

**CONSEQUENCES OF VERTICAL SEPARATION AND MONOPOLY:
EVIDENCE FROM THE TELECOM PRIVATIZATIONS**

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ABSTRACT

Policy variation across countries on the use of mandatory vertical separation and statutory monopoly allows me to assess their impact on basic telephone services (local, long distance, and international service). Panel data analysis from 67 countries during the seven-year period following the privatization of the main telephone provider indicates that vertical separation and monopoly harm those consumers that were precisely supposed to help: the downstream users of international telephony and the upstream users of residential local telephony. Mandatory vertical separation reduces the usage of international telephone service and the number of fixed lines in service, while statutory monopoly reduces the amount of fixed lines in service and increases the price of local residential telephony.

Key words: telecommunications, vertical separation, monopoly, privatization

JEL classification: L96, L42, L43, L51

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1. Introduction

The privatization of the telephone monopolies around the world provided policy makers with an unprecedented opportunity to restructure a whole industry. Before the sale, governments needed to decide on (1) whether the status quo of monopoly was to be maintained and (2) whether they should mandate vertical separation between the upstream local fixed telephone provider and the provider of downstream services such as long distance or international telephony.¹ The argument in favor of maintaining the *status quo* of monopoly was political. For decades governments pursued a policy of universal telephone service by subsidizing residential local telephony from business telephony (*i.e.*, long distance, international, and data communications services).² This cross-subsidy scheme could only be maintained under monopoly. Moreover, local fixed telephony was considered a natural monopoly while business services such as long distance or international telephony were deemed potentially competitive. In this view, allowing entry would only engender competition in long distance and international telephony but not in local fixed telephony. The prices of the downstream services (long distance and international) will fall but local residential rates would increase as the local service monopoly would struggle to maintain the level of profits it enjoyed before. A rise

¹ Few privatizing governments such as India, Canada, and Japan inherited a vertically separated industry. In other cases such as Argentina and Brazil separation was decided just before the privatization.

² Empirical evidence suggests that local residential services were priced at below marginal cost while business services such as long distance and international telephony were priced at well above marginal cost (Nambu, Suzuki, and Honda 1989; Crandall 1989; Palmer 1992. Hausman, Tardiff, and Belinfante 1993; Cronin, Colleran, Miller, and Raczkowski 1997).

on local residential rates was deemed politically unacceptable.³ To avoid a political backlash, it was argued, monopoly and cross subsidization needed to be maintained.⁴

The validity of this argument is suspect on several grounds. For example, it ignores gains on productive efficiency arising from the privatization of these firms. Private property exerts a powerful incentive to use resources more efficiently than under state control (Alchian 1965; Alchian 1969; and Furubotn and Pejovich 1972). Improvements on efficiency would reduce production costs and some of these gains will be passed onto the consumer in the form of lower prices. Efficiency gains are compounded when considering the effect of competition. Product market competition affects managerial behavior reducing the consumption of perquisites and increasing productive efficiency even further (Alchian and Kessel 1962; Williamson 1963; Leibenstein 1966; Comanor and Leibenstein 1969).

A second major policy decision was that of vertically separating the provision of local fixed telephony from long distance or international service. This time the argument was on economic grounds as supporters aimed at increasing competition on downstream

³ Although the argument for monopoly (and cross subsidization) was mainly political, Faulhaber (1975) found an economic justification. He proved that cross subsidization can increase social welfare as long as a multi-product monopolist exhibits economies of scope on joint production.

⁴ Bös (1993: 108) articulates this view: “In contrast to private firms, public enterprises have often been instructed to price according to distributional objectives. This implies charging lower prices for goods which are mainly demanded by lower-income earners. In this case the public enterprises rely on internal subsidization, where the internal deficit of the low-priced goods is financed by the internal profits earned from sales to higher-income or business customers. If the privatized firm operates in a competitive market, this internal subsidization becomes impossible and distributional pricing cannot be upheld.” Pilcher (1994: 401) puts it bluntly: “Governments, therefore, need to decide on a strategy to either introduce competition in long-distance and international service or to maintain the cross-subsidy.”

services.⁵ The argument closely follows the modification of the final judgment (MFJ) rationale used in the U.S. to justify the split of AT&T into several local fixed telephony providers and one long distance and international service provider. Briefly stated, the argument assumes that competition in local fixed telephony will not arise because of its natural monopoly characteristics while long distance and international service were viewed as potentially competitive. In this view, a vertically integrated local service monopoly can effectively keep potential entrants out of the lucrative long distance and international telephony markets by using non competitive tactics. For example, the vertically integrated firm can tie the monopolized local phone service with long distance and international service and sell the bundle of services at a lower price than buying them separately from different firms. This will effectively eliminate competitors in long distance and international service. Once this is accomplished, the integrated monopolist can raise the price of the tied good reducing social welfare (Whinston 1990). Because a vertically integrated firm owns a bottleneck input, local access to the fixed network, it has an ample array of non competitive tools to keep competitors at bay. For example, it can refuse to interconnect or delay interconnection through lengthy negotiations (Salop and Scheffman 1983); or it can provide low quality access links to degrade the service quality of competitors (Cremer, Rey, and Tirole 2000; Aviram 2003). The end result will be too little or no competition in downstream services such as long distance or international telephony.

⁵This view is spelled out by Bös (1993: 108) clearly: “The government should first attempt to encourage competition, as the UK, for instance, did with its splitting of the electricity industry into electricity generation (a potentially competitive business) and distribution.” Also Waterschoot (1994: 511) underscores the influence of the U.S. antitrust case against AT&T in shaping the post-privatization regulation of telecommunications around the world.

A vertically integrated firm could also use rate regulation to shift costs from the production of competitive services such as long distance to the monopolized local residential service. The vertically integrated local monopoly could then use predatory pricing to drive competitors out of the downstream markets while recovering the losses with higher regulated prices in local service. Vertical separation was seen as a remedy for these problems; it was supposed to boost competition on long distance and international telephony while using rate regulation to keep residential prices low.

Although these arguments seem plausible, they overlook several important issues. First, with open entry predatory pricing on the competitive downstream markets is unlikely to succeed because once prices are raised it will induce entry by new firms. Alternatively, foreclosure of the downstream markets may occur only if a monopolist is the least cost producer and uses a limit pricing strategy. This however, will increase social welfare because local rates will remain low (Milgrom and Roberts 1982; Tirole 1988: Chap. 9). Second, it overlooks the incentive effect that competition has on productive efficiency. Even if we accept that the price of regulated local service may increase due to cost shifting, this increase on price will attract entry on local service which in turn will reduce prices and put pressure on firms to reduce costs. Third and most important; firms integrate to minimize the transaction costs of using the market (Coase 1937). Breaking up a firm by administrative process in the hope that social welfare would increase implies that government agents know that the loss in efficiency after the break up more than compensates the gains; nothing ensures this. Indeed, Williamson (1971) identified three cases in which vertical separation may be inefficient, (1) when this creates bilateral monopolies (*i.e.*, double marginalization problem), (2)

when bargaining costs between parties are likely to be high, or (3) when large sunk investments are part of a transaction with incomplete contracts. A contract of a vertically separated local telephone monopoly with a downstream international or long distance service provider seem to have most of the characteristics just mentioned. It involves investment decisions that are asset-specific which creates an incentive on one party to renege on its commitment and appropriate the rents belonging to the other party (Klein, Crawford, and Alchian 1978; Williamson 1985). Indeed, voluntary vertical integration indicates that a firm's assets are interdependent (Williamson 1979, Alchian 1984) and integration, under a set of plausible assumptions, will increase social welfare (Riordan and Williamson 1985; Grossman and Hart 1986).⁶ In the context of telephone services, Biglaiser and DeGraba (2001) show that the existence of a vertically integrated firm increases social welfare even in the unlikely case that this firm forecloses the downstream markets by using predatory pricing.

Previous studies that assess the effect of private ownership and monopoly on the availability of telephone services found a positive effect of privatization and a negative effect of monopoly.⁷ In a closely related study, Wallsten (2004) finds that monopoly reduces the availability of basic telephone services in the post-privatization years.

Surprisingly the effect of mandatory vertical separation on telephone services has attracted little attention.⁸ This article fills this void extending Wallsten's (2004) study by increasing the sample of countries and adding a new policy variable: mandatory vertical

⁶ In a related contribution to the theory of vertical integration, Arrow (1975) showed that firms will integrate vertically when there is uncertainty in the supply of the upstream (intermediate) good.

⁷ See for example Ros (1999) and Fink et al (2003).

