23.660 .037 (49.662)
gross national product, 2000	9.245** .457 (3.004)	7.473* .370 (3.054)	9.101** .450 (2.839)	7.424** .367 (2.914)	7.902** .391 (2.876)	6.560* .324 (2.904)
private investment telecommunications, 2000	.113 .102 (.097)	.127 .115 (.094)	.096 .087 (.097)	.118 .107 (.096)	.123 .111 (.097)	.138 .125 (.096)
% urbanization, 2000	-.430 -.013 (3.164)	-1.299 -.039 (3.090)	.174 .005 (3.033)	-.734 -.022 (3.013)	.458 .014 (3.037)	-.558 -.017 (3.027)
PIV democracy level, 2000	.002 .055 (.004)	.002 .046 (.004)	.001 .028 (.004)	.001 .015 (.004)	.003 .073 (.004)	.002 .045 (.004)
primary education, enrollment ratio, 2000	.00005 .001 (.000)		.00004 .009 (.000)		-.00002 -.004 (.000)	
secondary education enrollment ratio, 2000		.00001 .199 (.000)		.00001* .205 (.000)		.00001* .202 (.000)
IMF debt service ratio, 2000	-48.476 -.098 (42.155)	-52.417 -.106 (40.997)				
IMF loan, 2000	.592 .138 (.376)	.527 .123 (.366)				
WB debt service ratio, 2000			20.772 .081 (22.191)	23.922 .093 (21.872)	23.698 .092 (22.303)	26.104 .101 (21.986)
WB loan, 2000			.482 .077 (508)	.363 .058 (.501)		
WB telecommunications loan, 2000					-.235 -.082 (.235)	-.159 -.055 (.235)
constant	-3.959 (13.784)	-.081 (13.460)	-18.548 (14.621)	-15.515 (14.315)	-14.897 (14.197)	-13.050 (13.928)
R-squared	.662	.681	.654	.674	.655	.674
no. of observations	69	69	75	73	75	73
Highest VIF	3.917	4.286	3.476	4.081	3.868	4.048
Mean VIF	1.905	2.062	1.907	2.060	1.922	2.067

Notes: The first number reported is the unstandardized regression coefficient, the second number is the standardized regression coefficient, and the number in parentheses is the standard error.

* indicates p <0.05, ** indicates p <0.01, *** indicates p < .001 for a one-tailed test

Appendix Table 4.3 LISTWISE Dependency

Internet users, 2008	*Eqn 1.1*	*Eqn 1.2*	*Eqn 1.3*	*Eqn 1.4*	*Eqn 1.5*	*Eqn 1.6*
Internet users, 2000	9.909*** .658 (1.486)	7.564*** .511 (1.956)	10.503*** .654 (1.696)	7.727*** .487 (1.824)	10.315*** .642 91.674)	7.672*** .484 (1.787)
trade as % of GDP, 2000	-8.843 -.042 (22.559)	1.001 .005 (22.404)	10.520 .047 (18.049)	5.565 .025 (18.221)	4.141 .018 (15.716)	2.863 .013 (17.582)
foreign direct investment stock as %GDP, 2000	2.485 .157 (1.555)	1.520 .097 (1.610)	1.154 .074 (1.415)	.915 .058 (1.359)	1.079 .069 (1.369)	.826 .053 (1.340)
real interest rates, 2000	-.147 -.111 (.093)	-.026 -.025 (.084)	-.129 -.092 (.082)	-.054 -.046 (.077)	-.089 -.064 (.083)	-.039 -.034 (.073)
primary education, enrollment ratio, 2000	.0009** .211 (.0003)		.0007* .133 (.0003)		.0007* .134 (.0003)	
secondary education, enrollment ratio, 2000		.00001** .307 (.000005)		.00001** .346 (.000005)		.00001** .331 (.000005)
IMF debt service ratio, 2000	-42.176 -.106 (37.646)	-41.589 -.096 (38.787)				
IMF loan, 2000	.254 .075 (.309)	-.031 -.009 (.336)				
WB debt service ratio, 2000			-8.194 -.034 (24.239)	1.643 .007 (24.838)	-6.833 -.029 (24.456)	3.181 .013 (24.845)
WB loan, 2000			.123 .025 (.349)	-.176 -.034 (.312)		
WB telecommunications loan, 2000					-.223 -.087 (.195)	-.213 .-088 (.199)
constant	-6.646 (9.088)	2.486 (7.913)	-6.878 (9.106)	-1.693 (8.645)	-4.029 (8.389)	-.044 (8.618)
R-squared	.617	.623	.572	.612	.578	.617
no. of observations	73	66	84	77	84	77
Highest VIF	1.91	2.24	1.54	2.06	1.53	2.05
Mean VIF	1.46	1.69	1.30	1.49	1.28	1.49
Breusch-Pagan	8.34**	11.90***	13.25***	17.61***	15.40***	17.58***

