The Degree of Commitment to Regulator Independence: Measurement and Impact*

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Abstract

This study computes measures of the degree of independence in practice of telecommunications regulators for Latin American and Caribbean countries in a new data set for 23 countries between 1990 and 2004. We focus on the degree to which governments are able to commit to preserve regulator independence. We combine this information with data on legal independence to construct indices of regulator independence that are more realistic than those used by the existing literature. Econometric results confirm that regulator independence has a positive impact on telecommunications performance, but purely legal indices appear to under-estimate this impact.

Keywords: regulation, independence, strategic delegation, telecommunications.

JEL classification: L51, L96.

1. Introduction

The regulation of network industries faces a time inconsistency or commitment problem:[1] given the irreversible nature of investments, regulators have the temptation to set prices that are too low once investments have been sunk. Mirroring the solution to the time inconsistency problem in monetary policy, academics have suggested that regulators that are

independent from government and that value industry profits more than representative politicians may alleviate under-investment. Arguments of expertise and policy stability reinforce the rationale of independence. International institutions and many countries claim to follow the academic advice and have advocated the creation of such independent regulators in network industries in the recent past.

The problem is that the creation of independent regulators does not solve, but it relocates, the commitment problem, which is transformed into one of the government committing not to undermine the independence of the regulator. Thus, work on the measurement of independence[2] which only takes into account legal provisions, especially those studies that only construct dummy variables, as Estache, Goicoechea and Manacorda (2006, 12) point out, "may not capture the degree of independence." Laws (*de jure* independence) leave a broad margin for interpretation and, as Cukierman (1992, 383) argues, "even when laws are very specific, these could be not operational if there exists a tradition or way of thinking in government that things must be made in a different way".

The measurement of independence in practice for Central Banks is quite developed in the literature,[3] but this is not the case for network industries.[4] We contribute to filling this gap by developing indices of independence in practice for the Telecommunications Regulatory Agencies (TRA's) in 23 Latin American and Caribbean countries. Following the empirical Central Bank independence literature, we measure the real duration in office of the regulator and its relationship with political changes. We compute with this a new, more realistic index of regulatory independence. Econometric results using this index show that independence has a positive effect on network penetration, and that this effect would be under-estimated using only a legalistic approach to independence.

In Section 2 we survey the independence debate and the studies on the independence in practice of Central Banks. In Section 3 we explain how we have constructed measures of regulator independence in practice by observing the actual time that regulators stay in their jobs; adding this to an existing index of legal regulation we create an index of both *de jure* and *de facto* independence. In Section 4 we quantify the impact of this measure of actual independence on fixed telecommunications penetration, using a regression analysis that takes the potential endogeneity of regulation into account. Finally, the last section presents concluding comments.

2. Related literature

In infrastructure industries, the importance of institutions is mainly driven by the sunk nature of the massive investments needed, which is the source of a time inconsistency problem, highlighted by Levy and Spiller (1996), Shirley, Cowan and Noll (2000), Noll (2000), Noll and Shirley (2002), Gutiérrez (2003a), Levine, Stern and Trillas (2005) and Newbery (2000), among others. Many countries face major difficulties in inducing sufficient investment to meet the capacity needs -at least at an acceptable cost of capital. Hence, the role of the regulatory institutions is crucial in providing the credibility that will support the necessary investment flows.

Especially for developing countries the credibility of commitments not to carry out expropriation activities, which may foster electoral support via short term benefits for consumers such as, e.g., lower prices, is crucial for the ability to secure often badly needed investment in infrastructure. Such credibility is linked to the institutional endowment of a country. One potential way to alleviate the time inconsistency problem in infrastructure policy, which has been explored recently both in developing and in developed countries, is regulator independence. If contracts (private contracts or concession contracts) are possible, discretional regulation is less necessary. However, complete contracts are even more problematic in developing countries than in developed ones. Discretional regulation can be replaced by ex ante rules, but these tend to perform poorly if there are unforeseen contingencies. Besides, in many cases regulation and contracts are complementary, because i) some sort of supervision is necessary to enforce previous agreements and react to unforeseen contingencies or contract renegotiation; and ii) discretional independent regulation needs to be accompanied by mechanisms of social control, accountability, and adequate procedures, if it is to obtain social legitimacy and market credibility.

In countries with skewed income distributions (such as many Latin American countries), governments pay a political price in terms of not satisfying the median (relatively poor) voter if they do not renege on promises made to remunerate specific private-sector investments. Thus the solution of combining privatization with strategically delegating into a relatively pro-industry regulator, in a similar way as governments delegate into an inflation averse central banker (see Levine, Stern and Trillas 2005).[5] The need to appoint authorities with a high expertise in complex matters and to avoid policy polarization reinforces the arguments in favour of delegation.

The problem of course is that independence does not solve, but it relocates, the commitment problem, which transforms itself into one of the government credibly committing not to undermine the independence of the regulator, which many countries have found very difficult. In a definition of Central Bank independence, Walsh (2005, 10) states that "legal measures of Central Bank independence may not reflect the relationship between the Central Bank and the government that actually exists in practice." Hence, the importance of developing continuous indices of independence in practice.

Thus, since Rogoff (1985) suggested the idea of strategically delegating into an inflation averse Central Banker, a rich empirical literature emerged trying to measure independence and trying to quantify its impact. According to Eijffinger and De Haan (1996) a Central Bank is independent if its monetary policy is not influenced by political cycles or by the preferences of politicians. As an example of the empirical literature on Central Bank independence, Cukierman (1992) creates a 16-variable legal index for 68 countries, reporting data on (i) hiring and firing rules for the Chairman; (ii) policy formulation; (iii) final objectives, and (iv) borrowing limitations.

As a *proxy* for independence in practice he uses the average time (or turnover ratio) in the position of Central Bank governor or chairman. Cukierman (1992, 383) clarifies that there is no obvious measure of actual (in practice) independence as opposed to legal Central

Bank independence. He points out that this is not because it is not important, but "because it is difficult to find a group of systematic measures of actual independence when this diverges from legal independence". He finds that the measure of legal independence and the turnover rate of the Central Bank governor differ by a larger amount in developing rather than in developed countries.

Cukierman and Webb (1995) calculate yet another variable of independence in practice which they call (political) vulnerability index. This reflects the political influence in the central bank by measuring the probability that the Central Bank governor will be replaced immediately after a political change in government. They use a sample of 67 countries for the 1950 to 1989 period. They find that in a six months period the governor changes in half of the cases after a non-radical (i.e., not related to a military rebellion, restoration of democracy or constitutional change) political change. They find that it is much less likely that the governor changes after six months of a routine transition in the Executive. There exists high variation among countries, and a large difference between developing (change in one quarter of cases) and developed countries (change in one tenth of cases). They also find that their measure is correlated with the level and variance of inflation, with real growth and with real interest rates.

The authors show that the frequency of governor changes is higher the closer the date of the political transition. They stress that the political turnover measure by itself is an imperfect measure of independence in practice. A *low* ratio does not necessarily mean high independence (in some cases such as Denmark, United Kingdom or Iceland it is; but not in others such as countries with stable authoritarian regimes). Instead, they argue that a *high* ratio does reflect low Central Bank independence, because high turnover ratios mean that the governor's period is shorter than the executive's and this makes the governor more vulnerable to the influence of the President or the political majorities. And hence will be less prone to try to implement long run policies.

De Haan and Kooi (2000) analyze Central Bank independence in practice for 82 developing countries. They conclude that (lack of) independence is only correlated with inflation if we take into account countries with large price increases. They report that independence works better in developed rather than in developing countries.[6] Table 1 summarizes the evidence.