⁸ Exceptions to this are the studies focusing on the U.S. after the break up of AT&T. These studies find that vertical separation did not produce the expected welfare gains from lower prices on downstream long-distance and international telephone services (Crandall 1988; Crandall 1989; Hausman, Tardiff and Belinfante 1993).

separation. Panel data analysis from 67 countries during the seven-year period following the privatization of the former state-owned monopoly indicates that vertical separation reduces the use of downstream phone services such as international telephony. The rationale for prohibiting the local service provider from competing in downstream services is not supported by the data.⁹ Moreover, vertical separation also reduces upstream services such as local fixed telephony. Therefore, vertical separation reduces downstream international telephone services indirectly, by reducing the number of access lines, and directly by reducing the use of international telephony holding all else constant. As expected, monopoly reduces the usage of international service and the number of fixed lines in service. Moreover, monopoly increases the price of residential local telephony, a previously subsidized service. Fears of increased residential telephony prices after the elimination of the state-owned monopoly were unfounded. Analysts underestimated the efficiency gains resulting from vertical integration and open entry.

2. The data

The dataset includes 67 countries that privatized the dominant telephone firm in the period 1984-2003. This period covers most of the worldwide privatizations of telephone firms. Some countries have multiple sales of blocks of equity in this period. The date of the earliest sale is identified as the privatization date. The main source for these data is Privatisation International monthly issues and the Privatisation International Yearbook. Additional data on sales transactions were gathered from the Multilateral Investment Guarantee Agency's database on privatizations (Privatization Link)¹⁰ and

⁹ See also Alchian (1995), Sappington (1995), and Crandall and Sidak (2002).

¹⁰ Available at <http://www.privatizationlink.com>

from the Economist Intelligence Unit Viewswire and Country Information databases. Appendix A lists the sample of countries along with the year of privatization. Next, information on the vertical structure of the telephone industry was collected, namely whether basic telephone services (*i.e.*, fixed local telephony, national long distance, or international telephony) were vertically separated. In addition, data was gathered on the number of years since the industry was vertically separated and on the years of monopoly awarded to the privatized firms. These data were mainly from the Economist Intelligence Unit Viewswire and Country Information database, each firm's annual reports, each country regulator's websites, and from the Commission of the European Communities. Data of basic telephony usage is from the International Telecommunications Union's World Telecommunication Indicators (2004). Country-wide data were obtained from the World Bank's World Development Indicators database.

3. Empirical analysis

The effect of statutory monopoly and mandatory vertical separation on upstream and downstream basic telephone services is tested using panel data estimation with unobserved heterogeneity assumed to be time-invariant and specific to each country. The unit of analysis is a country at time t . For each country, eight years of data are used starting with the year in which the first privatization sale took place t_0 , and ending seven years later $t_0 + 7$. The following equation is estimated,

$$y_{it} = c_i + x_{it}\beta + w_{it}\gamma + \mu_{it}, \quad (1)$$

where y_{it} is a vector that contains observations of an indicator of basic telephony in country i at time t ; c_i is the time-invariant unobserved heterogeneity of county i which

may be arbitrarily correlated with x_{it} and w_{it} . Matrix x_{it} contains observations in country i at time t of a set of industry or country variables. w_{it} is a matrix containing observations in country i at time t of the two policy variables of interest: monopoly and vertical separation.

The fixed effect transformation provides consistent estimates of β and γ as long as x_{it} and w_{it} are uncorrelated (conditional on c_i) with the unobserved stochastic error term u_{it} in equation (1). As it will become clear, some of my x_{it} may violate this strict exogeneity assumption. For example if past values of y_{it} are correlated with future values of x_{it} strict exogeneity is violated and fixed-effect estimates will be inconsistent (Wooldridge 2002: 265-7). On the other hand, my policy variables in w_{it} do not seem to violate strict exogeneity. Past or current values of y_{it} do not seem to affect future or current values of w_{it} (my policy variables). The reason being is that once governments decide to privatize, they need to clearly specify the terms of the license or contract agreement between the privatized firm and the government. This needs to be done before the sale to attract investors. Important terms that governments need to establish are whether the firm will enjoy monopoly rights and for how long; and whether the firm will be barred from the provision of downstream services (*i.e.*, vertical separation). Once these terms are set, they belong to a contract and remain fixed for the entire period of the agreement which may extend over 20 or 25 years.

Governments set these terms through several mechanisms which may include the legislature passing a new telecommunications law, the executive changing regulations of entry, drafting license or concession contracts, or more often, a combination of these. Of course, changes in regulations and in the contract terms are shaped by interest groups,

government's preferences, and political institutions prevailing at one point in time,¹¹ but once the decision on the contract terms is made, these remain fixed. Therefore, it seems plausible to assert that past values of y_{it} are uncorrelated with w_{it} , and strict exogeneity is not violated.

Some authors argue that policy variables should be treated as endogenous. For example, Besley and Case (2000) analyze the influence of worker's compensation insurance (the policy variable) on economic variables such as wages or employment (the dependent variable). They rightly stress the need to treat worker's compensation as endogenous because state regulators frequently change the amount of indemnity payments or reimbursements for medical expenses. These changes in turn may be influenced by past wages and employment level (the dependent variable). A similar argument is made by Duso and Röller (2003) in the context of entry in cellular telephony. They rightly point out that the amount of licensed cellular providers (the policy variable) is endogenous when the dependent variable is the number of mobile subscribers per worker. The reason being is that regulators have discretion to award new licenses to cellular telephony providers and thus, one can plausibly argue that current or past values of mobile subscribers (the dependent variable) may influence future or current decisions to grant more cellular licenses.

This situation is very different from that encountered at the time of the privatization of the dominant fixed telephone provider. In this case, if a license or contract stipulates a ten-year period of monopoly, regulators have no authority to

¹¹ See Viani (2007) for an analysis of the factors influencing the award of monopoly rights in the privatization of telephone firms.

unilaterally alter the terms of this contract.¹² Therefore, whether a policy variable should be regarded as endogenous depends on the specific case under analysis. As Besley and Case (2000: 674) conclude: “investigating the determinants of policies is an important prerequisite to understanding when and whether one can legitimately put policy on the right hand side...(…)...the source of policy variation must be fully understood by the researcher.”

The approach followed in this article is similar to that used by Papke (1994) to analyze the effect of enterprise zones on the performance of the local economy (the dependent variable). Although designation of enterprise zones (the policy variable) could be correlated with unobserved variables affecting the dependent variable y_{it} , once a community is designated as enterprise zone it remains as such during the period of analysis. Therefore, future values of designation (the policy variable) do not depend on past values of y_{it} and as such designation (the policy variable) is considered strictly exogenous.¹³

A final issue to consider is that of heterogeneity on telecommunications regulation across countries. Levy and Spiller (1996) show that a country’s institutions, and the rules governing the telecommunication’s regulator affect the performance of the industry. While institutional and regulatory heterogeneity may be important when the analysis spans over a long period of time, or when it coincides with a period of rapid regulatory changes, my period of analysis does not appear to fall in either category. First,

¹² Of course a government can choose to renege on a contract but this could be costly. In fact, many countries sought to signal their commitment not to change the rules by signing the Convention on the Settlement of Investment Disputes with the International Centre of Settlement of Investment Disputes (ICSID). This intends to circumvent poor systems of rule of law prevailing in many less developed countries (<http://www.worldbank.org/icsid/about/main.htm>).

¹³ See also Wooldridge (2002: 306)

my dataset spans only seven years after the privatization sale. Second, changes on the regulatory environment preceded the sale of the state-owned monopoly. In some cases, these changes were set and clearly specified in licenses, concession contracts, or in telecommunications laws. It seems plausible to assert that regulation can be regarded as time-invariant in the seven years following the privatization sale and that cross country heterogeneity on institutions and regulations should be adequately captured by each country's fixed-effect. With this in mind, let us proceed to test the effect of mandatory vertical separation and statutory monopoly on the use of downstream and upstream telephone services.

3.1. Vertical separation, monopoly, and international telephony

The hypothesis that vertical separation increases competition and therefore output on downstream telephone services is tested. The downstream service analyzed is international telephony rather than national long distance for two reasons. First, there is limited data on long distance service and thus, the sample size would be substantially reduced. Second, only Brazil mandates vertical separation between the local service provider and the long distance provider; therefore, the results would be determined by a single country. This is not the case for international telephony where nine countries have mandatory vertical separation.

The effect of statutory monopoly on international telephony is also assessed. The following null hypotheses are tested,

H_{01} : Vertical separation of local fixed service from international service increases the use of international telephony.

H_{02} : Monopoly has no effect on international telephony usage.

