No. 12-36
November 2012

WORKING PAPER

DO HIGH INTERNATIONAL TELECOM RATES BUY TELECOM SECTOR GROWTH?
An Empirical Investigation of the Sender-Pays Rule

By Eli Dourado

MERCATUS CENTER
George Mason University

Do high international telecom rates buy telecom sector growth? An empirical investigation of the sender-pays rule

Eli Dourado
Mercatus Center and Department of Economics
George Mason University
elidourado@gmail.com

Abstract

The possible extension of the telephone system's "sender-pays" rule to the Internet is a contentious international political issue under consideration at the World Conference on International Telecommunication (WCIT). This paper examines whether higher international telephone rates support or impede telecom sector growth in the receiving country. It uses data on international telephone rates from the US from 1992-2010 to explain growth in foreign telecom sectors during the same period. I find that higher international calling rates are correlated with slower growth in the telecom sector, which suggests that countries are not primarily using higher charges to finance additional expansion. These findings cast doubt on proposals that would extend sender-pays to the Internet sector.

JEL codes: O1, L8, F5

Introduction

The pricing of international telecommunication services provides a fascinating lens through which to examine and understand institutional economics. International service is provided via two or more telecommunication companies, often state-owned or politically connected monopolies, each of which must make expenditures to develop its network in order to be able to send or receive international data, such as phone calls or Internet traffic. Users on each side of the transmission typically pay a fee for basic service, plus fees for data transmission.

This paper empirically examines the effect of differing international fee structures on telecommunications sector growth. Superficially, putting the quality of institutions to the side, one might conclude that the fee structure should not matter.[1] However, the apportionment of fees between senders and receivers is a contentious international political issue. A number of governments and telecom firms support sender-pays rules on the grounds that they are capital-constrained and that the revenue can be used to build out the telecommunications network and support economic growth in poorer countries. The fact that governments are capital-constrained means that the transfer is unlikely to be offset through fee structure changes. It may represent additional net revenue, which may be used, as these governments claim, to build out the network. Or it may simply be kept by the government or the telecom company and not be used for additional investment in telecommunications infrastructure.

Although sender-pays is the default rule in the international telephone system, it is not the rule for international Internet transmissions. At the core of the Internet, most exchange of traffic is unpriced, a process known as *peering*.[2] Some governments and telecom firms are unsatisfied with this arrangement and want to extend sender-pays rules to the exchange of Internet traffic. Most recently, European telecommunications firms—through their industry association, the European Telecommunication Network Operators' Association (ETNO)—have made a formal proposal that would extend sender-pays rules to the Internet. The proposal is to be considered at the World Conference on International Telecommunication (WCIT), which is a UN meeting being held in December 2012 to revise the International Telecommunication Regulations (ITRs).[3] This proposal, though not supported by European governments, has found some support among developing country governments, presumably because it could mean more revenue for them. Even if the ENTO proposal fails at the WCIT, this issue is likely to come up again in the future.

---

[1] The cost of the transmission can be analyzed like a tax on the communication. If we assume that the sender and the receiver of the transmission are engaged in implicit or explicit commercial transactions or repeated dealings—factors that lower transaction costs—then the cost will be apportioned inversely with the elasticity of each party's demand for the transmission, much as the economic incidence of a tax is borne inversely with the elasticity of the consumer's demand or the producer's supply in goods markets, regardless of the statutory incidence of the tax. Transmissions will be made when economical, no matter how the fee is apportioned between the sending and receiving customers. Furthermore, one could argue that the apportionment of revenues and costs between sending and receiving *companies* is just a transfer with no efficiency implications, since it is customers, and not companies, that decide at the margin whether to make another transmission. This transfer can be offset via fees for basic service and ultimately through the transactions and repeated dealings of senders and receivers of international transmissions.

[2] See Woodcock and Adhikari (2011) for empirical data on informal and unpriced peering arrangements.

[3] The ETNO proposal is available at http://files.wcitleaks.org/public/ETNO%20C109.pdf.

While it is desirable for developing countries to improve their telecommunication infrastructures, and while such improvement requires revenues, simple claims that additional revenues generate development should be viewed skeptically. The development literature provides numerous counterexamples. For example, Sachs and Warner (2001) find that resource-rich countries grow more slowly than other countries even though natural resources provide ample revenue to governments. Foreign aid is another example of a revenue source that has not led to growth. Easterly (2003) argues that government-to-government aid is not effective in producing economic growth, and Djankov et al. (2008) find that foreign aid causes a deterioration of political institutions. A cynical interpretation of these findings is that lump sums of guaranteed revenue make the residual claimants of these revenues more concerned with maintaining their positions than with developing other sources of revenue, such as growing the tax base through economic development. They expend relatively more resources and energy holding onto power than growing the economy. Revenues that are not closely linked with service provision tend to create what Acemoglu and Robinson (2012) call "extractive" institutions.

This paper examines whether higher international telecommunication charges impair growth as natural resource and foreign aid revenue do, or whether they support growth as proponents of sender-pays rules claim. It uses data on international telephone rates in the United States from 1992 through 2010 to explain growth in foreign telecom sectors during the same period. I find that higher international calling rates are correlated with slower growth in the telecom sector, which suggests that countries are not primarily using higher charges to finance additional expansion. These findings cast doubt on proposals, like the ETNO proposal, that would in some way extend sender-pays rules to the Internet sector. If higher sender per-minute charges in the telephone sector are correlated with lower telecom growth in receiving countries, then absent other evidence, we should expect that higher sending-party data charges in the Internet sector will also lead to lower overall telecom growth in the very countries these proposals seek to help.