<p align="center">Table 1
STUDIES MEASURING CENTRAL BANK INDEPENDECE IN PRACTICE
IN DEVELOPING COUNTRIES</p>

Article	Number of countries (developing)	Estimation Period	¿Does it use a legal index?	Variable measuring independence in practice
Cuikermann (1992)	68 (49)	1950-1989	YES	Turnover Rate
Cuikermann *et al.* (1992)	71 (50)	1950-1989	YES	Turnover Rate
Cuikermann and Webb (1995)	67 (47)	1950-1989	YES	Vulnerability
Akhand 1998)	62 (40)	1960-1989	YES	Turnover Rate and Vulnerability
De Haan and Kooi (2000)	82 (82)	1980-1989	NO	Turnover Rate

3. The construction of measures of independent regulation in practice

In this Section, we first explain the data collection process about the beginning and end of the period in office of the head of TRA (Telecommunications Regulatory Authority). Next we explain the construction of two variables that use the changes in the head of the agency as a measure of independence in practice: the turnover rate and the inverse of vulnerability index.

The first country in Latin America to create a TRA was Chile in 1977; subsequently, it was in the nineties that Argentina (1990), Venezuela (1991), Colombia and Peru (1994) followed. Until 2002 the remaining countries in the sub-continent created their TRA with different degrees of independence, roles and responsibilities.[7] Among the 23 countries that we analyze, in 17 of them the period in office of the TRA head is legally prescribed. Of these, the law allows for re-election in 11 cases. The average age of a TRA as of 2004 was 9 years old. Among the countries with a prescribed time limit, the shortest period is that of Colombia (16 months) and the longest is Jamaica (7 years).[8] Data on the creation of the agency and the legal prescriptions for the duration in office are useful, since they give us how many heads on average should the office have had by law. These two measures help us measure legal independence.

3.1. Data collection

To create the turnover rate and the inverse of vulnerability index in Latin American TRA it is key to have information about the exact date of beginning and end of the period in office of the head of the agency. There is no specific publication with data on regulator turnover for our countries. There are some organizations such as *Asociación Hispanoamericana de Centros de Investigación y Empresas de Telecomunicaciones* (AHCIET), the World Bank (WB), the *Comisión Interamericana de Telecomunicaciones* (CITEL), the *Foro Latinoamericano de Entes Reguladores de Telecomunicaciones* (REGULATEL), the International Telecommunications Union (ITU), or the Caribbean Telecommunications Union (CTU), where the TRA report data, news of interest and new laws and regulations, but in no case do they report with periodicity about changes in the head of the agency.[9]

Therefore, to obtain the necessary data we resorted mainly to three groups of sources:

i)   The TRA's themselves. In some cases, in their web pages there are press bulletins, decrees, contracts, speeches or notes about the beginning and/or end of the time in office of the head.[10, 11]

ii) Data bases of news about the region, such as *ISI Emerging Markets, ProQuest* and *Lexis-Nexis*. We also used the press of every country as well as contact with some analysts or local telecommunications research centres.[12]

iii) Bulletins and web pages of the above mentioned organizations AHCIET, ITU and REGULATEL.[13]

We obtained complete data on the beginning and end of the director or chair person of the agency for 23 countries in the Latin America and Caribbean region for the period between 1990 and 2004.[14]

There is no precedent in the literature for measuring the independence in practice of TRA's. Taking then as a benchmark the above mentioned studies on Central Bank independence, we construct two variables that try to reflect the independence in practice through (i) the change or turnover of the director/chair of the TRA, namely the number of average months that the head of office remains in his job, and based on this the frequency of change of regulator per year, and (ii) the inverse index of political vulnerability, that is, the number of months that elapse between a change in the country's executive power and a change in the direction of the agency.

3.2. Turnover rate

The turnover rate measures the average actual duration in months of the time in office of the director or chair of the agency. It is a simple and interesting figure. In many cases, the regulator does not complete the prescribed period in office.[15] The average duration of a regulator in Latin American and Caribbean TRA's in the period 1990 to 2004 is approximately two years and a half, being those of lowest duration those in Colombia, Nicaragua and Argentina and those of highest duration those in Belize, Peru and Jamaica (see Table 3). Notice that the most stable countries are former British colonies and Chile.

The turnover rate does not distinguish amongst the reasons behind the change of the regulator. It only captures the effect of any type of changes, from the end of the legal period to resignations or removals for different reasons which diminish the effective time in the direction of TRA's relative to what is prescribed by law.[16] We also computed the frequency of change, which denotes the average turnover per year in the TRA's, a high frequency signalling continuous changes of regulator.

Note that the prescribed time in office can usually be evaded without violating the law, but clearly affecting the degree of independence.[17] If we focus on the 17 countries which have a period established by law, only in four of them the regulator completed the full period: Belize, Jamaica, Uruguay and Peru (which actually goes beyond the prescribed period), and the remainder (with the exception of Bolivia, Colombia and Surinam), stay in approximately half of the prescribed period (see Table 4).

3.3. Political Vulnerability Index

As mentioned above, Cukierman and Webb (1995) present an index of political vulnerability for Central Bank governors for countries all over the world. They argue that computing the turnover rate of the governor relative to political changes is important to evaluate the size and effect of these in the frequency of regulatory turnover. They think of this index as

a measure of political influence. Thus, the formula of the index of (inverse) political vulnerability of TRA's is defined for each country as the fraction of political transitions that are not quickly followed by a replacement in the director/chair of agency:

$$V(i) \equiv \frac{\text{Number of regulators that stay in his or her position for } i \text{ months after a political transition}}{\text{Number of political transitions}}, i = 1,6,12 \qquad (1)$$

Cukierman and Webb (1995) use in the numerator the number of political replacements, whereas we use the number of regulators that stay in his or her position for *i* months after a political transition. The reason for the change is that we want to give a higher score to less political influence in TRA. When measuring turnover in the head of TRA's in Latin America, we find that in 61% of occasions there is a change in the head of the agency within 1 month. If we take six months, in 73% of times in which there is a change in president there is turnover in the head of the TRA. If we take one year, the ratio rises to 88% (see Table 2).

Table 2
TURNOVER IN THE POSITION OF HEAD OF TRA
PERIOD: 1990-2004

Country	Turnover (number of months since political transition)							
	0-1	2-3	3-4	4-5	6-7	8-9	10-11	12 or more
1 Argentina	2	1						
2 Barbados								1
3 Belice								0
4 Bolivia				1				1
5 Brasil								1
6 Chile	3							
7 Colombia	1	1				1		
8 Costa Rica	2							
9 Dominican Rep.	2							
10 Ecuador	4			1				
11 El Salvador	2							
12 Guatemala	2							
13 Honduras		1					1	
14 Jamaica								1
15 Mexico							1	
16 Nicaragua	2							
17 Panama	1			1				
18 Paraguay	1					1		
19 Peru					1			
20 Surinam	2							
21 Trinidad and Tobago								0
22 Uruguay								0
23 Venezuela	1							1
Add	25	3	0	2	2	2	2	5

Note: We only compute one change of agency head per political transition.