Equation (1) is estimated using the natural logarithm of outgoing international minutes per person in country i at time t as the dependent variable y_{it} . Matrix w_{it} includes observations of the two policy variables: monopoly and vertical separation. I expect monopoly to be negatively correlated with output. Rate regulation could in theory make the monopolist price at Ramsey levels increasing output and social welfare. In practice, regulators face a tremendous problem of asymmetric information because they cannot observe, nor elicit accurate information on costs from the regulated firms. Given that rate regulation typically incorporates an implicit rate of return, inefficiency has zero or low cost to the regulated monopoly and rational utility-maximizing managers will increase the consumption of perquisites producing a decline on productive efficiency and output (Sappington 1980).¹⁴

Monopolies may behave differently if they have monopoly rights for say, 20 years instead of two years. Therefore, the monopoly variable is continuous and denotes the remaining number of years of statutory monopoly on international service. A similar Rationale is applied to the vertical separation variable which denotes the number of years since the dominant fixed telephone provider was excluded from the provision of downstream international telephony. A negative relationship between vertical separation and international telephony usage is anticipated.

When assets are interdependent, mandatory vertical separation increases transaction costs and the risk of a hold up problem (Williamson 1971, Klein, Crawford, and Alchian 1978; Williamson 1985) which in turn reduces efficiency. Agreements

¹⁴ For a good illustration of this and related problems see Berg and Tschirhart (1988: 505-511). See also Alchian and Kessel (1962), Williamson (1963), Leibenstein (1966) and Comanor and Leibenstein (1969).

between downstream and upstream firms on access fees require lengthy negotiations. Typically if no agreement is reached within a reasonable time the regulator determines the level of access fees necessary to compensate the fixed network owner for using his property. It can hardly be emphasized the large information burden imposed on a regulator trying to estimate optimal Ramsey access fees.¹⁵ Optimal access fees become even more elusive if we consider the political process by which they are set. Self-interested politicians and bureaucrats may choose a set of access fees far from the optimal levels as they do not bear the full cost of their choices. This would also invite rent-seeking activities (Tullock 1967, Posner 1975) increasing further the inefficiency due to mandatory vertical separation.

Matrix x_{it} includes a set of exogenous variables that affect the quantity demanded of international telephony. For example, I include the real income per capita and variables to control for the age distribution in the population. If international service is a normal good I expect a positive relationship between income and the amount of international minutes used. Age distribution may affect the taste for telephone services but I have no expectations on the sign of this effect. I also control for the number of foreign-born residents because they have family members abroad with whom they like to communicate. A positive relationship between this variable and international telephone usage is anticipated.

Also included are the number of fixed lines per person and a variable to control for a country's political stability. Local access and international service are complementary goods because one cannot make an international call without local

¹⁵ For a theoretical exposition of optimal access fees see Laffont and Tirole (2000: 80-83 and 97-105).

access. A positive relationship between these variables is expected. On the other hand, political stability may affect the usage of international service through its effect on the amount of fixed lines in service. The provision of fixed telephone service involves large sunk costs and this may be negatively affected by political instability.¹⁶ From the Polity IV database I use the durability of political regimes as an indicator of political stability. Table 1 presents the full list of variables used along with definitions and sources while Table 2 shows the summary statistics.

Except for fixed lines per person all other variables in x_{it} seem to be strictly exogenous. It is unlikely that current or past values of international telephony usage (y_{it}) will affect future immigration, income, demographic variables, or political durability (my variables in x_{it}). However, the level of past international telephony usage may affect the amount of future lines in service violating strict exogeneity. This seems plausible because international telephony and other services aimed mainly at businesses had traditionally been an important source of funds for the expansion of the fixed telephone network.¹⁷ Two-stage least squares (2SLS) estimation is used to overcome this potential endogeneity problem. As instruments I use all the exogenous regressors plus the degree of urbanization and the density of paved roads. Urbanization and road density should be partially correlated with fixed lines per person because the cost of digging trenches, laying down cables, and interconnecting towns and cities declines as urbanization and the number of miles of paved roads increase. On the other hand, urbanization and road density should be uncorrelated with the unobserved error term in equation (1). A positive

¹⁶ See for example Barro (1991) and Brunetti (1997) on the effect of political instability on investment and economic growth.

¹⁷ For example in 1991 the share of international service on total revenue for the Jamaican telephone monopoly was 77 percent (Wint 1996: 59).

Table 1. Definition of variables and sources

Variable	Definition	Source
Dependent variables		
Intl. minutes/pop	Number of outgoing international minutes per person in year t.	ITU. WTI 2004
Fixed lines/pop	The country's fixed telephone lines in service per person in year t.	ITU. WTI 2004
Residential Price	The price of one year of residential local fixed service in year t. Residential Price = Connection charge + 12 x monthly rate. In US dollars of 2005.	ITU. WTI 2004
Explanatory variables		
Intl. monopoly	Number of years until end of monopoly on international telephony in year t.	Own database
Local monopoly	Number of years until end of monopoly on local fixed telephony in year t.	Own database
Basic monopoly	Average years until end of monopoly on local, long distance, and international service.	Own database
Vertical separation	Number of years since the incumbent fixed line operator was separated from the main provider of international telephony.	Own database
Income	Country's real GDP per capita (thousand PPP US dollars of 2005) in year t.	World Bank. WDI 2004
Foreign born/pop	Stock of foreign-born population in year t (% of total population)	World Bank. WDI 2004
Pop 15-64	Population age 15 to 64 years at time t (% of total)	World Bank. WDI 2004
Pop 65+	Population age 65 or more years at time t (% of total)	World Bank.

Inflation 25+	Dummy variable has the value of one if annual inflation is higher than 25 percent and zero otherwise.	WDI 2004 World Bank. WDI 2004
Left-wing	Dummy variable has the value of one if the chief executive is classified as left-wing and zero otherwise.	Beck et al (2001). The World Bank. DPI 2004.
Fixed lines/pop	The country's fixed telephone lines in service per person in year t.	ITU. WTI 2004
Urban	Proportion of people living in urban areas (% population).	World Bank. WDI 2004
Paved roads	Density of paved roads. Kilometers of paved roads divided by a country's surface area at time t (km/square kilometers).	World Bank. WDI 2004
Durable	Number of years a political regime has been in place (at time t).	University of Maryland. Polity IV database
Mobile/pop	The country's number of cellular mobile subscriber per person in year t.	ITU. WTI 2004
Vehicles/pop	The number of vehicles per thousand people in year t.	World Bank. WDI 2004
Residential lines	The number of fixed residential lines in service at time t (million lines).	ITU. WTI 2004
Faults/lines	The number of telephone faults per 100 main lines at time t.	ITU. WTI 2004
Digital	Percentage of digitalization of the main fixed line network in year t (% of total).	ITU. WTI 2004

ITU = International Telecommunications Union. WTI = World Telecommunications Indicators. WDI = World Development Indicators. DPI = Database of Political Institutions.

Table 2. Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Intl. minutes/pop	397	51.760	75.255	0.213	466.096
Fixed lines/pop	397	0.269	0.197	0.004	0.745
Residential Price	375	265.394	262.988	4.606	3,441.068
Intl. monopoly	400	3.315	7.450	-10	36
Local monopoly	400	3.018	7.527	-10	36
Basic monopoly	400	3.166	7.452	-10	36
Vertical separation	397	3.655	11.083	0	51
Income	399	13.505	9.948	1.119	40.297
Foreign born/pop	402	8.665	12.072	0.114	76.474
Urban	405	64.239	18.519	21.070	100
Paved roads	297	0.825	1.083	0.001	4.516
Inflation 25+	405	0.099	0.299	0	1
Left-wing	405	0.346	0.476	0	1
Durable	383	30.159	32.040	0	153
Durable squared	383	1,933.475	3,798.334	0	23,409
Mobile/pop	397	0.163	0.234	0	0.937
Vehicles/pop	292	256.530	187.854	5.360	609.632
Residential lines	190	3.824	6.344	0.009	39.607
Faults/lines	287	38.308	42.381	0.5	228
Digital	392	78.977	25.736	0.8	100
Pop 15-64	190	64.247	4.997	51.172	72.209
Pop 65+	190	8.761	4.595	1.371	17.540

partial correlation between these instruments and fixed lines per person is expected. The results of the first-stage regression (first column in Appendix B) suggest that these are suitable instruments. The coefficient of urbanization is highly significant while that of road density is not but both exhibit the expected sign. In addition, they can be regarded as uncorrelated with the error term in equation (1) and with international telephony usage. A country's degree of urbanization and road density should have little effect on the cost of establishing satellite and microwave links for international communications.