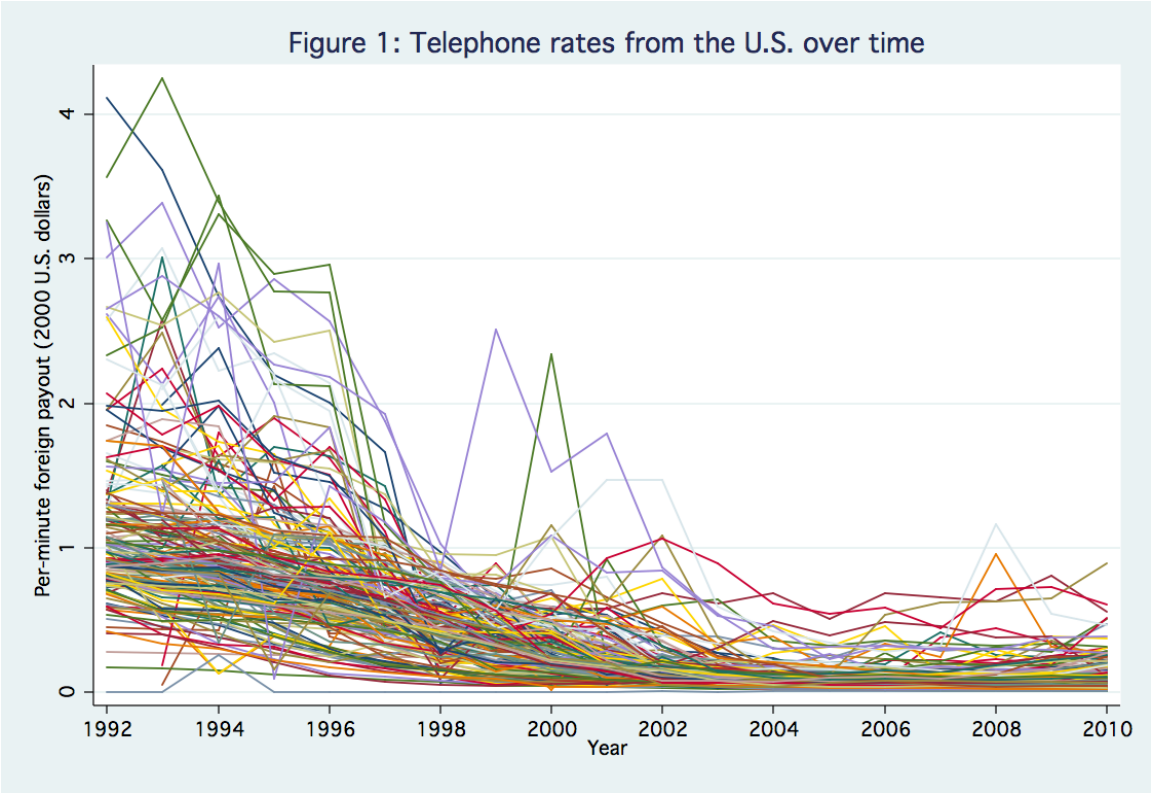
Data

I use publicly available data from the FCC's international bureau to calculate the average per-minute foreign payment for a telephone call from the United States to other countries from 1992 to 2010.[4] The average per-minute rate declines substantially over time sample period. In 1992, the global average rate was $0.676, while in 2010, it was $0.040.[5] The cross-sectional variation is much more extreme, however. In 1993, U.S. companies paid $4.253 per minute to Madagascar, and in 1992, $4.117 to Afghanistan. In

[4] Data can be downloaded by year at http://transition.fcc.gov/wcb/iatd/intl.html. I use table A1 from the Section 43.61 International Traffic Data Reports and divide the payout from U.S. telecom companies to foreign telecom companies by the number of minutes to each foreign country. I use per-minute rates rather than revenue per capita because FCC data on payments are limited to calls to and from the United States. Consequently, analysis that uses revenues that originate in the United States only would capture not only a "high rate" characteristic, but also a "ties to the United States" characteristic, which could itself drive telecom investment.

[5] Here and throughout the paper, all dollar figures are constant 2000 dollars.

recent years, payments to Canada have been around $0.008 per minute. Figure 1 shows the per-minute foreign payout for different countries over the sample period. Rates are higher and more variable both within and across countries in the beginning of the period, and lower and more consistent toward the end of the period.



I use GDP and telecom data from the World Bank's World Development Indicators.[6] My key variables for adoption of telecom services include fixed telephone lines per 100 people, mobile subscriptions per 100 people, Internet users per 100 people, and fixed broadband subscribers per 100 people. Globally, fixed telephone lines start at 10.4 per 100 people in 1992, peak at 19.4 in 2005, and decline to 17.8 in 2010. Mobile subscriptions skyrocket from 0.4 per 100 people in 1992 to 77.1 in 2010. Global Internet usage was unmeasured in 1992. It rises from fewer than 0.3 users per 100 people in 1993 to 29.5 in 2010. Global data on broadband subscribers is missing for several years early in the sample, but subscribers rise from 0.0 per 100 people in 1998 to 7.7 in 2010. Figures 2 through 5 show the cross-country variation over time in fixed-line telephones, mobile phones, Internet users, and fixed broadband subscriptions, respectively. These figures show that there is considerable variation in telecom adoption across countries. Broadly speaking, adoption of fixed-line telephones has not changed much over the sample period, but mobile cellular subscriptions and Internet users have experienced explosive growth in many countries. Broadband subscriptions have also grown, though in fewer countries and beginning at a later date.

[6] Data are available at http://databank.worldbank.org/.

Figure 2: Fixed-line telephones over time

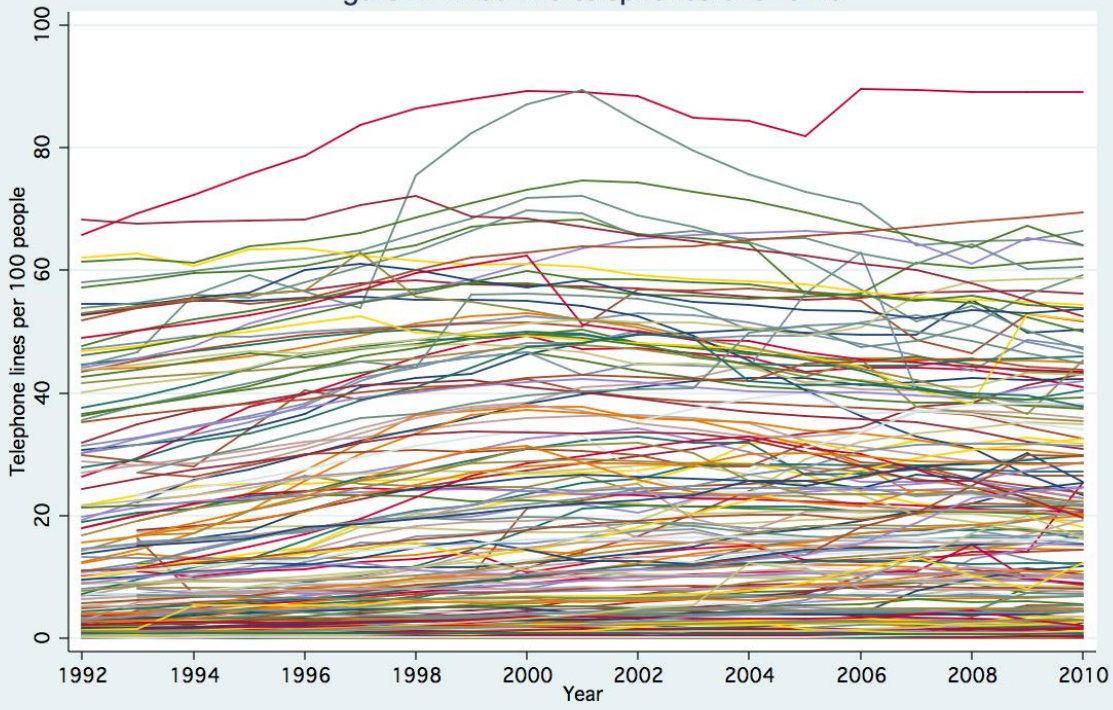
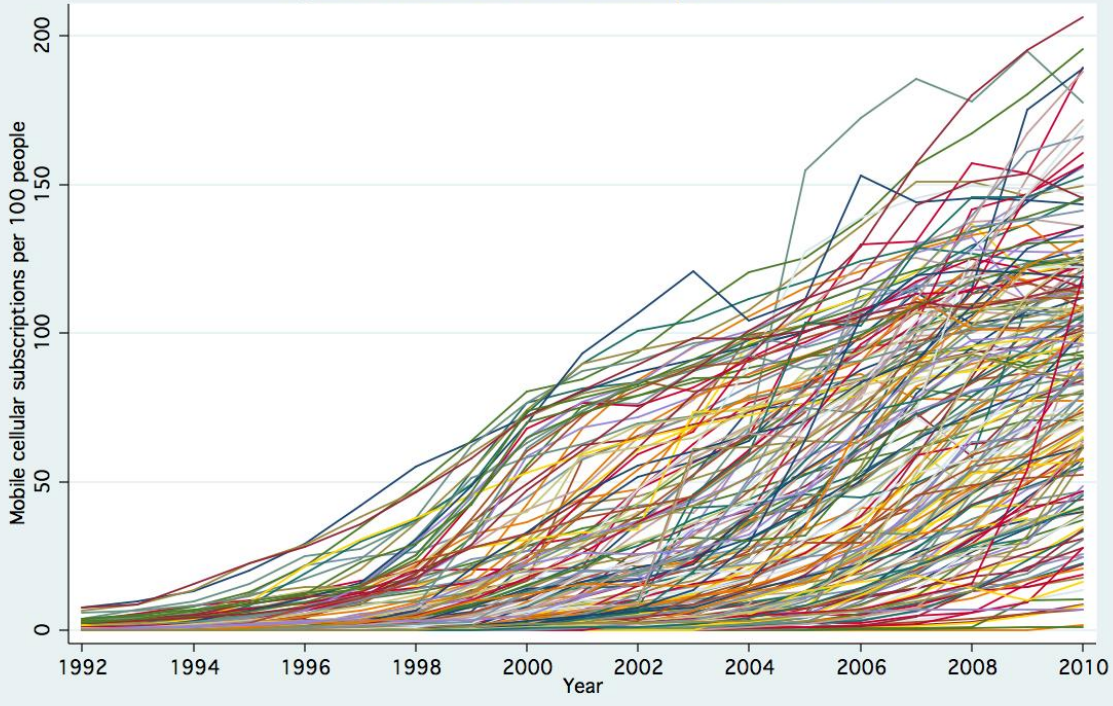