With the above mentioned information about turnover in TRA's, we have chosen one, six and twelve months after a political change in the country as periods of analysis for our sample. The index of inverse vulnerability for the average of 23 analyzed countries in Latin America and the Caribbean shows that TRA's are 21% more vulnerable after 6 months relative to 1 month, and 9% more vulnerable after 1 year relative to six months (see Table 3).[18]

Table 3
INVERSE INDEX OF POLITICAL VULNERABILITY OF TRAs, TURNOVER RATE (Average months in the job) AND FREQUENCY OF CHANGES PER YEAR PERIOD: 1990-2004

Country	Inverse of Vulnerability in			Turnover Rate (months)	Frecuency of Changes (per year)
	1 month	6 months	12 months		
All Latin America	*0.59*	*0.47*	*0.38*	*30*	*0.40*
1 Argentina	0.33	0.00	0.00	16	0.73
2 Barbados	1.00	1.00	1.00	24	0.50
3 Belice	1.00	1.00	1.00	72	0.17
4 Bolivia	1.00	0.75	0.75	40	0.30
5 Brasil	1.00	1.00	1.00	24	0.50
6 Chile	0.00	0.00	0.00	36	0.33
7 Colombia	0.67	0.33	0.00	13	0.91
8 Costa Rica	0.00	0.00	0.00	22	0.56
9 Dominican Rep.	0.00	0.00	0.00	21	0.57
10 Ecuador	0.20	0.00	0.00	20	0.60
11 El Salvador	0.00	0.00	0.00	22	0.56
12 Guatemala	0.00	0.00	0.00	22	0.56
13 Honduras	1.00	0.50	0.00	18	0.67
14 Jamaica	1.00	1.00	1.00	60	0.20
15 Mexico	1.00	1.00	0.00	27	0.44
16 Nicaragua	0.00	0.00	0.00	15	0.80
17 Panama	0.50	0.00	0.00	27	0.44
18 Paraguay	0.67	0.67	0.33	22	0.56
19 Peru	1.00	0.50	0.50	66	0.18
20 Surinam	0.00	0.00	0.00	42	0.29
21 Trinidad and Tobago	1.00	1.00	1.00	18	0.67
22 Uruguay	1.00	1.00	1.00	48	0.25
23 Venezuela	0.67	0.67	0.67	24	0.50

Source: Computed by the authors.

Among the weaknesses of the index of inverse vulnerability for TRA's, one is that it does not take into account those changes in the regulator during the remainder of the presidential period and which have a political motivation, be it because it took place after 1 year since the political transition, or because there has been more than one change of regulator during one president's period. In some of these cases, they are forced resignations for political motives or rivalries which do not involve a change in the executive.[19] There are also changes in the regulator due to cabinet reshuffles, promotions or resignations to run for elect-

ed jobs.[20] There are also interesting cases of directors who resign to find a job in the firms that they previously regulated, what is known in the literature as "revolving doors phenomenon".[21] These changes are not reflected in the index of inverse vulnerability, but the turnover rate or the frequency of changes does capture them.

Another situation that is not measured in the vulnerability index are those cases where the head of the agency is a member of the Executive (vulnerability 0.00) but where the period in office is longer than the region's average, especially in countries with high stability in their cabinets and presidential periods.[22]

3.4. Indices of Independence in Law and in Practice (LPI and LPI-A)

The vulnerability index has a limitation when it comes to its use in statistical analysis: it is an average figure for all the studied period, so that it only takes one value for the fifteen years of the period. This limitation causes poor estimation results. In order to overcome this limitation, we have created an Index of Independence in Law and in Practice (LPI), which combines the time-varying legal Index of Regulatory Independence (IRI) shown in Montoya and Trillas (2007)[23] and the index of inverse vulnerability (one month), through the product of both indices. As a result, the LPI is an index that varies over time and that captures the independence in law and in practice, being the first index of this type in the literature. It takes into account the same information as IRI (or indices that are shown in Montoya and Trillas, 2007, to be highly correlated with this, such as the one presented in Gutiérrez, 2003a), and it adds for the first time information about the degree of independence relative to the political majorities.

We have also created an Index of Independence in Law and Practice –Accomplishment (LPI-A) for 17 countries, which combines the time-varying Index of Regulatory Independence (IR1) and the turnover rate (see table 4), through the product of both indices.

LPI-A measures legal and practice independence in a different way, by combining information on the actual fulfilment of norms, rules and laws concerning the time in office. LPI-A has a piece of information which is not provided by LPI: the changes in the direction of TRAs after more than one year since the new president or prime minister took office.

If we compare the behaviour of countries for both indices we find cases of countries which keep in his position the director and respect the legally established period and countries that do not respect either of these.[24] There are cases where the new government must appoint a new TRA director by legal mandate, but it respects to some extent the duration of the period established by law.[25]

By computing the relationship between the executive and the agency for all the government's tenure and not only in the first months, LPI-A corrects for one of the weaknesses previously mentioned for LPI.

Table 4
DURATION OF TRA's HEADS BY LAW vs. TURNOVER RATE
(Only countries with duration prescribed by law)
PERIOD: 1990-2004

Country	Legally precribed (years)	Legally precribed (months)	Turnover Rate (months)	Accomplishment
All Latin America (17)	*4*	*54*	*32*	*60%*
1 Argentina	5	60	16	27%
2 Barbados*	4	48	24	50%
3 Belice	6	72	72	100%
4 Bolivia	5	60	40	67%
5 Brasil	5	60	24	40%
6 Colombia	1.3	16	13	81%
7 Costa Rica	4	48	22	46%
8 Dominican Rep.	4	48	21	44%
9 Ecuador	4	48	20	42%
10 El Salvador	7	84	22	26%
11 Honduras	4	48	18	38%
12 Jamaica	5	60	60	100%
13 Paraguay	5	60	22	37%
14 Peru	5	60	66	110%
15 Surinam	5	60	42	70%
16 Trinidad y Tobago	3	36	18	50%
17 Uruguay	4	48	48	100%

* The years by law in Barbados are 5 and in Uruguay 6, but we only count 4, from its creation in 2001 to the final year of our simple, 2004
Source: Computed by the authors.

3.5. Correlation Matrix

In Table 5 we show the correlation matrix of the variables of independence in practice, taking into account vulnerability at one month, six months and one year. We also show correlations with LPI, LPI-A and IR1.

Table 5
CORRELATION MATRIX

	Practice					Legal
	Vulnerability Index. 1 month	Vulnerability Index. 6 month	Vulnerability Index. 12 month	LPI	LPI-A	IR1
Vulnerability Index. 1 month	1.00					
Vulnerability Index. 6 month	0.92	1.00				
Vulnerability Index. 1 month	0.76	0.86	1.00			
Legal & Practice Index (LPI)	0.91	0.81	0.74	1.00		
Legal & Practice Index Accomplishment (LPI-A)	0.83	0.73	0.70	0.83	1.00	
Independence Regulation (IR1)	0.55	0.40	0.39	0.77	0.68	1.00

Source: Author's calculations.

The three indices of inverse vulnerability are highly correlated and the closer the time periods that are compared (one month with six months, and six months with one year), the values get closer to unity, which shows us that they are measuring basically the same phenomenon.

The two indices that measure both legal independence and independence in practice, LPI and LPI-A, are positively correlated with the inverse vulnerability measures, since the indices included the measure of vulnerability. Their correlations with IR1 are positive, but far from unity, which suggests that those independence indices, while not being necessarily contradictory, measure different phenomena.

IR1 and the vulnerability indices have a positive but low correlation, showing that these indices do not measure the same phenomenon. This clearly suggests that the indices of independence in practice do add information which is not contained in the legal indices.

4. The impact of independence

4.1. Econometric Approach

The purpose of this section is to use the indices constructed in the previous section to perform similar exercises to those that have been carried out with legal indices of regulation. To analyze the impact of independence on telecommunications performance, the general model we use can be expressed as:

$$Y_{it} = B_{1it} + B_2 X_{2it} + B_3 X_{3it} + B_{it} \tag{2}$$

where $X_{it} = (X_{2it}, X_{3it}, \dots X_{Kit})$ are the explanatory variables, including an independence index and control variables. $B = (B_1, B_2, \dots B_K)$ are their respective coefficients and μ_{it} is an error term. We use individual fixed and random effects for the 23 (LPI) and 17 (LPI-A) countries.

