

# An Experiment in Airwave Ownership: Spectrum Liberalization in Guatemala<sup>1</sup>

Thomas W. Hazlett<sup>2</sup> & Giancarlo Ibarguen<sup>3</sup>

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In 1996 Guatemala created de jure property rights for users of radio spectrum. This differs sharply from the traditional regulatory model in which spectrum is allocated according to administrative fiat rather than by the market. Also in 1996, a spectrum reform law was passed in neighboring El Salvador. While not as legally ambitious as the Guatemalan liberalization, it nonetheless allowed new entrants the right to use unoccupied frequencies on virtually an unregulated basis. Under these markedly liberal regimes, thousands of new licenses have been issued without undue conflict either administratively or due to confusion over rights in the marketplace. Moreover, in wireless telephone markets, an emerging sector of key economic importance, these two relatively poor countries exhibit exceptionally high growth and an advanced state of competitiveness, with among the lowest concentration ratios in Latin America. While mixed evidence is found with respect to price trends (Guatemala has the lowest mobile phone rates in Latin America, while El Salvador's are significantly higher), it appears that the policy of liberalization can substantially improve communications service and infrastructure even in small, developing nations.

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<sup>1</sup> This paper expands on a section of a much longer treatment of spectrum policy. See Thomas W. Hazlett, "The Wireless Craze, the Unlimited Bandwidth Myth, the Spectrum Auction Faux Pas, and the Punchline to Ronald Coase's 'Big Joke': An Essay on Airwave Allocation Policy," 15 *Harvard Journal of Law & Technology* (Spring 2001). The authors wish to thank Bruno Viani for outstanding research assistance.

<sup>2</sup> Manhattan Institute: [tw hazlett@yahoo.com](mailto:tw hazlett@yahoo.com).

<sup>3</sup> Francisco Marroquin University: [gis@ufm.edu.gt](mailto:gis@ufm.edu.gt).

## I. INTRODUCTION.

After the publication of my FCC article, I was invited... to prepare a report on Problems of Radio Frequency Allocation. This I did together with two economists at the Rand Corporation, Bill Meckling and Jora Minasian. A draft report was prepared which advocated a market solution. The draft report was circulated within Rand. The comments were highly critical and as a result, the report was suppressed. Here is an example that illustrates the character of the comments that were made:

“This is a remarkable document.... Time has somehow left the authors behind... [T]hey ignore the social, cultural, and political values which have come to inhere in mass communications, in particular, broadcasting, as well as fifty years of administrative law developments... I know of no country on the face of the globe – except for a few corrupt Latin American dictatorships – where the ‘sale’ of the spectrum could even be seriously proposed.”<sup>4</sup>

A centralized system of government spectrum allocation became firmly entrenched in the United States and most other countries in the 1920s and 1930s. Under the U.S. Radio Act of 1927, for instance, an independent government agency, the Federal Radio Commission, was established to determine how radio waves were used, and to assign licenses to wireless operators according to “public interest, convenience, and necessity.” Even when license assignments moved from “comparative hearings,” a political examination of competing claimants, to lotteries (approved by congressional legislation in 1981) and then competitive bidding (further legislation in 1993), the use of frequencies was still determined by the regulator.<sup>5</sup> Winning an FCC license at auction does not allow the licensee to use the allocated airspace for anything other than what is laid out in extensive, and rigid, government rules. These controls have maintained the central spectrum allocation system and pre-empted the formation of a market in wireless bandwidth.

This regulatory structure was once fiercely defended by a powerful political coalition, as demonstrated by its ability to abort even a debate of the issue by a thoughtful

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<sup>4</sup> Ronald H. Coase, *Comment on Thomas W. Hazlett: Assigning Property Rights to Radio Spectrum Users: Why Did FCC License Auctions Take 67 Years?* 41 J L & ECON 577 (Oct. 1998), 579.

<sup>5</sup> This history is detailed in Thomas W. Hazlett, *Assigning Property Rights to Radio Spectrum Users: Why Did FCC License Auctions Take 67 Years?* 41 J L & ECON 529 (Oct. 1998).

economist and future Nobel Laureate.<sup>6</sup> Yet, that coalition is today in disarray, as television and radio broadcasting are eclipsed by formidable entrants in communications markets, and as intense demands for spectrum access are voiced by emerging wireless networks tied to the New Economy. The consensus regulatory view is changing, as witnessed by a statement signed by 37 leading U.S. policy economists advocating rapid and widespread deregulation to enable frequencies now allocated by government planners to be deployed by private markets.<sup>7</sup> In February 2000, the Chairman of the U.S. Federal Communications Commission (successor to the Federal Radio Commission), inquired: “There are emerging markets for wireline bandwidth. Why not for wireless?”<sup>8</sup>

Spectrum policy liberalization is no longer taboo. Yet, the move from central allocation to markets yet represents a far leap, and political forces resist ambitious change. The burden of proof is always upon the reformer: How can one be sure that disaster will not strike? That is why the demonstration effect, seeing reforms implemented in some marketplace that has stepped out ahead, is a powerful input into the policy reform process. The irony, given Prof. Coase’s tumultuous experience in the matter, is that the “sale” of spectrum” is now taking place in one of the new democracies of Central America.

Guatemala today features perhaps the most liberal radio spectrum regulatory policy in the world.<sup>9</sup> There the wireless user or service provider gains an explicit right to radio frequencies: *Título de Usufructo de Frecuencia (TUF)*. Rather than *TUFs* being allocated and assigned by the state, users petition the state for rights to control unoccupied frequencies. The rights are awarded on request. Auctions are used when competing claims are made. Hence, the market allocates radio waves. This stands in

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<sup>6</sup> The 1991 Nobel Prize in Economics was primarily awarded for Ronald Coase’s contributions to analytical thinking about property rights. Coase’s work on FCC regulation of radio waves was actually responsible for this thinking and led directly to his “discovery” of the famous “Coase Theorem.”