Figure 3: Mobile cellular subscriptions over time



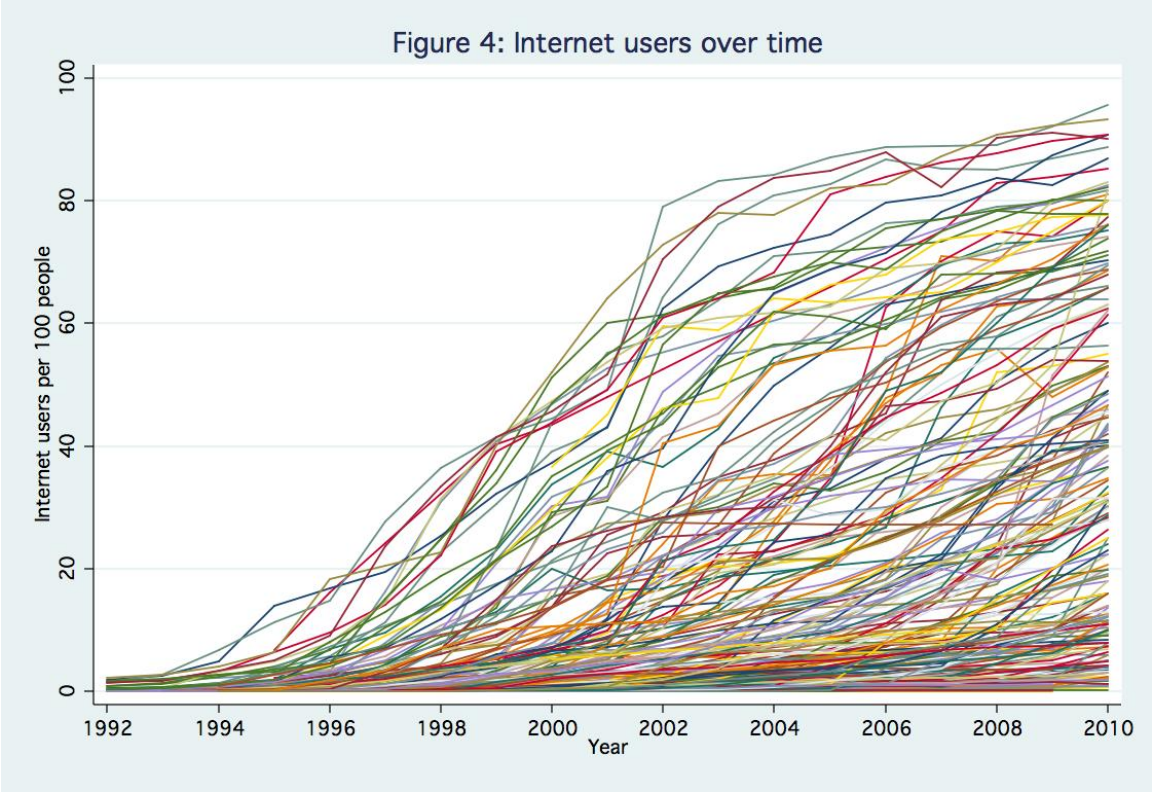


Figure 4: Internet users over time
Internet users per 100 people
0
20
40
60
80
100
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year