The error term is modelled as:

$$\mu_{it} = \mu_i + \mu_{it} \tag{3}$$

where μ_i denotes non-observable individual effects and v_{it} denotes the remainder of the residual.

This is a reduced form model, where the performance variable is the equilibrium value of fixed lines penetration in telephony. In equilibrium, the determinants of this performance include, besides regulatory conditions, supply and demand factors, mainly population density determining cost conditions and GDP per capita determining demand. Following Gutierrez (2003) we do not use price data, because this is difficult to obtain to perform cross coun-

try comparisons, and because it would be endogenous, and its inclusion would require a fully developed structural model, which is beyond the scope of our exercise.

4.2. The performance variable

The performance dependent variable Y_{it} in equation (1) is fixed telephone lines for every 100 inhabitants, obtained from the International Telecommunications Union data base. The indices, LPI and LPI-A, are our main explanatory variables of interest. Since one of the goals of our exercise is to compare the impact of our independence variables with legal independence variables previously used in the literature, we use the same dependent variable as these previous studies (such as Gutierrez, 2003a), namely, fixed lines per 100 inhabitants.

This is certainly not an ideal performance variable, as it would be for example total surplus in the telecommunications markets. However, fixed lines penetration is a commonly used variable in this empirical literature, as shown in the papers by Wallsten (2003), Ros (2003) and Gutierrez (2003a and b). It has the advantage that it is easy to obtain and comparable across countries. It is obviously related to investment levels, which fits with the theoretical framework on the necessary credibility of institutions to sustain investment.

It would also be interesting to test the impact of independence on the penetration of new services, such as mobile telephony and broadband Internet access. However, for most of our sample years (1990-2004) fixed telephony was the main telecommunications market in the countries we analyze, and the penetration of fixed telephony still experienced many problems and wide variabilility (as graph 1 shows for a selection of countries). Noll (2000) men-
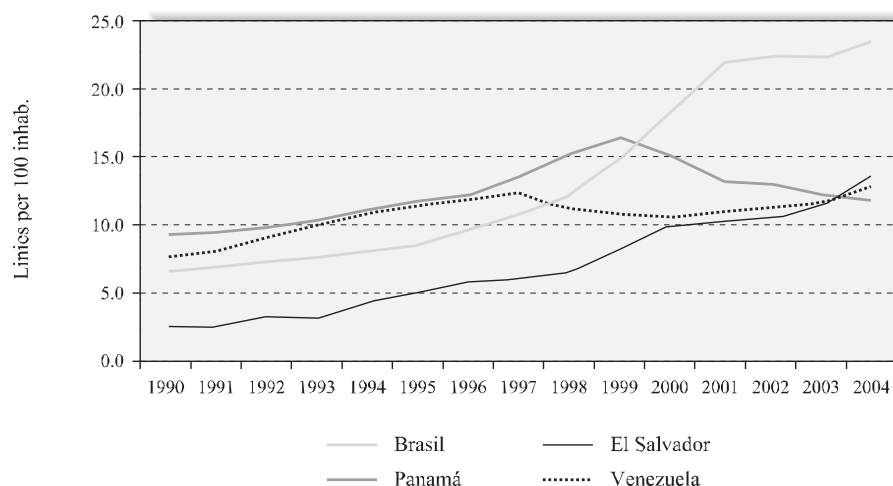
Graph 1. Main telephone lines per 100 inhabitants. Four LA countries

tions that a typical problem (one which precisely triggered the privatization and regulatory reform wave of the 1990s) in regulated sectors of developing countries was the lack of a good and reliable fixed telephony system.

We recognize that a careful analysis of the impact of regulatory independence on mobile and broadband markets is an important task for future research. Preliminary results along these lines [26] show that independence has also a positive impact on these markets. An advantage of the analysis using only fixed lines is that fixed telephony, at least for most of our sample years and countries, is mainly a monopoly, so that we can focus on regulatory variables and we do not lose much by ignoring competition measures. Such measures, however, become crucial if we analyse new telecommunications markets.

4.3. Control and instrumental variables

Along the lines of other work in this field [27], we use GDPppp per capita (GDPppp), Exports plus Imports as percentage of GDP (XMgdp) and Density (people per sq-kilometre), as control variables. We obtained those variables from the data base of the World Bank. We expect that an increase in income per capita and/or trade are associated with higher demand for telephone services. We also expect that a higher population density in the country is related to lower average costs for telephone services.

Due to possible correlation between LPI and the error term μ_{it}, we use instrumental variables and test for endogeneity using the Hausman test. To find suitable instruments, we need to find variables that have an independent effect on independence but that are not correlated with network expansion. We consider the following eight candidates as instrumental variables:

i)   The TRA'Year of President. The tenure of presidents or prime ministers.
ii)   The TRA'Democratic Age.
iii)   The TRA'Herfindahl Index of the Legislature. [28, 29]
iv)   The TRA'Political Constraints (PolCon III), measuring the probability of policy reversals. [30, 31]
v)   The TRA'Economic Freedom Index, measuring if a country is open to free enterprise.
vi)   The TRA'Overall Regulation, measuring an improving regulation of credit, work and businesses. [32, 33]
vii)   The TRA'The total number of full time employees in the telecommunications companies. [34, 35]
viii) The TRA'The legal origin of the country, based on La Porta et al (2002), with a value of 1 when the origin is English or Dutch, and zero when it is French. This variable proxies for the degree of interventionism of the state in economic matters. [36, 37]

Table 6
PARAMETER ESTIMATES FOR MAIN LINES PER 100 INHABITANTS. 23 COUNTRIES. 1990-2004

Regressors	Fixed Effects. All variables as exogenous	Random Effects. All variables as exogenous	2SLS Fixed-Effect with Endogenous Independence						2SLS Random Effects with Endogenous Independence	
	1	2	3	4	5	6	7	8	9	10
LPI	6.594*	7.728*	20.313*	17.168*	12.700	0.169	10.003*	-4.165	13.645*	34.938
t	7.75	8.85	3.07	10.34	1.27	0.03	3.90	-0.42	6.82	0.10
GDPppp	0.002*	0.002*	0.001**	0.001*	0.002*	0.003*	0.002*	0.003*	0.002*	-0.001
t	8.44	11.28	1.72	4.01	1.75	4.66	5.81	3.54	5.07	-0.00
XMgdp	0.010	0.056**	0.060***	0.049***	0.042	-0.014	0.022	-0.030	0.036	0.114
t	0.34	2.16	1.35	1.42	0.93	-0.37	0.74	-0.60	1.14	0.09
Density	0.179*	0.0123**	0.129*	0.141*	0.155*	0.203*	0.167*	0.219*	0.154*	0.076
t	7.22	1.66	3.15	4.59	3.45	5.72	6.20	4.61	5.46	0.06
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sqr	0.47	0.74	0.45	0.46	0.47	0.46	0.47	0.46	0.46	0.29
Hausman	55.2†		351.1‡	15.375,9‡	355.2‡	359.9‡	271.9‡	375.6‡	212.4‡	439.9‡
N-obs	345	345	345	345	322	345	345	345	345	345
Instrument used	–	–	Years President	Democr. Age	Herfi Index-1	PolCon III	Eco Free Index	Overall Index	Staff	Legal Origen

Notes: * Statistically significant at 1%.
    ** Statistically significant at 5%.
    *** Statistically significant at 10%.
Hausman Test to Ho: † Fixed Effects vs Random Effect.
    ‡ The explanatory variable is not endogenous.