Year dummy variables are included to control for unobserved technological changes in the telecommunications industry along with dummy variables to control for

high inflation and the existence of a left-wing chief executive. High inflation erodes the real price of regulated telephone services because telephone firms need approval from the regulator before increasing their prices. With high inflation, delays on the approval process will produce a fall on real prices and the quantity demanded of international telephony will increase. On the other hand, if the head of the executive branch belongs to a left-wing party, I expect the regulator (typically part of the executive branch) to subsidize more heavily the price of residential service with this subsidy being paid by business users. Because businesses are intensive users of international telephony I expect a left-wing executive to have a negative effect on international telephony usage.

Using Wooldridge (2002:282-283) and Drukker's (2003) procedure I found evidence of first-order serial correlation on the error terms within countries (clusters). Corrected standard errors which allow for heteroskedasticity and first-order serial correlation within countries (clusters) are reported.¹⁸

Using the Hausman procedure (Hausman 1978, 1983) the hypothesis that the natural logarithm of fixed lines per person is exogenous is rejected with only 75 percent confidence.¹⁹ For comparison purposes Table 3 shows OLS results in the first column along with results from 2SLS estimation in the second to fourth columns. The null hypothesis H_{01} is rejected with 90 percent confidence; vertical separation reduces the use of international telephony. As expected, statutory monopoly also reduces the use of international telephony; however, I am only able to reject the null hypothesis H_{02} with 80 percent confidence.²⁰ Other estimates have the expected sign or are not significant.

¹⁸ See Froot (1989) and Williams (2000).

¹⁹ Table 3 shows (at the bottom) the p-values of rejecting incorrectly the null hypothesis (H_0) in Hausman's test; where H_0 is the hypothesis that fixed lines per person (in logs) is exogenous.

²⁰ See also Wallsten (2004) for similar findings with a smaller sample and using OLS estimation.

Table 3. Effect of vertical separation and monopoly on international telephony use

	Dependent Variable: Log Intl. minutes/pop			
	(1)	(2)	(3)	(4)
Intl. monopoly	-0.070 (3.48)*	-0.046 (1.46)	-0.048 (1.53)	-0.049 (1.54)
Vertical separation	-0.007 (1.44)	-0.008 (1.70)***	-0.007 (1.48)	-0.008 (1.68)***
Log Income	0.990 (3.44)*	0.805 (2.28)**	0.822 (2.31)**	0.830 (2.31)**
Log Pop 15-64	0.958 (0.61)	-0.189 (0.14)	-0.332 (0.24)	-0.073 (0.05)
Log Pop 65+	0.250 (0.51)	0.600 (0.97)	0.563 (0.94)	0.558 (0.89)
Log Foreign born/pop	0.393 (1.53)	0.480 (1.64)	0.461 (1.61)	0.470 (1.59)
Durable	-0.004 (0.87)	-0.006 (1.12)	-0.006 (1.04)	-0.006 (1.02)
Durable squared	0.0000 (0.38)	0.0002 (1.01)	0.0001 (0.91)	0.0001 (0.90)
Log Fixed lines/pop	0.090 (0.63)	0.568 (1.20)	0.549 (1.16)	0.514 (1.09)
Left-wing			-0.048 (1.48)	
Inflation 25+	-0.012 (0.30)			0.004 (0.10)
Constant	-4.056 (0.61)	1.020 (0.17)	1.670 (0.28)	0.498 (0.08)
N	270	270	270	270
Countries	53	53	53	53
Estimation	OLS	2SLS	2SLS	2SLS
Year dummies	yes	yes	yes	yes
Country fixed-effects	yes	yes	yes	Yes
p-value Hausman test ^a	n.a.	0.223	0.245	0.280

Notes: Panel data estimation with country fixed effects and year dummies. Robust standard errors corrected for heteroskedasticity and within country correlation. Absolute value of t-statistics in parenthesis. * = 99 percent confidence; ** = 95 percent confidence; *** = 90 percent confidence. Potentially endogenous variable in the second to fourth column is Log Fixed lines/pop. Instruments are: Log Urban and Log Paved roads in addition to all the exogenous variables above.

^a Hausman test of endogeneity. H_0 : Instrumented variable is exogenous. P-value is the probability of rejecting H_0 incorrectly.

According to Crandall and Sidak (2004) the purported benefits of barring the local fixed line operator from downstream services such as international telephony are negligible compared to the increased cost of coordination of investment and production and forgone economies of scope. They concluded in the context of the U.S. experience: “Mandatory structural separation is unnecessary because the putative benefits that it would produce are, in fact nonexistent” (Crandall and Sidak 2004: 410). Moreover, Crandall and Winston (2003) assert that most of the observed increase in long distance competition after the break up of AT&T could be attributed to one requirement in the 1982 decree; that the Bell operating companies modify their switching facilities to provide equal access to long distance providers. Increase competition could have been achieved through regulation by the Federal Communications Commission without mandating vertical separation. Indeed, most countries mandate equal access to providers of downstream telephone services regardless of whether they mandate vertical separation. In a survey of 45 countries, Wallsten et al (2004) found that the only seven countries that did not have equal access regulation were those with the telephone service provider under statutory monopoly and therefore, with no need for interconnection.

The faulty rationale for mandating vertical separation becomes apparent if we analyze one of its key assumptions; that the owner of a bottleneck input (local access) can effectively preclude entry in the potentially competitive downstream markets. If this were true, we should observe no entry in countries with a dominant vertically integrated telephone firm. Table 4 contradicts this common assertion, entry does occur in the presence of a vertically integrated dominant fixed line service provider. Moreover,

Table 4. Number of international telephone providers after the end of statutory monopoly in countries with a dominant vertically integrated fixed telephone provider

Country	Entry allowed (t_0)	t_{0+1}	t_{0+2}	t_{0+3}	t_{0+4}	t_{0+5}
Australia	1991	3	3	3	3	3
Austria	1996	4	5	5>	5>	5>
Belgium	1998	5>	5>	3-5	5>	5>
Denmark	1998	5>	5>	5>	5>	5>
France	1998	5>	5>	5>	5>	5>
Ghana	1996	1	1	2	2	2
Guatemala	1996	1	1	5	5	n.a.
Ireland	1999	5>	5>	4	5>	n.a.
Israel	1996	3	3	n.a.	n.a.	n.a.
Italy	1998	5>	5>	5>	5>	n.a.
Malaysia	1994	1	1	1	1	n.a.
Mexico	1996	4	5>	5>	5>	5>
Netherlands	1997	n.a.	5>	5>	5>	5>
New Zealand	1989	1	2	2	2	2
Peru	1999	2	2	4	5>	5
South Korea	1991	2	2	2	2	2
Spain	1999	5>	5>	5>	5>	5>
Switzerland	1998	2	2	3	5>	5>
UK	1981	1	2	2	2	2

Only facilities based competition included.

Number of licensed firms in each country is much higher than the number of competitors shown above.

For Peru only competitors with more than 1 percent of market share are considered. For European countries, the number of firms refers to the choice available to at least 40 percent of the population.

n.a.: data not available. 5>: more than five service providers.

entrants are able to quickly grab market share from the dominant firm. For example, it took entrants only two years to capture more than 25 percent of the market for international calls in France and Italy. In the Netherlands and Austria, three years after entry was allowed, entrants captured 31 and 15 percent of the international market respectively.²¹ Probably more important than market share is that once the field is open to competition, the incumbent firm has a strong incentive to increase productive efficiency which results on increased industry output and social welfare.

3.1.1. Test of robustness and explanatory power

Table 3 reveals that the conclusions regarding monopoly and vertical separation are fairly stable. The fourth column is used to test further the robustness of these results. Using the average number of years of monopoly in all three basic services instead of monopoly on international service do not change the main conclusions (not reported). Estimating this equation without the year dummies does not change the conclusions regarding vertical separation but the coefficient of monopoly becomes not significant (not reported). Finally, one can conjecture that in some countries the date of privatization (the first sale of equity) may differ from the date in which managerial control was transferred to private owners. To account for this a dummy variable is added and the results are unchanged.²²

The fourth column in Table 3 is used to estimate the negative impact of vertical separation and monopoly on international telephony. An additional year of vertical separation reduces international telephony use by 0.8 percent, while an additional year of monopoly is associated with a 4.9 percent decline on international telephony usage. The relatively modest coefficient of vertical separation could be misleading unless one takes into account that in countries where vertical separation is mandatory, the average number of years of vertical separation is 23 years. Therefore, the average decline on international telephony usage is nearly 19 percent. This decline is compounded when considering the reduction on fixed lines due to vertical separation (see next section). Once the direct and

²¹ Commission of the European Communities. Seventh Report on the Implementation of the Telecommunications Regulatory Package (Nov. 26, 2001).