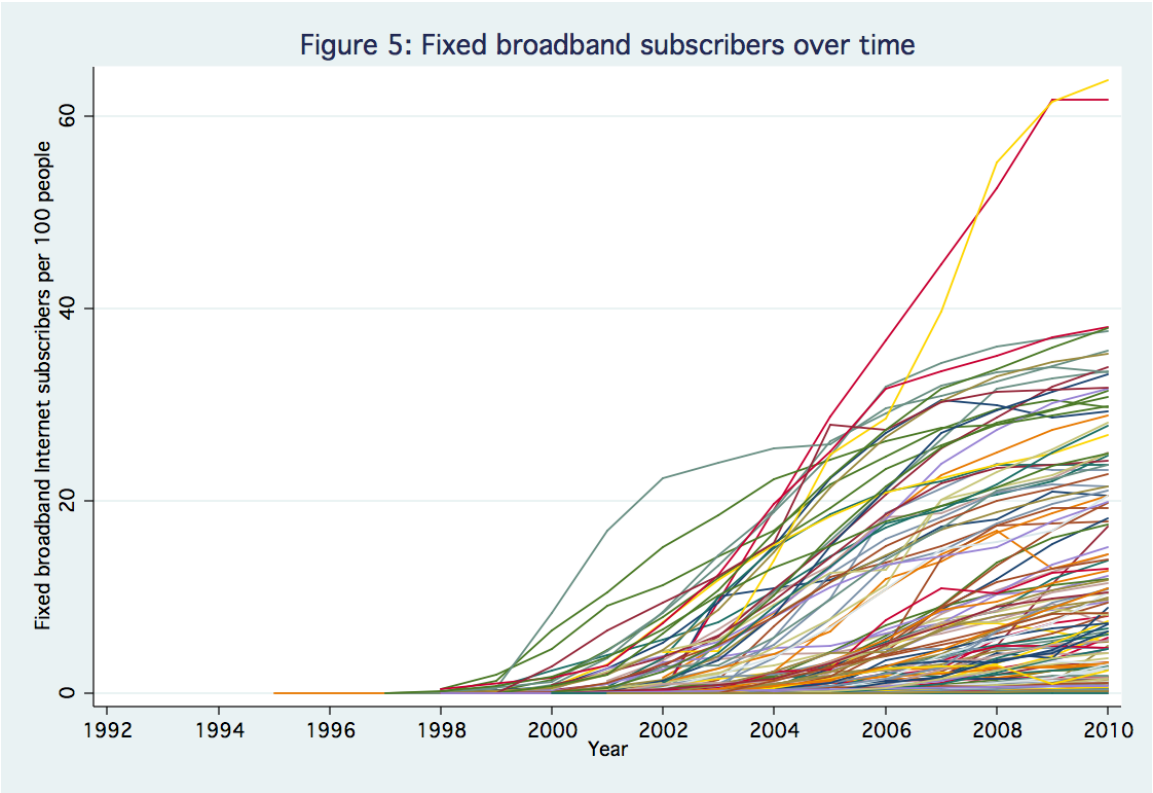
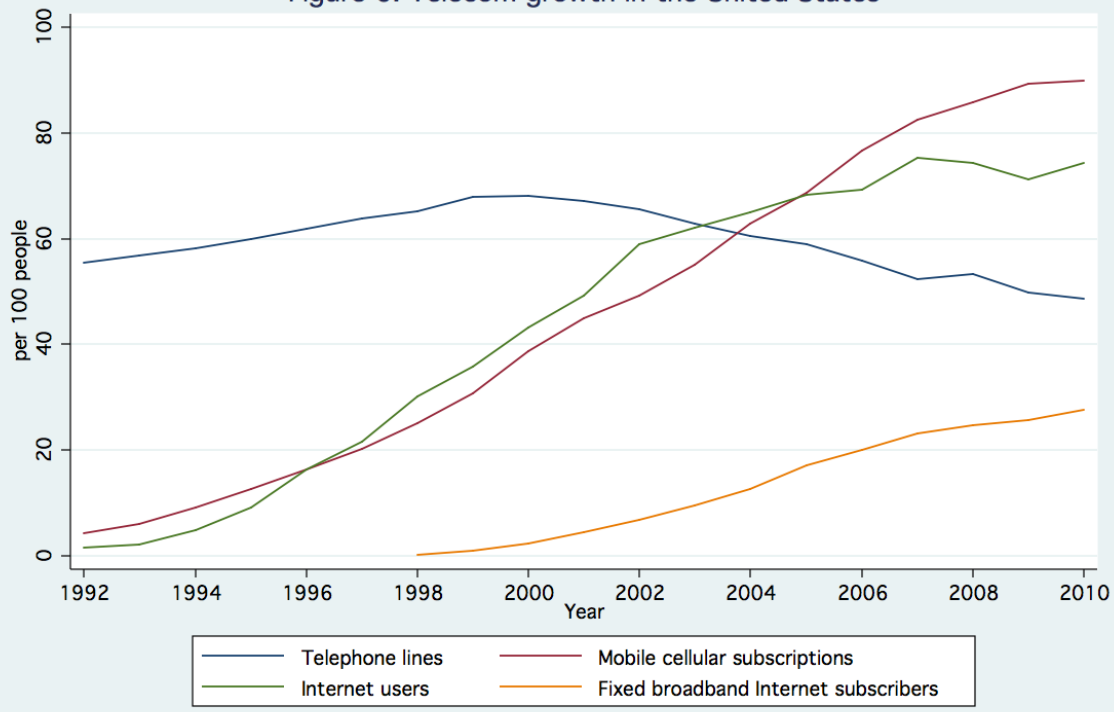


Figure 5: Fixed broadband subscribers over time
Fixed broadband Internet subscribers per 100 people
0
20
40
60
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year

Again, there is considerable cross-sectional variation in telecom usage patterns. More developed countries tend to have more fixed telephone lines. As figure 6 shows, the United States begins the sample period at 55.5 lines per 100 people. This figure peaks in 2000 at 68.1 and declines to 48.7 by 2010. Mobile subscriptions rise from 4.3 to 89.9 per 100 people over the sample period, and Internet users rise from 1.7 to 74.2. U.S. broadband subscribers start at 0.3 per 100 people in 1998 and rise to 27.6 in 2010. In contrast, developing countries in sub-Saharan Africa have fewer fixed line telephones in both absolute and relative terms. In 1992, they averaged 1.0 lines per 100 people; in 2010, 1.4 (see figure 7). The explosion in mobile subscriptions happened more suddenly in sub-Saharan Africa. At the beginning of the sample period, there were 0.0 mobile subscriptions per 100 people, and there were fewer than 1.0 as late as 1999. However, this number rose to 45.1 by 2010. Internet usage and broadband subscribers went from zero at the beginning of the sample to 10.0 and 0.2 per 100 people, respectively, by 2010.