Table 7
PARAMETER ESTIMATES FOR LOG MAIN LINES PER 100 INHABITANTS. 23 COUNTRIES. 1990-2004

Regressors	Fixed Effects. All variables as exogenous	Random Effects. All variables as exogenous	2SLS Fixed-Effect with Endogenous Independence						2SLS Random Effects with Endogenous Independence	
	1	2	3	4	5	6	7	8	9	10
LPI	0.672*	0.799**	1.280*	1.671*	0.154	2.497*	2.081*	3.965**	1.133*	4.936
t	10.19	10.21	2.90	12.05	0.19	3.01	6.60	1.79	7.43	0.08
GDPppp	0.001*	0.001*	0.001	0.001	0.001***	-0.001	-0.001	-0.001	0.001*	-0.001
t	4.59	7.45	1.07	0.48	1.45	-0.70	-0.49	-0.90	2.32	-0.05
XMgdp	0.001	0.006*	0.003	0.004***	0.001	0.007***	0.006**	0.013	0.002	0.017
t	0.28	2.32	0.99	1.54	0.31	1.49	1.68	1.23	0.99	0.07
Density	0.026*	0.002*	0.023*	0.022*	0.027*	0.019*	0.020*	0.013***	0.024*	0.010
t	13.37	2.75	8.66	8.60	7.60	4.03	6.38	1.32	11.28	0.04
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sqr	0.63	0.47	0.54	0.37	0.55	0.12	0.13	0.05	0.58	0.28
Hausman	177.1†		76.3‡	445.3‡	77.9‡	43.6‡	447.3‡	4.108,3‡	304.1‡	91.4‡
N-obs	345	345	345	345	322	345	345	345	345	345
Instrument used	–	–	Years President	Democr. Age	Herfi Index-1	PolCon III	Eco Free Index	Overall Index	Staff	Legal Origen

Notes: * Statistically significant at 1%.
         ** Statistically significant at 5%.
         *** Statistically significant at 10%.
Hausman Test to Ho: † Fixed Effects vs Random Effect.
                      ‡ The explanatory variable is not endogenous.

4.4. Results

In each table, we first estimate the equation by OLS with fixed effects (1) and with random effects (2). Next we use 2SLS in the regressions where independence (LPI or LPI) is assumed endogenous and instrumental variables (IV) are used. First this is done with fixed effects (3 to 9) and finally with random effects (10). We also used a semi-logarithmic model (Tables 7 and 9).

For the 15 years and 23 countries of our sample, Table 6 shows that higher independence (both legal and in practice) is associated with higher network expansion. In equations 1 to 4, 7 and 9 the coefficient for independence is positive and statistically significant.[38] The semi-log equation on Table 7 also shows that legal and practice independence is associated with higher network expansion. In equations 1 to 4 and 6 to 9 the coefficient for independence is positive and statistically significant.

The results confirm those reported in most of previous studies[39]. However, most of the coefficients are between 5 and 200 per cent higher than in the results of Montoya and Trillas (2007), where the model is estimated taking into account only legal independence. Hence, measuring independence without taking into account *de facto* information tends to under-estimate the impact of independence on telecommunications performance.

On Tables 6 and 7, the LPI independence index has a significant and positive effect in equations (1) and (2). The null hypothesis of rejecting random effects through the Hausman test shows that the hypothesis is rejected at the 1% significance level.

In the four regressions, GDP per capita and Trade are positive and significant determinants of network expansion, but the magnitude of the effect is low: a one thousand dollar increase in income per capita is associated to a very small growth in the network. The results for this variable coincide with those obtained by Ros (1999 and 2003) and Gutierrez (2003a), suggesting that the income elasticity of fixed telephony demand is quite low after some minimum threshold is achieved. Density has a positive, small and significant effect (equations 1 to 9). These results are also along the lines of previous studies.

The Hausman test shows that the null hypothesis of exogeneity cannot be rejected. This result is consistent with other studies on the impact of regulatory policies.[40] We report nevertheless the results with IV in equations (3) to (10). Given that the Hausman test is contingent on the use of specific instruments, it could well be that better instruments should be tried.

The results of equations using the LPI-A (Tables 8 and 9) for 17 countries do not differ much from those obtained with LPI. The independence coefficients stay positive and significant in most equations. The control variables for income, international trade and population density show as well similar coefficients than in previous regressions. Significance levels for these control variables are slightly tighter, but bear in mind that the sample now is smaller: six countries and 90 observations less.

Table 8
PARAMETER ESTIMATES FOR MAIN LINES PER 100 INHABITANTS. 17 COUNTRIES. 1990-2004

Regressors	Fixed Effects. All variables as exogenous	Random Effects. All variables as exogenous	2SLS Fixed-Effect with Endogenous Independence						2SLS Random Effects with Endogenous Independence	
	1	2	3	4	5	6	7	8	9	10
LPI	7.138*	7.927*	16.795*	18.230*	11.391***	-0.461	10.648*	-8.881	31.389	31.637
t	7.15	7.72	3.66	9.57	1.52	-0.07	4.57	-0.74	0.66	0.51
GDPppp	0.002*	0.002*	0.001	0.001***	0.01***	0.003*	0.002*	0.004	-0.001	-0.001
t	5.18	8.24	1.21	1.33	1.33	3.45	3.38	2.58	-0.16	-0.09
XMgdp	-0.027	0.064**	0.016	0.023	0.007	-0.061	-0.011	-0.099	0.082	0.092
t	-0.65	1.68	0.31	0.44	0.13	-1.14	-0.26	-1.23	0.36	0.38
Density	0.198*	0.011***	0.173*	0.170*	0.183*	0.217*	0.189*	0.238*	0.137	0.095**
t	6.60	1.41	4.67	4.57	5.01	5.90	6.06	4.52	1.04	1.84
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sqr	0.46	0.74	0.42	0.41	0.45	0.48	0.45	0.49	0.28	0.25
Hausman	51.9†		229.8‡	1.591,3‡	232.2‡	240.8‡	162.4‡	261.3‡	247.4‡	330.8‡
N-obs	255	255	255	255	240	255	255	255	255	255
Instrument used	–	–	Years President	Democr. Age	Herfi Index-1	PolCon III	Eco Free Index	Overall Index	Staff	Legal Origen

Notes: * Statistically significant at 1%.
      ** Statistically significant at 5%.
      *** Statistically significant at 10%.
Hausman Test to Ho: † Fixed Effects vs Random Effect.
           ‡ The explanatory variable is not endogenous.