Notes: The first number reported is the unstandardized regression coefficient, the second number is the standardized regression coefficient, and the number in parentheses is the robust standard error.
* indicates p <0.05, ** indicates p <0.01, *** indicates p < .001 for a one-tailed test

Appendix Table 4.4 LISTWISE Economic Liberalization

Internet users, 2008	***Eqn 1.1***	***Eqn 1.2***	***Eqn 1.3***	***Eqn 1.4***	***Eqn 1.5***	***Eqn 1.6***
Internet users, 2000	8.489***	7.593***	8.908***	7.532**	8.932***	7.624**
	.651	.595	.593	.507	.594	.513
	(1.751)	(1.733)	(2.297)	(2.576)	(2.161)	(2.585)
gross capital formation, 2000	160.714*	191.736**	102.682	137.976	87.876	118.198
	.218	.242	.123	.152	.105	.130
	(69.636)	(69.208)	(100.239)	(115.309)	(89.941)	(100.936)
gross national product, 2000	2.354	3.165	3.454	3.001	2.067	2.425
	.141	.186	.184	.157	.110	.127
	(3.581)	(2.909)	(5.555)	(4.597)	(5.469)	(4.558)
private investment	.092	-.004	-.002	-.013	.031	.003
telecommunications, 2000	.106	-.005	-.002	-.015	.029	.003
	(.103)	(.075)	(.137)	(.084)	(.139)	(.086)
% urbanization, 2000	1.394	.589	1.359	-.557	2.123	.260
	.066	.026	.054	-.021	.084	-.009
	(2.99)	(3.036)	(3.417)	(3.571)	(3.325)	(3.540)
PIV democracy level, 2000	-.008*	-.007*	-.003	-.004	-.003	-.003
	-.210	-.212	-.087	-.095	-.067	-.079
	(.003)	(.003)	(.004)	(.004)	(.004)	(.004)
primary education,	.00007		-.00004		.0000007	
enrollment ratio, 2000	.021		-.010		.0001	
	(.0003)		(.0003)		(.0003)	
secondary education		.000008		.00001*		.00004*
enrollment ratio, 2000		.174		.279		.271
		(.000004)		(.000007)		(.000007)
IMF debt service	7.390	15.291				
ratio, 2000	.021	.042				
	(33.729)	(33.246)				
IMF loan, 2000	.347	.373				
	.118	.128				
	(.267)	(.269)				
WB debt service			-6.242	2.022	-1.321	4.051
ratio, 2000			-.029	.009	-.006	.019
			(27.173)	(29.128)	(29.214)	(30.432)
WB loan, 2000			.182	.212		
			.043	.049		
			(.327)	(.369)		
WB telecommunications					-.176	-.055
loan, 2000					-.090	-.029
					(.176)	(.183)
constant	-29.974*	-33.509*	-18.339	-20.197	-17.009	-17.223
	(11.531)	(12.895)	(17.392)	(21.434)	(16.243)	(19.327)
R-squared	.717	.747	.633	.669	.638	.668
no. of observations	57	53	62	58	62	58
Highest VIF	7.58	4.96	6.13	4.58	6.26	4.76
Mean VIF	2.61	2.24	2.40	2.18	2.38	2.21
Breusch-Pagan	1.35	1.57	18.45***	22.11***	18.63***	22.13***

Notes: The first number reported is the unstandardized regression coefficient, the second number is the standardized regression coefficient, and the number in parentheses is the robust standard error. For Equations 1.1 and 1.2, number in parenthesis is the standard error. * indicates p <0.05, ** indicates p <0.01, *** indicates p < .001 for a one-tailed test.