Figure 6: Telecom growth in the United States



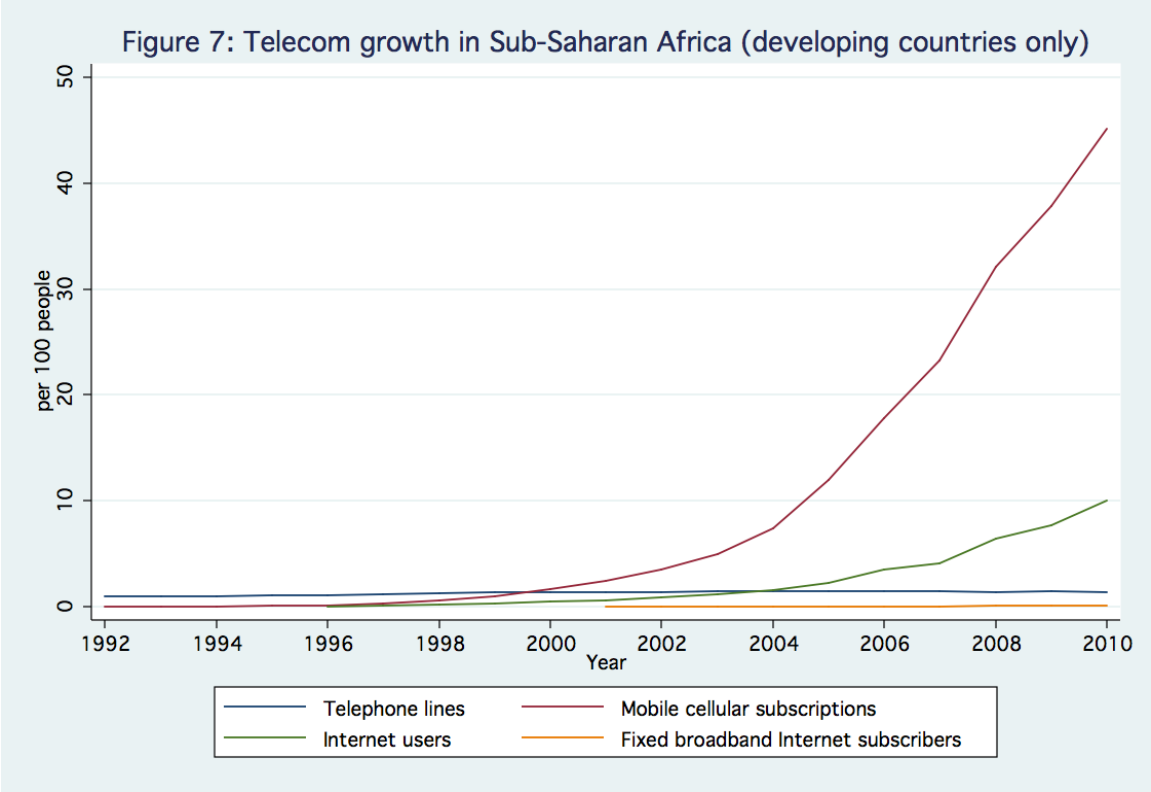


Table 1 shows additional summary statistics for the key variables.

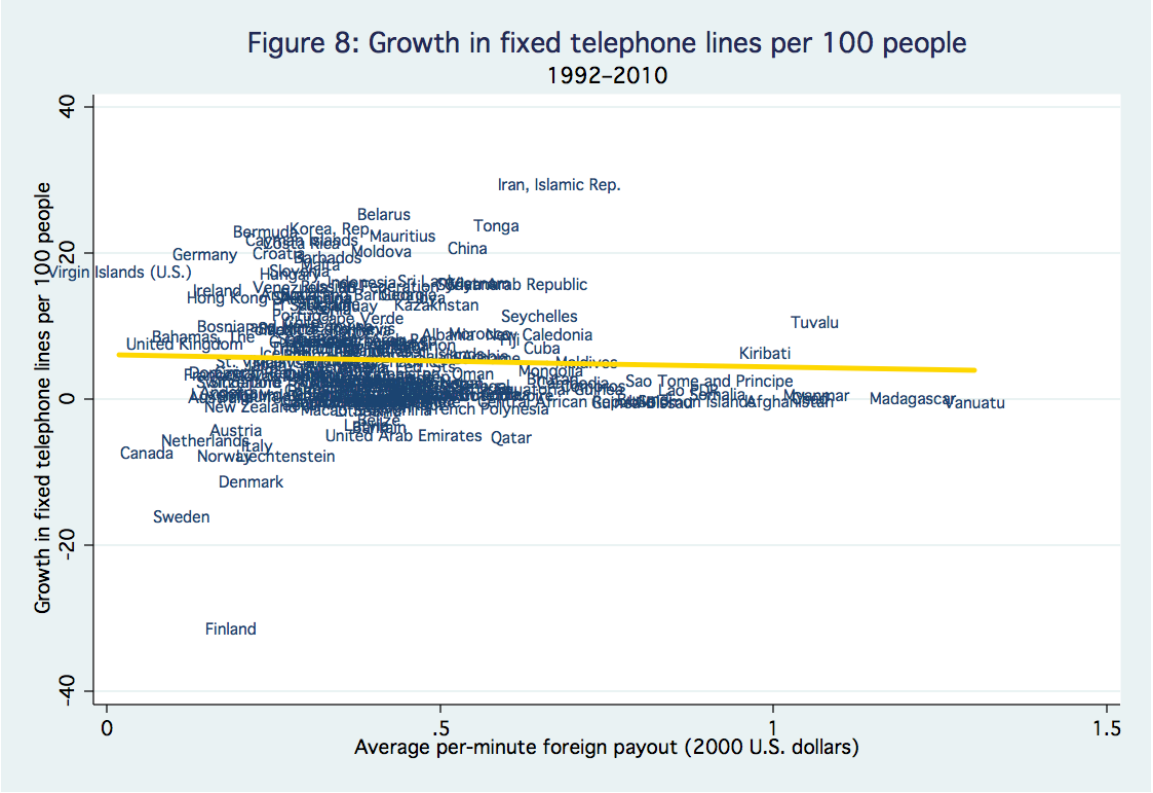
Table 1

	N	Mean	Standard Deviation	Minimum	Maximum
Per-minute foreign payout (2000 U.S. dollars)	3639	.4250912	.4941318	.0000781	4.252668
Fixed telephone lines per 100 people	3592	18.77962	19.66386	.0057592	89.62505
Annual change in fixed telephone lines per 100 people	3586	.3270184	1.445441	-22.41367	21.59001
Mobile cellular subscriptions per 100 people	3560	30.66422	41.12231	0	206.4285
Annual change in mobile cellular subscriptions	3544	4.830726	7.34276	-21.43076	87.6324
Internet users per 100 people	3075	14.54298	21.4705	0	95.62579
Annual change in Internet users per 100 people	2902	2.166842	3.274349	-8.006771	31.5
Fixed broadband Internet subscribers per 100 people	1997	4.411455	8.537498	0	63.83215
Annual change in fixed broadband Internet subscribers per 100 people	1754	.931971	1.617072	-3.976887	15.48034

Rates versus Telecom Sector Growth

If higher international long-distance rates lead to greater telecom sector growth in the receiving country, then rates should be positively correlated with adoption of telecom services. I start my analysis by comparing average rates from 1992 through 2010 to total

growth in each telecom segment over the same period. For example, figure 8 shows a scatterplot of growth in the fixed telephone segment versus the average foreign payout to each country over the sample period. If higher rates led to increased telecom sector growth, then one might expect the countries on the right side of the graph to cluster in the top half, and countries in the left side of the graph to cluster in the bottom half. However, there are few countries in the top-right quadrant, and the trend line is close to flat. This result suggests that there is little relationship between international calling charges and investment in the fixed line telephone system.



However, if we look at the countries that had the most negative growth in fixed line telephones, such as Finland, Sweden, and Denmark, it becomes apparent that growth in fixed telephone lines in this period has little to do with capital constraints. These are wealthy countries, and the decline in fixed telephone lines must be due to substitution into mobile phones and other technologies. Consequently, figure 9 performs the same analysis for mobile cellular subscriptions.

There is a clear negative correlation between growth in mobile cellular subscriptions and international per-minute payouts. This is preliminary evidence that higher rates are associated with *lower* mobile growth, not higher growth as sender-pays advocates claim.

Figure 10 repeats the analysis for growth in Internet users and figure 11 does it for broadband subscribers. Once again, there is a clear negative correlation between growth in each telecommunication sector and incoming international calling rates. Again, this correlation is only preliminary evidence against the hypothesis that higher rates lead to greater telecom sector growth because we have not yet controlled for any other factors.