²² The dummy variable takes the value of one if managerial control was transferred and zero otherwise. A problem is that not all privatization sales specify whether managerial control was transferred. In those sales

indirect effects (through a reduction on fixed lines) are considered, an additional year of vertical separation reduces international telephony usage by 1.2 percent,²³ or an average decline of nearly 28 percent.

The negative effect of monopoly on international service is larger than it appears once we consider that monopoly also reduces the number of fixed lines in service (see next section). Once the direct and indirect effects are considered, additional years of monopoly reduce international telephony by 8.1 percent.²⁴ Given that the average monopoly period is 8.7 years (in countries with statutory monopoly), this translates into an average decline of 70 percent on international telephony use.

3.2. Vertical separation, monopoly, and local fixed lines in service

A common assertion made in the pre-privatization years was that monopoly was needed to advance universal telephone service through cross subsidization. The following null hypothesis is tested,

H_{03} : Monopoly on local fixed telephony is associated with more lines in service.

I assume managerial control was transferred if either (1) the government announced the sale of equity to a private "strategic partner," or (2) as a result of the sale the government's equity share fell below 50 percent.²³ The direct effect of additional years of vertical separation on international service is 0.8 or the coefficient of this variable in the fourth column in Table 3. The indirect effect of vertical separation on international telephony is found by first finding its effect on fixed lines per person. This is the coefficient of vertical separation in the fourth column in Table 5 which is 0.8 percent (see next section). Second, we need the elasticity of international telephony with respect to fixed lines. From Table 3 we find it to be approximately 0.5; therefore, the indirect effect of vertical separation on international service is 0.4 (0.8 times 0.5) and the direct plus indirect effect of additional years of vertical separation on international telephony is 1.2 percent.

²⁴ Again, the indirect effect of additional years of monopoly on international telephony is found by first finding its effect on fixed lines per person. From the fourth column in Table 5 (next section) we find this to be about 6.5 percent. Second, we need to use the elasticity of international telephony with respect to fixed lines which we found to be approximately 0.5 from the fourth column in Table 3. Therefore, the indirect effect of monopoly is approximately 3.2 percent (0.5 times 6.5) and the direct plus indirect effect of additional years of monopoly on international telephony is 8.1 percent.

Panel data estimation with country fixed effects is used to estimate equation (1) using the natural logarithm of fixed lines per person in country i at time t as the dependent variable y_{it} . Again, matrix w_{it} includes the two policy variables, monopoly and vertical separation, while x_{it} includes a set of variables affecting the quantity demanded of fixed lines per person. For example, it includes the real income per capita, variables to control for age distribution in the population, the degree of urbanization, and the density of paved roads. Urbanization and road density should affect the cost of digging trenches, laying down cables, erecting telephone poles, and so on. Assuming a central office with a fixed switching capacity, as the network expands toward less densely populated areas or with less paved roads (especially in less developed countries), the marginal cost per line should increase reducing the number of lines in service.

A dummy variable to control for high inflation is added because getting approval for rate increases could be a lengthy process. Delays on the approval process would cause a decline on the real price of phone services and an increase on the number of lines in service. Inflation however, could have the opposite effect; if regulated prices adjust with a lag, soon profits will fall along with new investment to expand the telephone network. The net effect of inflation on fixed lines in service is therefore, ambiguous.

Again, the durability of political regimes is used to control for the possible effect of political instability on fixed lines in service and a positive relationship is expected between these variables. Finally, the number of mobile phones per person (in logs) is added because studies have shown fixed and mobile phones to be closed substitutes (Gruber and Verboven 2001, Sung and Lee 2002). Except for this last variable, all others seem to be strictly exogenous. It seems unlikely that current or past values of the number

of fixed lines in service would cause an increase on income, migration to cities, or an increase on paved roads. Neither would it change political stability or inflation. However, if fixed and mobile phone services are substitutes, or even if they are complements, the level of past fixed lines in service may affect the future number of mobile phones which would violate the strict exogeneity assumption. Proceeding with two-stage least squares (2SLS) estimation, all the exogenous regressors in x_{it} are instruments for the natural logarithm of mobile phones per person plus a new instrument, the natural logarithm of the number of vehicles per person. To be a good instrument this variable must be partially correlated with the natural logarithm of mobile phones per person and uncorrelated with the unobserved error term in equation (1). As the number of vehicles increase, the demand for mobile phones should increase. The results from the first-stage regression (second column in Appendix B) suggest that the natural logarithm of vehicles per person is a suitable instrument because its coefficient is highly significant and exhibit the expected sign. Again, year dummy variables and a dummy variable to control for a left-wing chief executive are included. Corrected standard errors are reported because evidence of first-order serial correlation in the error terms within clusters was found.²⁵ Using Hausman procedure (Hausman 1978, 1983) the hypothesis that the natural logarithm of mobile phones per person is exogenous cannot be rejected. Therefore, OLS results are included in the first column in Table 5 along with 2SLS estimates in the second to fourth columns. Using the results from 2SLS estimation I can only reject the null hypothesis H_{03} with 80 percent confidence. Wallsten (2004) finds

²⁵ See Wooldridge (2002: 282-283) and Drukker (2003) for the test used.

Table 5. Vertical separation, monopoly, and fixed line telephony

	Dependent Variable = Log fixed lines/pop			
	(1)	(2)	(3)	(4)
Local monopoly	-0.046 (1.96)***	-0.071 (1.44)	-0.070 (1.50)	-0.065 (1.44)
Vertical separation	-0.009 (4.01)*	-0.007 (2.21)**	-0.007 (2.28)**	-0.008 (2.54)**
Log Income	0.072 (0.37)	0.120 (0.62)	0.124 (0.68)	0.028 (0.12)
Log Pop 15-64	-1.416 (0.66)	0.436 (0.09)	0.407 (0.08)	0.008 (0.00)
Log Pop 65+	-1.641 (2.95)*	-1.645 (2.64)*	-1.629 (2.68)*	-1.604 (2.56)**
Log Urban	1.411 (1.30)	1.163 (0.98)	1.172 (0.98)	1.638 (1.21)
Log Paved roads	0.006 (0.08)	0.022 (0.23)	0.022 (0.23)	0.032 (0.33)
Durable	0.013 (1.01)	0.030 (0.82)	0.029 (0.87)	0.025 (0.77)
Durable squared	-0.0004 (3.58)*	-0.0005 (3.15)*	-0.0005 (3.47)*	-0.0005 (3.18)*
Log Mobile/pop	0.076 (2.76)*	-0.002 (0.01)	-0.001 (0.01)	0.011 (0.08)
Left-wing			0.006 (0.12)	
Inflation 25+	-0.034 (1.92)***			-0.048 (1.27)
Constant	2.561 (0.23)	-4.794 (0.20)	-4.750 (0.19)	-4.737 (0.20)
N	141	141	141	141
Countries	40	40	40	40
Estimation	OLS	2SLS	2SLS	2SLS
Year dummies	yes	yes	yes	yes
Country fixed-effects	yes	yes	yes	yes
p-value Hausman test ^a	n.a.	0.616	0.598	0.668

Notes: Panel data estimation with country fixed effects and year dummies. Robust standard errors corrected for heteroskedasticity and within country (cluster) correlation. Absolute value of t-statistics in parenthesis. * = 99 percent confidence; ** = 95 percent confidence; *** = 90 percent confidence. Potentially endogenous variable in the second to fourth column is Log Mobile/pop. Instruments are: Log Vehicles/pop in addition to all the exogenous variables above.

^a Hausman test of endogeneity. H_0 : Instrumented variable is exogenous. P-value is the probability of rejecting H_0 incorrectly.

similar results in a related study with a smaller sample. Notice however, the significant negative effect of vertical separation on fixed lines in service per person. Vertical separation not only harms the provision of downstream international service but also the upstream local fixed telephone service. Several things may account for this. First, vertical separation may have increased transaction costs to coordinate investment decisions between upstream and downstream firms on assets that are specific or interrelated. Second, vertical separation increases the uncertainty to the downstream firm on the conditions under which an essential input (local access) is supplied.²⁶ As firms try to reduce contractual uncertainty, transaction costs would increase for both firms and investment would fall. Third, as access fees between upstream and downstream firms are regulated, firms will use resources on rent seeking activities (Tullock 1967, Posner 1975) to get a favorable rate. In this process, productive efficiency and investment on network expansion will decline. Fourth, vertical separation prevents the realization of economies of scope in the joint production of upstream and downstream telephone services. The coefficients of the other regressors have the expected sign but for the most part lack significance.

3.2.1. Test of robustness and explanatory power

Table 5 reveals that the conclusions regarding monopoly and vertical separation are fairly robust. The fourth column is used to test further the robustness of these results.