Table 9
PARAMETER ESTIMATES FOR LOG MAIN LINES PER 100 INHABITANTS. 17 COUNTRIES. 1990-2004

Regressors	Fixed Effects. All variables as exogenous	Random Effects. All variables as exogenous	2SLS Fixed-Effect with Endogenous Independence						2SLS Random Effects with Endogenous Independence	
	1	2	3	4	5	6	7	8	9	10
LPI	0.766*	0.836*	1.304*	1.632*	-0.219	1.893*	1.722*	2.409**	4.223	4.427
t	11.14	10.17	4.24	11.86	-0.31	3.44	7.91	1.86	0.60	0.45
GDPppp	0.001**	0.001*	-0.001	-0.001***	0.001***	-0.001	-0.001***	-0.001	-0.001	-0.001
t	1.97	5.00	-0.23	-1.34	1.46	-1.07	-1.39	-0.88	-0.43	-0.31
XMgdp	-0.001	0.006**	0.002	0.003	-0.002	0.004	0.003	0.007	0.015	0.016
t	-0.31	1.93	0.46	0.83	-0.33	0.88	0.88	0.84	0.45	0.38
Density	0.024*	0.002*	0.022*	0.022*	0.026*	0.021*	0.021*	0.020*	0.015	0.012
t	11.61	2.35	9.22	8.07	7.74	6.29	7.56	3.85	0.76	0.78
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sqr	0.65	0.48	0.56	0.42	0.32	0.25	0.36	0.11	0.01	0.35
Hausman	134.1†		13.9‡	358.4‡	245.1‡	2.37‡	395.3‡	1.111.0‡	33.9‡	23.2‡
N-obs	255		255	255	240	255	255	255	255	255
Instrument used	–	–	Years President	Democr. Age	Herfi Index-1	PolCon III	Eco Free Index	Overall Index	Staff	Legal Origen

Notes: * Statistically significant at 1%.
         ** Statistically significant at 5%.
         *** Statistically significant at 10%.
Hausman Test to Ho: † Fixed Effects vs Random Effect.
         ‡ The explanatory variable is not endogenous.

The comparison between estimations using LPI and LPI-A suggest that both indices measure the same phenomenon although with slightly different information. Countries which change the regulator immediately after a change of administration, and countries that have difficulties in respecting the legally established time period for regulators, will likely face difficulties in encouraging investment to expand telephone lines.

5. Conclusions

This article takes the suggestion made in the conclusions of several empirical studies on the measurement and impact of regulatory independence, and makes the first effort to measure the practice of regulatory independence in TRA's. The literature has evolved from a seminal stage where independence was measured using a dummy 0-1 variable, to a stage where the use of legal *de jure* independence indices has become quite common. Gutierrez (2003a) is perhaps the study that has made most progress along these lines.

We take this evolution one step forward, by

i)   Obtaining detailed information about the practice of independence in 23 Latin American and Caribbean countries between 1990 and 2004.
ii) Constructing with this information two indices of independence that combine legal and practice issues, borrowing from the methodology used in the Central Bank Independence literature.
iii) Quantifying the impact of this better measured regulator independence on network penetration.

For example, the legal indices used so far computed the prescribed number of years that the head of agency was allowed to stay in office. With our index, we correct this legal prescription with the actual time period that the regulator is in office. Estimation results confirm that regulator independence is associated to higher network penetration. However, the impact would be underestimated if we only took into account a legalistic definition of independence.

Our results on the impact of independence give an accurate picture of commitment difficulties to the extent that countries do not vary their ability to respect regulator independence for the whole sample period. This is because the legal part of our index varies over time, but the practical part is an average. A limitation of our study is that we only compute the ability to commit relative to investments in fixed telephony. We leave the study of the impact of independence on mobile telephony penetration and broadband infrastructures for future research. The work done so far, however, illustrates quite clearly the weaknesses of purely legalistic approaches.

Notes

1. See Levy and Spiller (1996).

2. Stern and Cubbin (2003), Pargal (2003), Edwards and Wavermann (2006), Gual and Trillas (2004 and 2006) and Montoya and Trillas (2007) are representative of the line of research that construct mainly legal indices and acknowledge the need for indices of independence in practice. See also Gutierrez (2003a), Ros (1999 and 2003), Viani (2006), Wallsten (2003), Ai *et al.* (2004) and Fink, Matto and Rathindran (2002).

3. See Eijffinger and De Haan (1996), De Haan and Kooi (2000) and Arnone, Laurens and Segalotto (2006).

4. Levine *et al.* (2005, 463) argue that "the fundamental rationale for an independent utilities regulator and an independent central banker is extremely similar".

5. Levine *et al.* (2005) also point out notable differences between the task of strategically delegating into a central banker and a regulator: slow asset depreciation and slow demand growth, compounded by a multiplicity of tasks, make the challenge of delegating into an independent regulator more difficult than delegating into an inflation averse central banker.

6. See also Akhand (1998).

7. In seven countries in the sample, the same agency also regulates other industries (such as electricity, water, or postal services). For the purposes of this study, we use the acronym TRA to denote telecommunications regulatory agencies, even in the case that the same agency regulates other industries.

8. See Table A1 in the Appendix.

9. For more information and data about the index construction see Montoya & Trillas (2008).

10. For an analysis comparing the web sites of TRA in Latin America and the Caribbean, see Mahan (2005).

11. In the case of Belize the consultation with the TRA was by telephone.

12. In the case of Mexico, for example, we contacted the *Instituto del Derecho de las Telecomunicaciones* (IDET), the *Programa de Investigación de las Telecomunicaciones* from *Centro de Investigación y Docencia Económica* (CIDE) and a specialised editorialist in newspaper *Reforma*.

13. Their web pages are: http://www.ahciet.net (AHCIET), http://www.itu.int (ITU), http://www.regulatel.org (REGULATEL).

14. For Haiti and Guyana it was impossible to obtain complete data for the period. We also exclude Cuba and Puerto Rico for their specific political or market characteristics.

15. There are some striking examples in the region. Argentina changed the regulator almost a dozen times since the creation of the agency in 1990, including two interventions (2002 y 2004) where the government removed the board and assigned a controller who took charge of the application of government's policy in the sector. In Ecuador, between 1995 and 2004 there were six presidents in the country and the same number of regulators.

16. The local press mentioned colourful scandals around some turnover episodes, such as one of telephone spying related to France Telecom in El Salvador, or due to alleged nepotism in Panama, where the spouse of the private secretary of the country's president was appointed as regulator. There are also cases of removals in Mexico or Peru due to bad practices to benefit the incumbent firm.

17. For example, in Costa Rica the general regulator is appointed by the executive by law and for the same period as the president, allowing for re-election, but there is no re-election for the country's president. In practice, the regulator has never been re-elected. Another potentially interesting issue is that the retirement age can be a way to appoint an official for a short period of time, as the Pravas (2003) report suggests for the case of India. For Latin America and the Caribbean, only Belize prescribes 55 years old as the retirement age, but it has not affected the period in office of the regulator. There can also be changes in the regulator by changing the rules

of the agency. For example, in the case of Mexico, a new president in the country can change the rules (something the executive can do) without being necessary to change the law and after changing the commissioners.

18. Barbados, Brazil and Jamaica are the only Latin American and Caribbean countries where the new country's president kept the same director at least for one year after taking office. In Dominican Republic, Ecuador, El Salvador and Guatemala when the president takes office, by law, the president must choose a new agency's head.

19. One of the most representative cases is Argentina, where there have been 11 directors of CNC (previously CNT) in our period, and we only counted three for the index. Only in the presidency of Carlos Menem there were 7 different directors. The local press also reflects other cases of political pressures to force the resignation of the director, like in Bolivia, Brazil and Panama; or resignations due to differences amongst cabinet ministers, like in Chile; or resignations due to a change in party membership of the head of the agency, like in Nicaragua.

20. We find examples in Mexico, where a director became cabinet minister; in Nicaragua and Venezuela two regulators became ministers. In Paraguay one agency head resigned to run for Parliament elections.

21. In Nicaragua a Director General became executive of the country's subsidiary of the Spanish electricity firm Unión FENOSA. In Panama a former regulator founded and chaired a local and long distance telecommunications firm; in Colombia a former commissioner founded a consulting firm working for a cellular telephony firm; in Paraguay the government appointed the president of the agency as director general of the state-owned telecommunications monopoly. For an analysis of the revolving door phenomenon, see for example Che (1995) and Salant (1995).