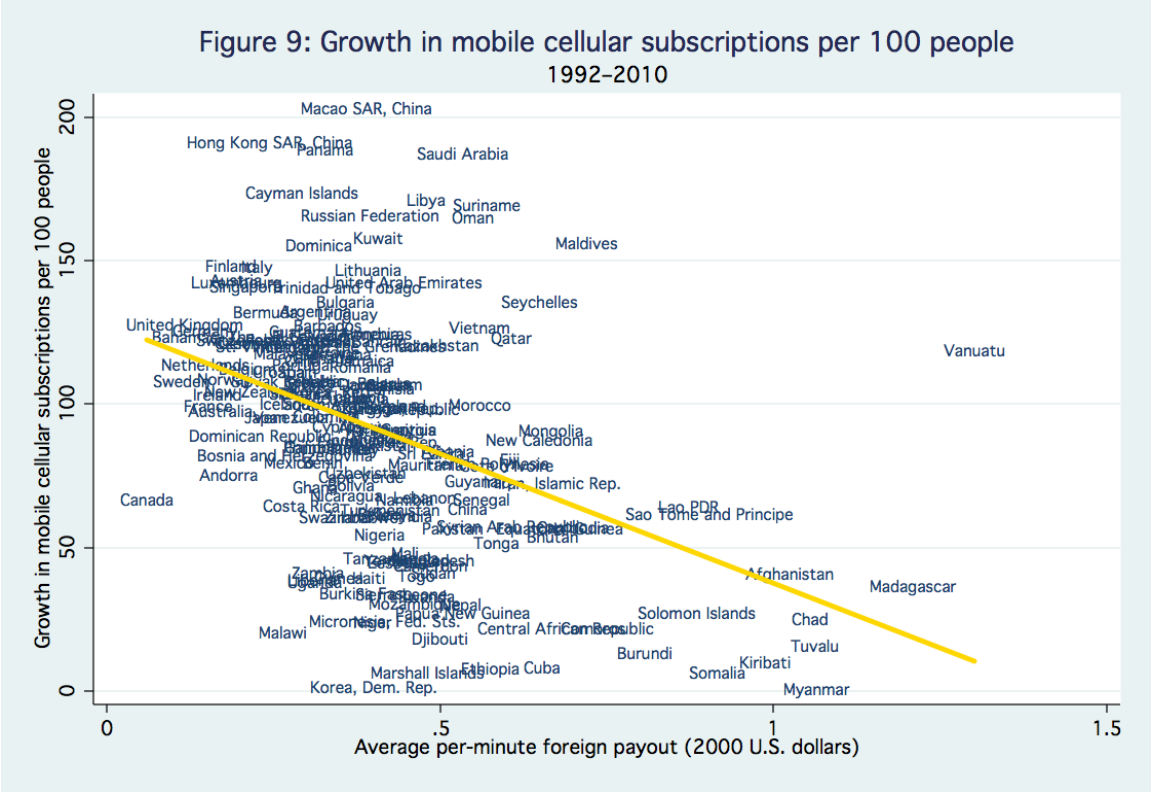


Figure 9: Growth in mobile cellular subscriptions per 100 people
1992–2010
Growth in mobile cellular subscriptions per 100 people
0
50
100
150
200
Macao SAR, China
Hong Kong SAR, China
Panama
Saudi Arabia
Cayman Islands
Libya
Suriname
Russian Federation
Oman
Dominica
Kuwait
Maldives
Finland
Italy
Lithuania
Luxembourg
Singapore
Trinidad and Tobago
United Arab Emirates
Bulgaria
Seychelles
Bermuda
Uruguay
United Kingdom
Barbados
Vietnam
Qatar
Vanuatu
Netherlands
Jamaica
Sweden
Romania
Morocco
France
Iceland
Australia
Dominican Republic
Mongolia
New Caledonia
Bosnia and Herzegovina
Mexico
Fiji
Andorra
Mauritius
Guyana
Canada
Bolivia
Ghana
Nicaragua
Lebanon
Senegal
Costa Rica
China
Lao PDR
Sao Tome and Principe
Nigeria
Tonga
Bhutan
Afghanistan
Madagascar
Zambia
Haiti
Togo
Solomon Islands
Chad
Micronesia, Fed. Sts.
Papua New Guinea
Malawi
Central African Republic
Djibouti
Tuvalu
Burundi
Kiribati
Ethiopia
Cuba
Somalia
Marshall Islands
Myanmar
Korea, Dem. Rep.
0
.5
1
1.5
Average per-minute foreign payout (2000 U.S. dollars)