Changing the monopoly variable to monopoly in all basic services does not alter the results (not reported). Estimating this equation without the year dummies does not

²⁶ See Arrow (1975) for the effect of uncertainty on the incentive on firms to integrate vertically.

change the signs of the coefficients of monopoly and vertical separation but monopoly becomes insignificant while vertical separation becomes significant only with 80 percent confidence (not reported). Finally, I again test whether adding a dummy variable to control for the transfer of management to a private entity changes the results.²⁷ Adding this variable does not alter the conclusions, monopoly and vertical separation significantly lower the number of fixed lines per person.

The fourth column in Table 5 is used to estimate the negative impact of monopoly and vertical separation on the quantity of fixed lines per person. Each additional year of monopoly reduces the quantity of fixed lines per person by 6.5 percent and each additional year of vertical separation reduces fixed lines per person by 0.8 percent. Again, the seemingly small explanatory power is misleading. In countries where statutory monopoly on local service was granted, the average length is 7.6 years which translates into an average decline of approximately 49 percent on fixed lines per person. In a similar way, in countries that mandated vertical separation, the average length of this rule is 23.3 years which translates into an average decline of nearly 19 percent on fixed lines per person.

3.3. Monopoly and the price of local residential service

Few governments that privatized thought that allowing competition on basic services would lead to a break down of the cross-subsidy scheme and an increase on residential local rates which was deemed politically undesirable. In this section the effect of

²⁷ As in the previous section this variable takes the value of one if managerial control was transferred and zero otherwise.

monopoly and vertical separation on the price of local residential telephony is assessed.

Specifically, the following null hypothesis is tested,

H_{04} : Monopoly on local fixed telephony is associated with lower residential telephone rates.

Panel data estimation with country fixed effects is used to estimate equation (1) with the natural logarithm of the price of local residential telephony as the dependent variable y_{it} .

Matrix w_{it} includes the two policy variables: monopoly and vertical separation while

matrix x_{it} includes a set of variables that affect the price of residential local telephony.

Unfortunately several variables included in x_{it} appear to violate strict exogeneity. These include the natural logarithm of fixed residential lines in service, the natural logarithm of the number of faults per lines in service, and the degree of digitalization of the fixed network. A negative relationship is expected between the natural logarithm of fixed residential lines and the natural logarithm of residential rates. However, the quantity of residential lines can also affect the price of residential service and a problem of endogeneity arises. Something similar occurs with the number of faults per line and the degree of digitalization. Past prices of local service may affect the future quality (*i.e.*, faults per main line) or the decision to upgrade the telephone network with digital technology. For example, if regulators force the firm to price below cost, profits will decline along with service quality and investment on digitalization.

Two-stage least squares estimation is used. All the exogenous regressors in x_{it} are used as instruments for the aforementioned endogenous regressors plus three new instruments: the degree of urbanization, the density of paved roads, and a measure of political stability. As stated before, highly urbanized areas and the abundance of paved roads

should lower the marginal cost of local phone service and thus increase the number of lines in service. The same rationale applies to the adoption of digital technology because laying down fiber optic cables and installing digital switches should cost less in urban areas and in countries with substantial road infrastructure. Therefore, urbanization and paved road density should increase digitalization. I also expect the third instrument: political stability, to be positively related with the number of fixed lines and with digitalization because these variables represent investment on infrastructure, and political stability increases investment (Barro 1991, Brunetti 1997). The effect of these instruments on the number of faults per lines in service is difficult to predict. The availability of roads and a higher degree of urbanization may reduce the cost of repairs and maintenance lowering the number of telephone faults. On the other hand, it seems plausible to postulate a positive relationship between political stability and expenditures on network maintenance, repairs, upgrading, and therefore, a negative relationship with the amount of telephone faults. The results of the first-stage regressions (third to fifth columns in Appendix B) suggest that these instruments are adequate because for the most part they are partially correlated with the instrumented variables and have the expected sign. Again, year dummy variables and a dummy variable to control for the existence of a left-wing chief executive are included. Corrected standard errors are reported that allow for first-order serial correlation in the error terms within clusters. The results of Hausman's test (Hausman 1978, 1983) of exogeneity suggest that the three instrumented variables are endogenous. The p-values for this test appear in Table 6 at the bottom. In all three specifications the hypothesis of exogeneity is rejected with at least 94 percent

confidence. For comparison purposes OLS results are included in the first column in Table 6 along with the 2SLS estimates in the second to fourth columns.

Table 6. Vertical separation, monopoly, and the price of local residential telephony

	Dependent Variable: Log Residential price			
	(1)	(2)	(3)	(4)
Local monopoly	0.109 (1.81)***	0.158 (2.49)**	0.152 (1.97)***	0.158 (2.06)**
Vertical separation	-0.016 (0.84)	-0.009 (0.47)	-0.011 (0.57)	-0.011 (0.62)
Log Income	2.491 (1.79)***	1.856 (1.45)	2.685 (2.08)**	2.693 (2.13)**
Log Residential lines	-0.972 (2.24)**	-1.765 (2.97)*	-2.057 (3.85)*	-2.074 (3.75)*
Log Faults/lines	-0.176 (2.28)**	-0.358 (0.95)	-0.428 (1.19)	-0.409 (1.11)
Digital	-0.001 (0.25)	0.0124 (1.46)	0.009 (1.16)	0.009 (1.20)
Log Pop 15-64	9.910 (1.45)		12.174 (1.61)	13.039 (1.72)***
Log Pop 65+	-1.285 (0.50)		-2.998 (0.77)	-2.715 (0.68)
Left-wing	0.164 (1.29)			0.112 (0.80)
Constant	-38.363 (1.22)	1.306 (0.45)	-44.600 (1.18)	-48.844 (1.27)
N	181	181	181	181
Countries	45	45	45	45
Estimation	OLS	2SLS	2SLS	2SLS
Year dummies	yes	Yes	Yes	Yes
Country fixed-effects	yes	Yes	Yes	Yes
p-value Hausman test ^a	n.a.	0.059	0.006	0.007

Notes: Panel data estimation with country fixed effects and year dummies. Robust standard errors corrected for heteroskedasticity and within country (cluster) correlation. Absolute value of t-statistics in parenthesis. * = 99 percent confidence; ** = 95 percent confidence; *** = 90 percent confidence. Potentially endogenous variables in the second to fourth columns are Log Residential lines, Log Faults/lines, and Digital. Instruments used are Log Urban, Log Paved roads, Durable, and Durable squared in addition to all the exogenous variables above.

^a Hausman test of endogeneity. H_0 : All three instrumented variables are exogenous. P-value is the probability of rejecting H_0 incorrectly.

Using the results of 2SLS estimation the null hypothesis H_{04} is rejected with at least 90 percent confidence. Monopoly in local telephony is associated with higher prices of local residential telephony. The pre-privatization fears that a sharp increase on the prices of the subsidized residential service would follow the end of monopoly were unwarranted.²⁸ Analysts underestimated the power of private property and competition to enable gains in productive efficiency that would more than compensate the private investor's appetite for above marginal cost pricing in the post-privatization years. The coefficient of vertical separation has the expected sign but lacks significance while the other coefficients have the expected signs.

3.3.1. Test of robustness and explanatory power

The fourth column in Table 6 is used to test the robustness of these results. Changing the monopoly variable to indicate monopoly in all basic services leave the conclusions unchanged. Similar results are obtained when changing the dependent variable to an alternative indicator of the price of residential telephony (not reported).²⁹ Adding a variable to account for the transfer of managerial control to a private entity³⁰ does not change the main conclusions and hypothesis H_{04} is rejected with 90 percent confidence (not reported).

From the fourth specification in Table 6, each additional year of monopoly increases the price of residential local service by 15.8 percent. In countries with statutory

²⁸ Even AT&T's chairman Charles Brown (cited in Temin 1987: 307) agreed with the conventional view: "with competition, this subsidization of local rates by AT&T's long distance service is no longer possible and will be gradually phased out. Long distance rates will come down, and local rates will rise."

²⁹ This is computed as the one-time connection charge plus the monthly rate for perpetuity. A discount rate of 5 percent is assumed in the perpetuity formula. Therefore, Price = Connection charge + monthly rate/0.05.

³⁰ This dummy variable takes the value of one if managerial control was transferred and zero otherwise.

monopoly in local service the average length is 7.6 years which translates into an average increase on local residential rates of more than double (120 percent).

4. Conclusions

Two myths have been dispelled analyzing the post-privatization experience of telecommunications around the world. The first one is that statutory monopoly on basic telephone services is needed to maintain low prices of local residential telephony. The second is that mandatory vertical separation between downstream and upstream telephone services is needed to increase competition and output on downstream services such as international telephony.