22. Chile is the clearest of these cases. It has a low inverse vulnerability index, but the period in office of the telecommunications deputy secretary (the non-independent regulator, actually a cabinet minister) is longer than the region's average. For our period, in this country there has been only one regulator that has not finished his period with the country's president.

23. IRI has 10 components which measure legal independence, along the same lines as the indices of Edwards and Waverman (2006) and Gual and Trillas (2004 and 2006).

24. In the first case we find Bolivia, Peru and Jamaica. In the second we find Argentina and Paraguay.

25. Surinam is an example where the director is appointed in the first month of the new government and stays in his position for 42 months on average (the fourth that stays for longer in the region) of the 60 established by law. In Colombia the duration by law is 16 months and the real duration is 13 months.

26. Reported in Montoya (2007) where it is shown in a simple econometric exercise that independence in practice has a positive and significant impact on the penetration of mobile telephony and broadband.

27. See Gutierrez (2003a), Ros (1999) and Wallsten (2003).

28. These data come from the "Political Institutions Data Base" of the World Bank. See Beck *et al.* (2001) and http://www.worldbank.org/wbi/governance/other_data.html

29. For the study of telecommunications, this data base has been used by Li and Xu (2002).

30. The data base on "policy constraints" due to Henisz (2000) is based on four variables that help estimate the probability of policy reversal for the period between 1900 and 2004, for 234 countries.

31. For the study of the privatization, liberalization and regulation of telecommunications, it has been used by Henisz and Zeller (2001), Gual and Trillas (2004 and 2006) and mentioned by Gutierrez (2003b). Henisz, Zelner and Guillen (2005) create and use a data base with three variables to measure (formal) regulator independence, competition and privatization for 205 countries in the period 1960-1999. Both data bases can be obtained in http://www-management.wharton.upenn.edu/henisz/

32. The Fraser Institute creates, for 129 countries in the period 1970-2004, the data base about "Economic Freedom in the World", with 29 variables, related to i) government size; ii) legal structure and safety of property rights; iii) access to safe money; iv) freedom of trade; v) regulation of credit, work and businesses. See Gwartney and Lawson (2005) and http://www.freetheworld.com/

33. These indices have been used for the study of telecommunications by Gutierrez (2003b).

34. The International Telecommunications Union (ITU) publishes its own data base with 83 input and performance variables for 150 countries. See http://www.itu.int/home/index.html.

35. Efficiency data have been used by Ros (2003), Gual and Trillas (2004 and 2006) and by Gutierrez (2003a).

36. The data base reported in La Porta et.al (2002) informs about the legal origin of countries' institutional systems.

37. In the study of telecommunications Gual and Trillas (2004) have used this data base. La Porta has also participated in the construction of a data base containing 20 variables about governance, institutions and social issues for 135 countries between 1960 and 2000 in Glaeser *et al.* (2004). These data have not been used in the study of telecommunications, to our knowledge. Both data bases can be found in http://mba.tuck.dartmouth.edu/pages/faculty/rafael.laporta/publications.html

38. In all equations we also used year dummy variables without significant changes in the results.

39. See Gutierrez (2003a) and Ros (2003).

40. See Ros (2003), Dewenter and Kruse (2006), Edwards and Waverman (2006) and Viani (2006).

References

AHCIET (Asociación Hispanoamericana de Centros de Investigación y Empresas de Telecomunicaciones) (2003), "La Regulación de las Telecomunicaciones en Iberoamérica", Madrid.: AHCIET.

Ai, C.; Martinez, S. and Sappington, D. (2004), "Incentive Regulation and Telecommunications Service Quality" Journal of Regulatory Economics 26:3 263–285, and its "Technical Appendix to Accompany (…)." http://bear.cba.ufl.edu/sappington/.

Akhand, H. A. (1998), "Central Bank Independence and Growth: A sensibility Analysis", *Canadian Journal of Economics,* 31: 303-317.

Arnone, M.; Laurens, B. and Segalotto, J. (2006), "The Measurement of Central Bank Autonomy: Survey of Models, Indicators, and Empirical Evidence", *IMF Working Paper,* WP/06/227.

Beck, T.; Clarke, G.; Groff, A.; Keefer, P. and Walsh, P. (2001), "New Tools and New Tests in Comparative Political Economy: The Database of Political Institutions", *World Bank Economic Review,* 15(1), 165-176 (September).

Che, Y. (1995), "Revolving doors and the optimal tolerance for agency collusion", *RAND Journal of Economics,* 26(3), 378–397.

Cukierman, A. (1992), "Central Bank Strategy, Credibility, and Independence: Theory and Evidence", *MIT Press,* Cambridge, MA.

Cukierman, A.; Webb, S. and Neyapti, B. (1992), "Measuring the Independence of Central Banks and Its Effect on Policy Outcomes", *The World Bank Economic Review,* 6 (3), 353-398.

Cukierman, A. and Webb, S. (1995), "Political influence on the central bank: International evidence", *The World Bank Economic Review,* 9, 397-423.

De Haan J. and Kooi, W. (2000), "Does Central Bank Independence Really Matters? New evidence for developing countries using a new indicator", *Journal of Banking and Finance,* 24, 643-664.

Dewenter, R. and Kruse, J. (2006), "Calling Party Pays or Receiving Party Pays?" Helmut-Schmidt-Universität. *Discussion paper,* 43.

Edwards, G. and Waverman, L. (2006), "The Effects of Public Ownership and Regulatory Independence on Regulatory Outcomes: A Study of Interconnect Rates in EU Telecommunications", *Journal of Regulatory Economics,* 29(1), 23-67.

Eijffinger, S. and De Haan J., (1996), "The Political Economy of Central-Bank Independence", *Princenton Special Papers in International Economics,* 19. Princenton University Press.

Estache, A.; Goiecochea, A. and Manacorda M. (2006), "Telecommunications Performance, Reforms, and Governance", *World Bank Policy Research Working Paper,* 3822

Fink, C.; Mattoo, A. and Rathindran, R. (2002), "An Assessment of Telecommunications Reform in Developing Countries", *World Bank Policy Research Working Paper,* 2909.

Glaeser E.; La Porta R.; Lopez-de-Silanes, F. and Shleifer A. (2004), "Do Institutions Cause Growth?", *Journal of Economic Growth,* 9(3), 271-303.

Gual, J. and Trillas F. (2004), "Telecommunications Policies: Determinants and Impacts", *CEPR Discussion Paper,* 4578.

Gual, J. and Trillas F. (2006), "Telecommunications Policies: Measurement and Determinants", *Review of Network Economics,* 5(2), 249-272.

Gutierrez, L. (2003a), "The Effect of Endogenous Regulation on Telecommunications Expansion and Efficiency in Latin America", *Journal of Regulatory Economics,* 23(3), 257-28.

Gutierrez, L. (2003b), "Regulatory Governance in the Latin American Telecommunications Sector", *Utilities Policy,* 11: 225-240.

Gwartney, J. and Lawson, R. with Gartzke, E. (2005), "Economic Freedom of the World 2005 Annual Report", *Fraser Institute.*

Henisz, W. (2000), "The Institutional Environment for Economic Growth", *Economics and Politics*, 12(1), 1-31.

Henisz, W. and Zelner, B. (2001), "The Institutional Environment for Telecommunications Investment", *Journal of Economics & Management Strategy,* 10(1), 123-147.

Henisz, W.; Zelner, B. and Guillen, M. (2005), "Coercion, Emulation and Credibility in Policy Reform: Market Oriented Reforms in Telecommunications and Electricity, 1977-99", *American Sociological Review* (forthcoming).

International Telecommunications Union (2005), "World Telecommunication Indicators Database", 9th Edition in CD-Rom.