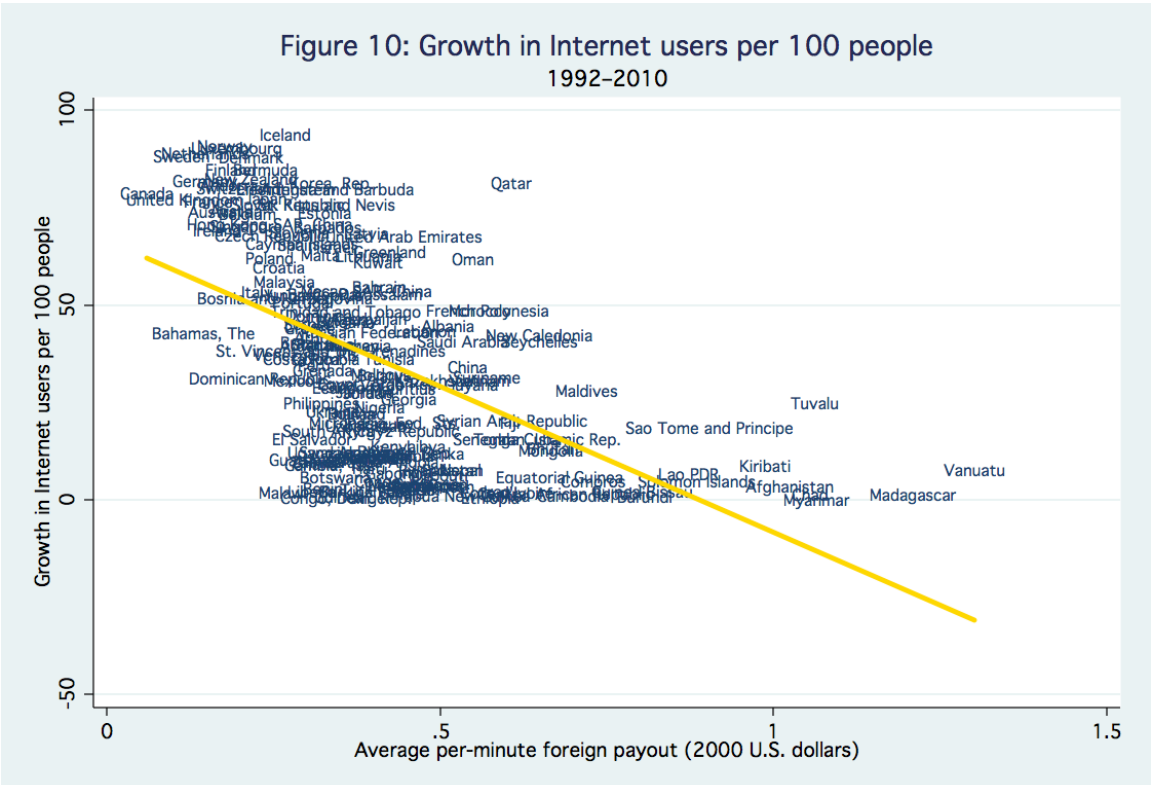
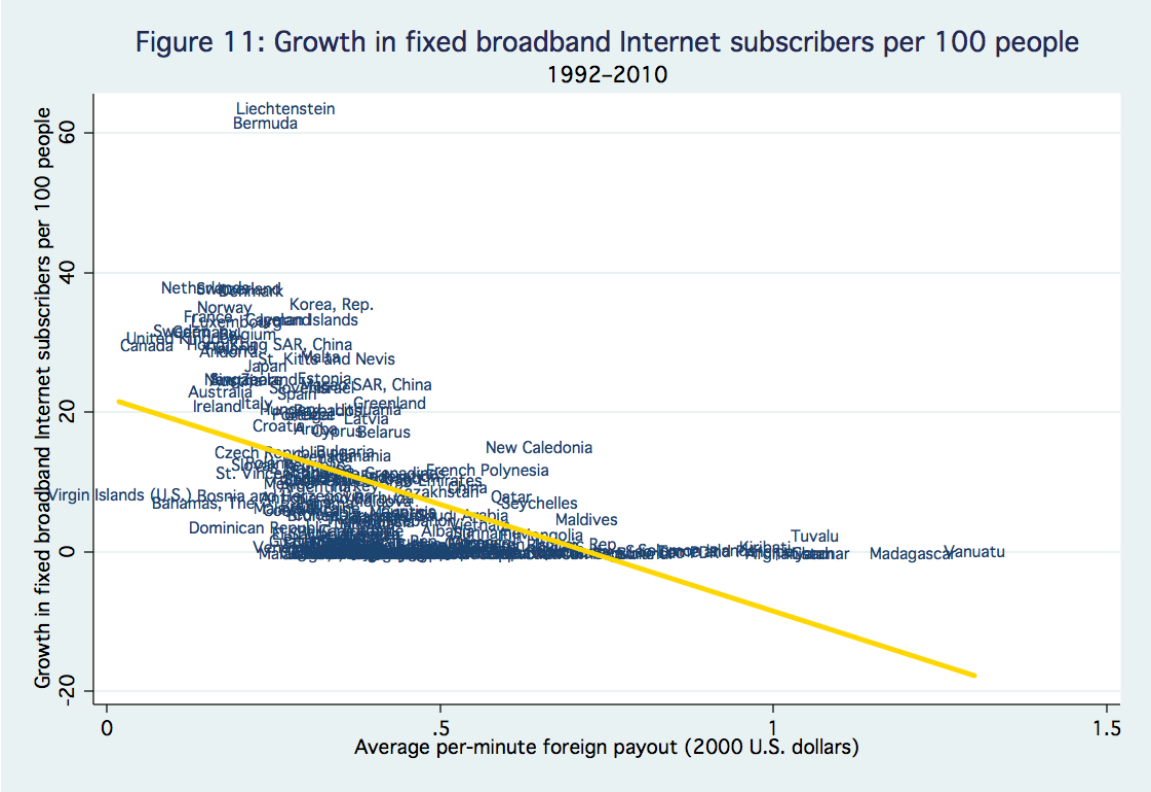


Figure 10: Growth in Internet users per 100 people
1992–2010
Growth in Internet users per 100 people
-50
0
50
100
Iceland
Qatar
Barbuda
Nevis
Arab Emirates
Oman
Malaysia
Croatia
Bahamas, The
New Caledonia
Seychelles
China
Maldives
Tuvalu
Sao Tome and Principe
Kiribati
Vanuatu
Lao PDR
Afghanistan
Madagascar
Myanmar
0
.5
1
1.5
Average per-minute foreign payout (2000 U.S. dollars)



We can perform the same analysis using statistical regression and add controls for other factors. Table 2 shows the results of OLS regressions equivalent to the previous four figures, augmented with a control for mean real GDP per capita over the sample period. It also runs an equivalent regression on a constructed telecom sector index, composed of the sum of the other four telecom sector components. Coefficients are in bold if they are statistically significant at the 5 percent level, and I report robust standard errors in parentheses.

In every regression in table 2, the estimated effect of per-minute foreign payouts on telecom sector growth is negative, although the effect on fixed telephone lines is not statistically significant. In no case is there any support for the claim that higher rates lead to more telecom sector growth. A $1 per minute higher average calling rate over this period would be expected to result in around 50 fewer mobile subscriptions, 39 fewer Internet users, and 13 fewer broadband subscribers per 100 people by the end of the period.

Table 2

	Change in telephone lines per 100 people	Change in mobile subscriptions per 100 people	Change in Internet users per 100 people	Change in fixed broadband subscribers per 100 people	Telecom index (sum of first 4 dependent variables)
Per-minute foreign payout	-2.830942 (2.785517)	**-49.53136** (18.98627)	**-39.35076** (7.119262)	**-12.62105** (2.808432)	**-96.8137** (22.82657)
Number of countries	183	177	180	182	173
R^2	0.0293	0.2576	0.6446	0.7484	0.5313

Controls: mean real GDP per capita over the sample period

Table 3 shows the results of regressions that also control for region of the world. This control is important because it may cost more to offer service in or to some regions of the world. For example, countries in the Oceania region might charge more to accept a call from the United States, but this higher charge may simply reflect their higher costs of providing the connection, not any sort of extractive institutions. Controlling for regions allows us to more effectively compare countries to their neighbors, who may share similar costs of providing service.

Table 3

	Change in telephone lines per 100 people	Change in mobile subscriptions per 100 people	Change in Internet users per 100 people	Change in fixed broadband subscribers per 100 people	Telecom index (sum of first 4 dependent variables)
Per-minute foreign payout	-.462609 (2.637136)	-22.45807 (20.525)	**-32.13528** (7.876491)	**-6.743498** (2.360305)	**-59.3559** (22.85692)
Number of countries	183	177	180	182	173
Adjusted R^2	0.1100	0.3900	0.7476	0.8215	0.6563
Controls: mean real GDP over the sample period, region dummy variables					

The results of these regressions continue to find no support for the hypothesis that higher per-minute rates lead to additional telecom sector growth. The estimated effect of per-minute foreign payouts continues to be negative in every case, although for mobile subscriptions it is no longer statistically significant. The effect on Internet adoption remains strong. A $1 per minute higher average calling rate over the sample period would be expected to result in around 32 fewer Internet users and 7 fewer broadband subscribers per 100 people by the end of the period.

Year-to-year changes

A more sophisticated regression model can be used to look more closely at year-to-year changes in each telecom segment in response to rates and GDP per capita in that year. Table 4 shows the results of such regressions that build on the regressions shown in table 3. In addition to controlling for region, the new regressions also control for year effects, because the cost of deploying new telecommunication services varies by year. Because broadband data are available on an annual basis for fewer years than the other variables, I construct a "lite" telecom index that excludes broadband data. Finally, in order to avoid additional statistical significance simply on the basis of using more data per country, I cluster the standard errors by country.