Data shows that statutory monopoly increases the price of residential local service. Therefore, monopoly does not advance the stated policy of universal service, it retards it. In addition, monopoly reduces the usage of downstream services such as international telephony. Vertical separation also harms universal service provision by reducing the number of fixed lines per person. In addition, vertical separation reduces the use of downstream international service. In summary, statutory monopoly and mandatory vertical separation reduce social welfare and harm those consumers that were precisely designed to help: the downstream (business) users of international telephony and the upstream users of residential local telephony. These findings could help illuminate current policy discussions on the desirability of mandatory vertical separation in telecommunications (see for example OECD 2003).

Appendix A. Countries and year of privatization

Argentina (1990)	Guinea (1996)	Panama (1997)
Armenia (1997)	Guinea-Bissau (1989)	Peru (1994)
Australia (1997)	Guyana (1991)	Poland (1998)
Austria (1998)	Hungary (1993)	Portugal (1995)
Barbados (1991)	India (1991)	Puerto Rico (1992)
Belgium (1995)	Indonesia (1994)	Qatar (1998)
Belize (1988)	Ireland (1996)	Romania (1998)
Brazil (1998)	Israel (1990)	Sao Tome (1989)
Canada (1990)	Italy (1997)	Senegal (1997)
Cape Verde (1995)	Jamaica (1988)	Serbia (1997)
Chile (1988)	Japan (1987)	Singapore (1993)
Cote D'Ivoire (1997)	Jordan (1999)	Slovakia (2000)
Croatia (1999)	Latvia (1994)	South Africa (1997)
Cuba (1994)	Lithuania (1998)	South Korea (1993)
Czech Republic (1995)	Malaysia (1990)	Spain (1995)
Denmark (1994)	Mauritania (2000)	Sri Lanka (1997)
El Salvador (1998)	Mauritius (2000)	Switzerland (1998)
Estonia (1993)	Mexico (1990)	Taiwan (2000)
Finland (1998)	Mongolia (1995)	Trinidad & Tobago (1989)
France (1997)	Morocco (2000)	U.K. (1984)
Ghana (1996)	Netherlands (1994)	Venezuela (1991)
Greece (1996)	New Zealand (1990)	
Guatemala (1998)	Pakistan (1994)	

Appendix B. Results of first-stage regressions from Tables 3, 5, and 6

	Dependent Variables				
	(1) ^a	(2) ^b	(3) ^c	(4) ^c	(5) ^c
	Log Fixed lines/pop	Log Mobile/pop	Log Resid. lines	Log Faults/lines	Digital
Intl. monopoly	-0.033 (1.63)				
Local monopoly		-0.279 (3.70)*	-0.074 (2.52)**	0.100 (0.98)	-10.995 (4.96)*
Vertical separation	0.002 (0.29)	0.014 (2.46)**	-0.007 (1.46)	0.005 (0.46)	-0.183 (0.43)
Log Income	0.396 (1.52)	-1.392 (1.42)	0.011 (0.05)	3.514 (2.13)**	11.701 (0.58)
Log Pop15-64	0.855 (0.33)	20.462 (2.56)**	2.386 (1.07)	-3.467 (0.48)	323.218 (0.15)
Log Pop 65+	-0.455 (0.64)	-0.096 (0.04)	-1.649 (2.06)**	-6.265 (1.75)***	-142.993 (2.58)**
Log Foreign-born/pop	-0.421 (1.71)***				
Durable	0.005 (1.03)	0.170 (4.35)*	0.007 (1.73)***	-0.051 (1.91)***	1.074 (2.85)*
Durable squared	-0.0002 (1.51)	-0.0004 (1.00)	-0.0005 (5.32)*	0.0007 (1.82)***	-0.041 (3.29)*
Log Urban	2.408 (2.27)**	3.192 (0.78)	2.398 (2.62)*	-2.864 (0.77)	-167.648 (2.14)**
Log Paved roads	0.136 (1.26)	0.393 (1.11)	0.077 (1.00)	0.280 (1.06)	-0.255 (0.03)
Inflation 25+	-0.053 (1.99)**	-0.249 (1.78)***			
Log Vehicles/pop		1.121 (1.89)***			
Left			0.029 (0.70)	-0.146 (1.37)	4.520 (1.43)
Constant	-14.471 (1.41)	-107.756 (2.63)*	-15.430 (1.27)	34.231 (1.13)	969.493 (0.93)
N	270	141	181	181	181
Countries	53	40	45	45	45
Year dummies	yes	yes	Yes	Yes	yes
Country fixed-effects	yes	yes	Yes	Yes	yes

Notes: Panel data estimation with country fixed effects and year dummies. Robust standard errors corrected for heteroskedasticity and within country (cluster) correlation. Absolute value of t-statistics in parenthesis. * = 99 percent confidence; ** = 95 percent confidence; *** = 90 percent confidence. The dependent variables in this table are the instrumented variables that appear in Tables 3, 5, and 6.

^a First-stage of the fourth column in Table 3.

^b First-stage of the fourth column in Table 5.

^c First-stage of the fourth column in Table 6.

References

- Alchian, Armen A. 1965. "Some Economics of Property Rights." *Il Politico*. 30 (4): 816-829.
- Alchian, Armen A. 1969. "Corporate Management and Property Rights." In *Economic Policy and the Regulation of Corporate Securities*, Manne, Henry, ed. (Washington, DC: The American Enterprise Institute).
- Alchian, Armen A., and Reuben A. Kessel. 1962. "Competition, Monopoly and the Pursuit of Money." in *Aspects of Labor Economics*. National Bureau of Economic Research (Princeton, NJ: Princeton University Press).
- Alchian, Armen A. 1984. "Specificity, Specialization, and Coalitions." *Journal of Institutional and Theoretical Economics*. Vol. 140 (1): 34-49.
- Alchian, Armen A. 1995. "Vertical Integration and Regulation in the Telephone Industry." *Managerial and Decision Economics*. Vol. 16(4): 323-326.
- Arrow, Kenneth J. 1975. "Vertical Integration and Communication." *The Bell Journal of Economics*. Vol. 6 (1):173-183.
- Aviram, Amitai. 2003. "Regulation by Networks." *Brigham Young Law Review*. Vol. 2003 (4): 1179-1235.
- Barro, Robert J. 1991. "Economic Growth in a Cross Section of Countries." *Quarterly Journal of Economics*. Vol. 106 (2):407-443.
- Berg, Sanford V. and John Tschirhart. 1988. *Natural Monopoly Regulation. Principles and Practice*. (Cambridge, UK: Cambridge University Press)
- Besley, Timothy and Anne Case. 2000. "Unnatural Experiments? Estimating the

- Incidence of Endogenous Policies.” *The Economic Journal*. Vol. 110 (467): 672-694.
- Biglaiser, Gary and Patrick DeGraba. 2001. “Downstream Integration by a Bottleneck Input Supplier Whose Regulated Wholesale Prices are above Costs.” *Rand Journal of Economics*. Vol. 32 (2):302-315.
- Bös, Dieter. 1993. “Privatization in Europe: A Comparison of Approaches.” *Oxford Review of Economic Policy*, Vol. 9 (1): 95-111.
- Brunetti, Aymo. 1997. *Politics and Economic Growth: What Can We Learn From Cross-Country Data?* (Paris: OECD Publications).
- Coase, R. H. 1937. “The Nature of the Firm.” *Economica*. Vol. 4 (16): 386-405.
- Comanor, William S., and Harvey Leibenstein, 1969. “Allocative Efficiency, X-Efficiency and the Measurement of Welfare Losses.” *Economica*. 36 (143): 304-309.
- Crandall, Robert W. 1988. “Surprise from Telephone Deregulation and the AT&T Divestiture.” *The American Economic Review*. Vol. 78 (2): 323-327.
- Crandall, Robert W. 1989. “The Role of the U.S. Local Operating Companies.” In Crandall, Robert W. and Kenneth Flamm, eds., *Changing the Rules*. (Washington, DC: The Brookings Institution).
- Crandall, Robert W. and J. Gregory Sidak. 2002. “Is Structural Separation of Incumbent Local Exchange Carriers Necessary for Competition?” *Yale Journal on Regulation*. Vol. 19 (2): 335-411.
- Crandall, Robert W. and Clifford Winston. 2003. “Does Antitrust Policy Improve