La Porta, R.; López de Silanes, F.; Shleifer, A. and Vishny, R. (2002), "The Regulation of Entry", *Quarterly Journal of Economics*, 117(1), 1-37.

Levine, P.; Stern, J. and Trillas F. (2005), "Utility price regulation and time inconsistency: comparisons with monetary policy", *Oxford Economic Papers,* 57, 447-479.

Levy, B. and Spiller, P. (1996), "Regulations, Institutions, and Commitment. Comparative Studies of Telecommunications", Cambridge University Press.

Li, W. and Xu, L. (2002), "The Political Economy of Privatization and Competition: Cross-Country Evidence from the Telecommunications Sector", *Journal of Comparative Economics*, 30(3), 439-462.

Marshall, M. G. and Jaggers, K. (2002), "Polity IV Project: Political Regime Characteristics and Transitions, 1800–2002, Dataset Users' Manual". Integrated Network for Societal Conflict Research (INSCR). Program Center for International Development and Conflict Management (CIDCM). University of Maryland.

Montoya M. (2007), "Independencia y Compromiso en la Regulación de las Telecomunicaciones: Una aproximación desde la economía al compromiso de los gobiernos con la independencia de las agencias de regulación en América Latina y el Caribe". Ph.D Thesis. Applied Economics Department. Universitat Autonoma de Barcelona.

Montoya M. and Trillas, F. (2007), "The Measurement of The Independence of Telecommunications Regulatory Agencies in Latin America", *Utilities Policy*, 15: 182-190.

Montoya M. and Trillas, F. (2008), "The Measurement of Regulator Independence in Practice in Latin America & Caribbean", forthcoming in *International Journal of Public Policy*.

Newbery, D. (2000), "Privatization, Restructuring and Regulation of Network Utilities", *MIT Press.*

Noll, R. (2000), "Telecommunications Reform in Developing Countries", in Anne Krueger, ed., *Economic Policy Reform: The Second Stage,* University of Chicago.

Noll, R. and Shirley, M. (2002), "Telecommunications Reform in Sub-Saharan Africa: Politics, Institutions and Performance", mimeo.

REGULATEL (Foro Latinoamericano de Entes Reguladores de Telecomunicaciones), Boletín Electrónico, several issues.

Rogoff, K. (1985), "The Optimal Degree of Commitment to an Intermediate Monetary Target", *Quarterly Journal of Economics,* 100, 1169-90.

Ros, A. (1999), "Does the Ownership or Competition Matter? The Effects of Telecommunications Reform on Network Expansion and Efficiency", *Journal of Regulatory Economics*, 15, 65-92.

Ros, A. (2003), "The Impact of the Regulatory Process and Price Cap Regulation in Latin American Telecommunications Markets", *Review of Network Economics,* Vol. 2, Issue 3.

Pargal, S. (2003), "Regulation and Private Sector Participation", in *The Limits of Stabilization,* edited by Easterly W. and Servén L., World Bank.

Salant, D. (1995), "Behind the revolving door: A new view of public utility regulation.", *RAND Journal of Economics*, 26(3), 362-377

Shirley, M.; Cowan, S. and Noll, R. (2000), "Reforming Urban Water Systems in Developing Countries", in Anne Krueger, ed., *Economic Policy Reform: The Second Stage,* University of Chicago.

Stern, J. and Cubbin, J. (2003), "Regulatory Effectiveness: The Impact of Regulation and Regulatory Governance Arrangements on Electricity Industry Outcomes: A Review Paper", *Regulation Initiative WPS,* 56, LBS.

Viani, B. (2006), "Consequences of Vertical Separation and Monopoly: Evidence from Telecom Privatization", *AEI-Brookings Joint Center for Regulatory Studies.* WP. 06-20.

Wallsten, S. (2003), "Of Carts and Horses: Regulation and Privatization in Telecomunications Reform", *Journal of Policy Reform,* 6(4), 217-231.

Walsh, C. (2005), "Central Bank Independence", Prepared for New Palgrave Dictionary. In http://econ.ucsc.edu/~walshc/

World Bank, The, (2005), "World development indicators" en CD-ROM. Washington, D.C.

Resumen

Este estudio elabora medidas del grado de independencia en la práctica de los reguladores de telecomunicaciones para 23 países de América Latina y el Caribe entre 1990 y 2004. Nos centramos en el grado en que los gobiernos son capaces de comprometerse a preservar la independencia de sus reguladores. Combinamos esta información con datos sobre independencia legal para construir índices de independencia de la regulación que son más realistas que los que se han utilizado en la literatura existente. Los resultados econométricos confirman que la independencia de la regulación tiene un impacto positivo sobre el desempeño del sector de las telecomunicaciones, pero los índices puramente legales infravaloran este impacto.

Palabras claves: regulación, independencia, delegación estratégica, telecomunicaciones.

Clasificación JEL: L51, L96.

APPENDIX

Table A1
THE 23 TRA's ANALYZED IN THIS STUDY

Country	Nama of Agency	Year of Creation	Legally prescribed numbre of years for the regulator
Argentina	Comisión Nacional de Comunicaciones (CNN)	1990	5
Barbados	Fair Trading Commission (FTC)	2001	5 (with possibility of re-election)
Belice	Public Utilities Commission (PUC)	1999	6 (with possibility of re-election)
Bolivia	Superintendencia de Telecominicaciones (SITTEL)	1995	5
Brasil	Agencia Nacional de Telecomunicaciones (ANATEL)	1997	5 (with possibility of re-election)
Chile	Subsecretaría de Telecomunicaciones (SUBTEL)	1977	Not defined
Colombia	Comisión de Regulación de Telecomunicaciones (CRT)	1994	1.3 (16 months)

Table A1
THE 23 TRA's ANALYZED IN THIS STUDY
(Continued)

Country	Nama of Agency	Year of Creation	Legally prescribed numbre of years for the regulator
Costa Rica	Autoridad Reguladora de Servicios Públicos (ARESEP)	1996	4 (with possibility of re-election)
Dominican Republic	Instituto Dominicano de Telecomunicaciones (INDOTEL)	1998	4 (with possibility of re-election)
Ecuador	Comisión Nacional de Telecomunicaciones (CONATEL)	1995	4 (with possibility of re-election)
El Salvador	Superintendencia General de Electricidad y Telecomunicaciones (SIGET)	1996	7 (with possibility of re-election)
Gautemala	Superintendencia de Telecomunicaciones (SIT)	1996	Not defined
Honduras	Comisión Nacional de Telecomunicaciones (CONATEL)	1995	4 (with possibility of re-election)
Jamaica	Office of Utilities Regulation (OUR)	1995	Between 3 and 7
Mexico	Comisión Federal de Telecomunicaciones (COFETEL)	1996	Not defined
Nicaragua	Instituto Nicaragüense de Telecomunicaciones y Correos (TELCOR)	1995	Not defined
Panama	Ente regulador de Servicios Públicos (ERSP)	1996	Not defined
Paraguay	Comisión Nacional de Telecomunicaciones (CONATEL)	1996	5
Peru	Organismo Supervisor de la Inversión Privada en Telecomunicaciones (OSITEL)	1994	5 (with possibility of re-election)
Surinam	Telecommunicatie Authoriteit Suriname (TAS)	1998	5 (with possibility of re-election)
Trinidad & Tobago	Telecommunications Authority of Trnidad & Tobago (TATT)	2002	3
Uruguay	Unidad Reguladora de los Servicios de Telecomunicaciones (URSEC)	2001	6 (with possibility of re-election)
Venezuela	Comisión Nacional de Telecomunicaciones (CONATEL)		

Source: Agencies, AHCIET and ITU.