Table 4

	Change in telephone lines per	Change in mobile subscriptions	Change in Internet users per	Change in fixed broadband	Telecom index (sum of first 4	Telecom index lite (sum of first

	100 people	per 100 people	100 people	subscribers per 100 people	dependent variables)	3 dependent variables)
Per-minute foreign payout	**-.484943** (.0829505)	**-1.441556** (.4432055)	**-1.337159** (.5526179)	.0648065 (.4627852)	**-13.33158** (2.706504)	**-6.764243** (1.673799)
Number of countries	185	185	185	184	183	185
Total observations	3,387	3,356	2,772	1,663	1,610	2,754
Adjusted R^2	0.0898	0.2611	0.2497	0.4590	0.1674	0.2475
Controls: annual real GDP per capita, region dummy variables, year dummy variables						

Using these annual data, all statistically significant coefficients on per-minute foreign payout continue to be negative. A $1 per minute higher rate is expected to result in 0.5 fewer fixed telephone lines, 1.4 fewer mobile subscriptions, and 1.3 fewer Internet users per 100 people, for *every year that the higher rate is in place*.

The coefficient on per-minute foreign payout for broadband subscribers is not significant. This result makes sense when broadband access and telephone service are viewed as substitutes. When international calling rates are high, consumers may have more demand for broadband Internet access since it affords them the ability to use free voice over Internet protocol (VOIP) software, such as Skype, to make international calls. This substitution effect could be offsetting a decline more generally in telecom sector investment. If so, then the regression does not really capture the negative effects of higher rates on broadband investment, since the broadband adoption that is occurring is actually welfare-reducing—people in the receiving country are being pushed into spending relatively more on telecommunication than they would like to.[7]

Lagged model

The regressions in the previous section cannot rule out the possibility of reverse causality. It could be the case that high international rates today raise revenue to fund expansion of the telecom sector in the future, leading to lower rates and higher adoption of services in the future period. This behavior would generate negative correlations between rates and growth, as seen in the preceding set of regressions. In order to test for this possibility, I augment the basic model with lags of my primary independent variable, the per-minute foreign payout. If high rates today are used to fund expansion in the future, then lagged values of the rate coefficient should be positive—that is, high rates today should correlate with high growth a few years from now. In addition to the current-year data on rates, I include three lags of the rate variable. Table 5 shows the results of these regressions.

[7] In this important respect, a sender-pays rule for the Internet could be expected to be *worse* than a sender-pays rule for telephone calls. When international telephone rates are high, people can circumvent the higher rates through Internet services. But when international Internet transfer rates are high, there is not (yet) an alternative technology that can be substituted for Internet service, and people will be forced to pay the rates if they wish to communicate internationally.

Table 5

	Change in telephone lines per 100 people	Change in mobile subscriptions per 100 people	Change in Internet users per 100 people	Change in fixed broadband subscribers per 100 people	Telecom index (sum of first 4 dependent variables)	Telecom index lite (sum of first 3 dependent variables)
Per-minute foreign payout	**-.3386631** (.1262057)	**-1.788547** (.5734285)	-.2781527 (.4382448)	.0540536 (.4026424)	-3.790462 (4.401925)	**-4.07572** (1.072273)
1 lag	-.2325642 (.1616025)	-.4277512 (.4008983)	-.5609252 (.3065304)	-.1282259 (.3574402)	-1.070837 (3.794525)	-1.630411 (.717776)
2 lags	-.0744521 (.1855185)	-.2487251 (.3118685)	-.3198984 (.257992)	.356289 (.2280151)	-2.926031 (1.742518)	-.9241457 (.6632844)
3 lags	-.0697554 (.0784511)	**-1.157689** (.4237955)	**-1.21146** (.3488928)	-.2247493 (.2089237)	**-6.706004** (2.227613)	**-3.075078** (.8166871)
Number of countries	185	185	185	184	183	185
Total observations	2,857	2,846	2,619	1,663	1,610	2,602
Adjusted R^2	0.0878	0.2137	0.2537	0.4584	0.1762	0.2422
Controls: annual real GDP per capita, region dummy variables, year dummy variables						

These lagged regressions provide some evidence that the effect of international calling rates on telecom sector growth is causal. Once again, all of the statistically significant coefficients on per-minute foreign payout are negative, including on the lagged variables. As a result, this analysis provides evidence against a scenario in which rates are *temporarily* high to accumulate funds for investment, and then lowered after the successful investment is made. In addition, the significance of the negative coefficients on several of the lagged variables implies that the effect of high rates could last for many years.

Discussion: Telecom, Institutions, and Growth

My results contradict the hypothesis that the ability to charge more for international Internet traffic is all that is needed to build out telecommunications infrastructure in poor countries. High international telephone collection rates have not led to greater buildout and adoption of telecommunications infrastructure in the past two decades. It seems unlikely, therefore, that adopting a sender-pays model for Internet traffic would increase buildout of Internet infrastructure today.

Sender-pays rules allow governments to export some of their statutory tax burden. While it is understandable why some governments might be eager to implement such a policy, it does not follow that the revenue from such a policy will go to help residents of the tax-exporting country. Such funding, in combination with institutions that funnel resources to activities that promote the general welfare, could improve telecom infrastructure, but we cannot take such institutions for granted. Some countries don't have good institutions in the first place, and others might, at the margin, suffer

institutional deterioration from the availability of an external revenue source that is largely uncorrelated with the health of the domestic economy.

It is nevertheless clear that poor countries need some kind of financing to support the expansion of their telecom networks. To maximize the probability that revenues do reach infrastructure projects, the analysis in this paper provides some support for two possible alternatives to a sender-pays policy. First, benevolent governments should favor systems that funnel resources directly to infrastructure projects, rather than letting them pass through the public or quasi-public sector. Simply allowing private firms to invest in their own infrastructure systems accomplishes this goal, as does foreign aid in which the donor country or institution manages the construction directly. Second, governments should rely as much as possible on domestic revenue for infrastructure projects. Internal financing creates a tighter link between the incentives of governments and the needs of the public, which could lead to the better institutions that countries need to grow in the first place.

References

Acemoglu, Daron and James Robinson. *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*. Crown Business (2012).

Djankov, Simeon, Jose G. Montalvo, and Marta Reynal-Querol. "The curse of aid." *Journal of Economic Growth*, Vol. 13 (2008), pp. 169–194.

Easterly, William. "Can foreign aid buy growth?" *Journal of Economic Perspectives*, Vol. 17, No. 3 (Summer 2003), pp. 23–48.

Sachs, Jeffrey and Andrew Warner. "The curse of natural resources." *European Economic Review*, Vol. 45 (2001), pp. 827–838.

Woodcock, Bill and Vijay Adhikari. "Survey of characteristics of Internet carrier interconnection agreements," Packet Clearing House, May 2, 2011, http://www.pch.net/resources/papers/peering-survey/PCH-Peering-Survey-2011.pdf.