- Consumer Welfare? Assessing the Evidence.” *Journal of Economics Perspectives*. Vol. 17 (4):3-26.
- Cremer, Jacques; Patrick Rey and Jean Tirole. 2000. “Connectivity in the Commercial Internet.” *The Journal of Industrial Economics*. Vol. 48(4): 433-472.
- Cronin, Francis J.; Elisabeth Colleran; Michael Miller and Richard Raczkowski. 1997. “Local Exchange Competition, Rate Restructuring, and Universal Service.” *Telecommunications Policy*. Vol. 21 (3): 251-264.
- Drukker, David M. 2003. “Testing for Serial Correlation in Linear Panel-Data Models.” *Stata Journal* Vol. 3 (2): 168-177.
- Duso, Tomaso and Lars-Hendrik Röller. 2003. “Endogenous Deregulation: Evidence from OECD Countries.” *Economics Letters*. Vol. 81 (1): 67-71.
- Faulhaber, Gerald R. 1975. “Cross-Subsidization: Pricing in Public Enterprises.” *The American Economic Review*. Vol. 65 (5): 966-977.
- Fink, Carsten, Aaditya Mattoo and Randeep Rathindran. 2003. “An Assessment of Telecommunications Reform in Developing Countries.” *Information Economics and Policy*. Vol. 15 (4): 443-466.
- Froot, Kenneth A. 1989. “Consistent Covariance Matrix Estimation with Cross-Sectional Dependence and Heteroskedasticity in Financial Data.” *Journal of Financial and Quantitative Analysis*. Vol. 24 (3):333-355.
- Furubotn, Eirik G., and Svetozar Pejovich, 1972. “Property Rights and Economic Theory: A survey of Recent Literature.” *Journal of Economic Literature*. 10 (4): 1137-1162.
- Grossman, Sanford J. and Oliver D. Hart. 1986. “The Costs and Benefits of Ownership:

- A Theory of Vertical and Lateral Integration.” *The Journal of Political Economy*.
Vol. 94 (4): 691-719.
- Gruber, Harald and Frank Verboven. 2001. “The Diffusion of Mobile
Telecommunications Services in the European Union.” *European Economic
Review*. Vol. 45 (3):577-588.
- Hausman, J. A. 1978. “Specification Tests in Econometrics.” *Econometrica* Vol. 46 (6):
1251-1271.
- Hausman, J. 1983. “Specification and Estimation of Simultaneous Equations Models.” In
Griliches, Z. and M.D. Intriligator, eds. *Handbook of Econometrics* Vol. 1,
(Amsterdam: North Holland).
- Hausman, Jerry, Timothy Tardiff and Alexander Belinfante. 1993. “The Effects of the
Breakup of AT&T on Telephone Penetration in the United States.” *The American
Economic Review*. Vol. 83 (2): 178-184.
- Klein, Benjamin; Robert G. Crawford and Armen A. Alchian. 1978. “Vertical
Integration, Appropriable Rents, and the Competitive Contracting Process.”
Journal of Law and Economics. Vol. 21(2): 297-326.
- Laffont, Jean-Jacques and Jean Tirole. 2000. *Competition in Telecommunications*.
(Cambridge, MA: The MIT Press)
- Leibenstein, Harvey, 1966. “Allocative Efficiency vs. ‘X-Efficiency’.” *The American
Economic Review*. 56 (3): 392-415.
- Levy, Brian and Pablo Spiller. 1996. “A Framework for Solving the Regulatory
Problem,” In Brian Levy and Pablo Spiller, eds., *Regulations, Institutions, and
Commitment*. (New York, NY: Cambridge University Press).

- Milgrom, Paul and John Roberts. 1982. "Limit Pricing and Entry Under Incomplete Information: An Equilibrium Analysis." *Econometrica* Vol. 50 (2): 443-460.
- Nambu, Tsuruhiko, Kazuyuki Suzuki and Tetsushi Honda. 1989. "Deregulation in Japan." In Crandall, Robert W. and Kenneth Flamm, eds. *Changing the Rules*. (Washington, DC: The Brookings Institution).
- OECD. 2003. "The Benefits and Costs of Structural Separation of the Local Loop." Manuscript. Directorate for Science, Technology and Industry. Committee for Information Computer and Communications Policy. DSTI/ICCP/TISP(2002)13/FINAL. (Nov. 3, 2003).
- Palmer, Karen. 1992. "A Test for Cross Subsidies in Local Telephone Rates: Do Business Customers Subsidize Residential Customers?" *The Rand Journal of Economics*. Vol. 23 (3): 415-431.
- Papke, Leslie E. 1994. "Tax Policy and Urban Development. Evidence from the Indiana Enterprise Zone Program." *Journal of Public Economics*. Vol. 54 (1): 37-49.
- Pilcher, Joseph E. 1994. "The Point of view of a Global Operator: Cable & Wireless." In Wellenius, Bjorn and Peter A. Stern, eds., *Implementing Reforms in the Telecommunications Sector. Lessons form Experience*. (Washington, DC: The World Bank).
- Posner, Richard A. 1975. "The Social Costs of Monopoly and Regulation." *The Journal of Political Economy*. Vol. 83 (4): 807-828.
- Riordan, Michael H. and Oliver E. Williamson. 1985. "Asset Specificity and Economic Organization." *International Journal of Industrial Organization*. Vol. 3 (4):365-378.

- Ros, Agustin J. 1999. "Does Ownership or Competition Matter? The Effects of Telecommunications Reform on Network Expansion and Efficiency." *Journal of Regulatory Economics*. Vol. 15 (1) pp. 65-92.
- Salop, Steven C. and David T. Scheffman. 1983. "Raising Rivals' Costs." *The American Economic Review*. Vol. 73 (2): 267-271.
- Sappington, David. 1980. "Strategic Firm Behavior Under a Dynamic Regulatory Adjustment Process." *The Bell Journal of Economics*. Vol. 11 (1) 360-372.
- Sappington, David E. M. 1995. "Revisiting the Line-of-Business Restrictions." *Managerial and Decision Economics*. Vol. 16 (4): 291-300.
- Sung, Nakil and Yong-Hun Lee. 2002. "Substitution Between Mobile and Fixed Telephone in Korea." *Review of Industrial Organization*. Vol. 20 (4):367-374.
- Temin, Peter and Louis Galambos. 1987. *The Fall of the Bell System. A Study in Prices and Politics*. (Cambridge, UK: Cambridge University Press).
- Tirole, Jean. 1988. *The Theory of Industrial Organization*. (Cambridge, MA: The MIT Press).
- Tullock, Gordon. 1967. "The Welfare Costs of Tariffs, Monopolies, and Theft." *Western Economic Journal*. Vol. 5 (June): 224-232.
- Viani, Bruno E. 2007. "Monopoly Rights in the Privatization of Telephone Firms." *Public Choice* (forthcoming).
- Wallsten, Scott J. 2004. "Privatizing Monopolies in Developing Countries: The Real Effect of Exclusivity Periods in Telecommunications." *Journal of Regulatory Economics*. Vol. 26 (3): 303-320.
- Wallsten, Scott, George Clarke, Luke Haggarty, Rosario Kaneshiro, Roger Noll, Mary

- Shirley, and Colin Xu. 2004. "New Tools for Studying Network Industry Reforms in Developing Countries: The Telecommunications and Electricity Regulation Database." AEI-Brookings Joint Center Related Publication 04-05. March 2004.
- Waterschoot, Paul. 1994. "Regulation and Competition Policy. In Wellenius, Bjorn and Peter A. Stern, eds., *Implementing Reforms in the Telecommunications Sector. Lessons form Experience*. (Washington, DC: The World Bank).
- Williams, Rick L. 2000. "A Note on Robust Variance Estimation for Cluster-Correlated Data." *Biometrics*. Vol. 56 (2):645-646.
- Williamson, Oliver E. 1963. "Managerial Discretion and Business Behavior." *The American Economic Review*. 53 (5): 1032-1057.
- Williamson, Oliver E. 1971. "The Vertical Integration of Production: Market Failure Considerations." *The American Economic Review*. Vol. 61 (2): 112-123.
- Williamson, Oliver E. 1979. "Transaction-Cost Economics: The Governance of Contractual Relations." *Journal of Law and Economics*. Vol. 22 (2):233-261.
- Williamson, Oliver E. 1985. *The Economic Institutions of Capitalism*. (New York, NY: The Free Press).
- Whinston, Michael D. 1990. "Tying, Foreclosure, and Exclusion." *The American Economic Review*. Vol. 80 (4): 837-859.
- Wint, Alvin G. 1996. "Pioneering Telephone Privatization: Jamaica." In Ramamurti, Ravi, ed. *Privatizing Monopolies: Lessons From the Telecommunications and Transport Sectors in Latin America*. (Baltimore, MD: Johns Hopkins University Press)

Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*.

(Cambridge, MA: The MIT Press)