Appendix Table 4.5 MEAN SUBSTITUTION Dependency

Internet users, 2008	*Eqn 1.1*	*Eqn 1.2*	*Eqn 1.3*	*Eqn 1.4*	*Eqn 1.5*	*Eqn 1.6*
Internet users, 2000	12.909*** .709 (1.133)	10.549*** .579 (1.284)	12.797*** .703 (1.215)	10.531*** .579 (1.333)	12.606*** .692 (1.179)	10.485*** .576 (1.33)
trade as % of GDP, 2000	19.399 .077 (15.374)	17.786 .070 (14.471)	25.930 .103 (13.716)	23.631 .094 (13.259)	17.565 .069 (14.159)	18.350 .072 (13.109)
foreign direct investment stock as %GDP, 2000	-.280 -.019 (.791)	-.083 -.005 (.824)	-.380 -.263 (.797)	-.139 -.009 (.834)	-.479 -.033 (.809)	-.211 -.015 (.847)
real interest rates, 2000	-.084 -.063 (.077)	-.085 -.063 (.066)	-.076 -.057 (.072)	-.079 -.059 (.062)	-.051 -.038 (.073)	-.065 -.048 (.062)
primary education, enrollment ratio, 2000	.0003 .062 (.0002)		.0003 .069 (.0002)		.0003 .057 (.0002)	
secondary education, enrollment ratio, 2000		.00001* .236 (.000004)		.00001** .236 (.000004)		.00001** .227 (.000004)
IMF debt service ratio, 2000	-16.858 -.028 (28.835)	-23.399 -.039 (26.369)				
IMF loan, 2000	.225 .054 (.248)	.192 .045 (.233)				
WB debt service ratio, 2000			3.787 .013 (17.115)	7.025 .025 (16.062)	7.727 .027 (17.410)	9.481 .033 (16.307)
WB loan, 2000			.382 .062 (.307)	.261 .043 (.280)		
WB telecommunications loan, 2000					-.237 .084 (.138)	-.133 .033 (.139)
constant	-5.329 (5.877)	-3.277 (5.005)	-9.544 (6.304)	-8.330 (5.432)	-5.218 (6.207)	-5.948 (5.494)
R-squared	.553	.585	.544	.585	.557	.586
no. of observations	149	149	149	149	149	149
Highest VIF	1.38	1.80	1.41	1.81	1.34	1.80
Mean VIF	1.23	1.36	1.21	1.34	1.22	1.36
Breusch-Pagan	24.62***	24.45***	22.00***	22.11***	25.38***	24.34***

Notes: The first number reported is the unstandardized regression coefficient, the second number is the standardized regression coefficient, and the number in parentheses is the robust standard error.
* indicates p <0.05, ** indicates p <0.01, *** indicates p < .001 for a one-tailed test

Appendix Table 4.6 MEAN SUBSTITUTION Economic Liberalization

Internet users, 2008	*Eqn 1.1*	*Eqn 1.2*	*Eqn 1.3*	*Eqn 1.4*	*Eqn 1.5*	*Eqn 1.6*
Internet users, 2000	6.884*** .378 (1.563)	6.018*** .331 (1.597)	7.061*** .388 (1.564)	6.188*** .340 (1.622)	6.781*** .373 (1.533)	5.983*** .328 (1.620)
gross capital formation, 2000	18.014 .053 (19.636)	22.693 .067 (19.379)	27.606 .082 (20.157)	31.995 .095 (20.122)	34.765 .103 (19.830)	37.387 .111 (19.792)
gross national product, 2000	8.522** .411 (2.673)	7.362* .355 (2.94)	8.405** .405 (2.658)	7.312* .353 (2.889)	7.310** .353 (2.619)	6.418* .309 (2.804)
private investment telecommunications, 2000	.040 .029 (.068)	.039 .028 (.064)	.030 .021 (.063)	.034 .024 (.058)	.052 .037 (.059)	.053 .038 (.057)
% urbanization, 2000	.919 .028 (2.372)	.589 .017 (2.354)	1.463 .044 (2.350)	1.116 .0338 (2.339)	1.826 .055 (2.411)	1.382 .042 (2.366)
PIV democracy level, 2000	.002 .053 (.003)	.0024 .053 (.003)	.001 .040 (.003)	.002 .039 (.003)	.003 .075 (.003)	.003 .066 (.003)
primary education, enrollment ratio, 2000	.00002 .005 (.0002)		.00006 .012 (.0002)		-.00001 -.003 (.0002)	
secondary education enrollment ratio, 2000		.000009 .149 (.00004)		.000009* .154 (.000004)		.000009* .148 (.000004)
IMF debt service ratio, 2000	-26.968 -.045 (23.252)	-28.724 -.048 (22.816)				
IMF loan, 2000	.378 .090 (.206)	.309 .074 (.203)				
WB debt service ratio, 2000			16.849 .059 (17.017)	18.393 .065 (16.402)	21.912 .077 (17.479)	22.687 .079 (16.811)
WB loan, 2000			.394 .064 (.341)	.303 .050 (.320)		
WB telecommunications loan, 2000					-.271*(.030) -.096 (.124)	-.224(.066) -.080 (.121)
constant	-12.486 (8.265)	-11.008 (7.911)	-21.370* (.9.887)	-20.240* (9.549)	-20.091 (9.866)	-19.659 9.537
R-squared	.623	.635	.624	.637	.627	.639
no. of observations	149	149	149	149	149	149
Highest VIF	3.06	3.29	2.95	3.14	2.98	3.09
Mean VIF	1.66	1.78	1.63	1.74	1.66	1.76
Breusch-Pagan	33.93***	35.71***	32.63***	33.26***	31.58***	33.09***

Notes: The first number reported is the unstandardized regression coefficient, the second number is the standardized regression coefficient, and the number in parentheses is the robust standard error.

* indicates p <0.05, ** indicates p <0.01, *** indicates p < .001 for a one-tailed test