<sup>7</sup> *Comment of Thirty-Seven Economists*, In the Matter of Promoting Efficient Use of Spectrum by Eliminating Barriers to the Development of Secondary Markets, Federal Communications Commission, WT Docket No. 00-230 (Feb. 7, 2001); <http://www.aei.brookings.org/publications/related/fcc.pdf>.

<sup>8</sup> Thomas W. Hazlett, *The Wireless Craze, the Unlimited Bandwidth Myth, the Spectrum Auctions Faux Pas, and the Punchline to Ronald Coase’s ‘Big Joke’: An Essay on Airwave Allocation Policy*, 15 HARV J L & TECH (Spring 2001).

<sup>9</sup> Giancarlo Ibarguen S. 1995 monograph detailed the essential logic of spectrum reform. See also Ibarguen, *Privatizar Las Ondas de Radio* (Guatemala City: CEES, Feb. 15, 1992). In 1996, Thomas W. Hazlett was retained, as was Prof. Pablo Spiller of U.C. Berkeley, as an expert by the Government of Guatemala to advise on telecommunications reform legislation. The privatization and deregulation of wireline telecommunications in Guatemala are described in Pablo Spiller and Carlo G. Cardilli, *The Frontier of Telecommunications Deregulation: Small Countries Leading the Pack*, in T. Bell and S. Singleton, eds., *Regulators’ Revenge: The Future of Telecommunications Deregulation* (Wash. D.C.: Cato Institute, 1998), 38.

sharp contrast to the policies established for decades in the United States and virtually all other countries in which administrative allocation of radio waves, combined with inflexible license rules, pre-empts the emergence of spectrum markets.

## II. BASIC ELEMENTS OF GUATEMALA'S 1996 REFORM.

Guatemala's spectrum rules were revamped in a sweeping November 1996 telecommunications law.<sup>10</sup> "The basic building block of Guatemala's approach to the spectrum is that all spectrum not currently assigned to [users]... can be requested by any person."<sup>11</sup> Allocation of Guatemalan radio spectrum is bottom-up. This inverts the standard regulatory practice of top-down block allocation, with bandwidth use administratively determined.

The most striking legal innovation of the spectrum reform is the creation of usufruct titles, *de jure* property rights controlling the use of radio waves. In other countries, wireless licenses (including those auctioned in the United States, United Kingdom, Europe, and Asia for billions of dollars over the past decade) explicitly establish the terms by which radio frequencies are used. The rights assigned users permit operation of facilities (and businesses) only as prescribed by regulators; private re-deployment of frequencies from one service (or technology) to another as per economic incentives is generally prohibited. Hence, a market for radio spectrum is excluded by fiat. Guatemala's far-reaching reforms enable such a market to emerge.

In the Guatemalan Civil Code the usufruct carries the right to use and enjoy the property of another to the extent that such use and enjoyment does not destroy or diminish its essential substance.<sup>12</sup> Since electromagnetic waves are infinitely reusable and are not "destroyed or diminished" when employed, the *TUF*'s are a close approximation of private property rights in radio spectrum.<sup>13</sup> The 1996 law specifically states that the *TUF* may be leased, sold, subdivided or consolidated for a limited period (fifteen years). The *TUF* may be used as equity or collateral.<sup>14</sup> The usufruct term can be extended for an additional 15 years by a simple request (no cost to *TUF* owners).

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<sup>10</sup> Ley General de Telecomunicaciones, D.C.A. 14 de Noviembre de 1996 (Guat.).

<sup>11</sup> Pablo T. Spiller and Carlo Cardillo, *Towards a Property Rights Approach To Communications Spectrum*, 16 YALE J. REG. 53 (Winter 1999), 75.

<sup>12</sup> República de Guatemala. Código Civil, Libro II, De los Bienes, de la Propiedad y demás Derechos Reales, Título III, Usufructo, uso y habitación.

<sup>13</sup> Ownership of spectrum itself was barred by Article 121 of the Guatemalan Constitution of 1985, which assigns the property of the radio waves to the State.<sup>13</sup> The framers of the Constitution argued that the radio spectrum, along with water masses (underground or above), ocean and river shores, air space, subsurface (including minerals), natural gas and oil, was inherently scarce and, thus, "strategic." Previous Constitutions had also nationalized these valuable resources.

<sup>14</sup> The number of *TUF* endorsements indicates an evolving secondary market. Of the total *TUF*'s issued, about 26% have been endorsed since 1996. This is only a partial indication of the secondary market because the rights may also be leased, but these data

The distinction between a usufruct title and a standard wireless authorization is key. The *TUF* is not an operating license, but a right to use radio spectrum. A standard license gives the licensee permission to engage in some special activity not generally open to others. This leads to specification of the terms of the wireless services defined in the license, including extensive regulatory constraints on services offered, technologies employed, business models allowed, the structure of the market (number of competitors permitted), and other operational details easily separable from the issue of frequency interference. A right to use airwaves, conversely, constitutes a generic entitlement. The governmental interest is to define the edges of that right such that others may equally exercise their rights to use airwaves.

Before the enactment of the 1996 General Telecommunications Law, private radio spectrum users were licensed under a model similar to that used by the U.S. Federal Communications Commission (FCC). An office inside Guatel,<sup>15</sup> the state telephone company privatized in 1997, was managed by a branch of the military. It zoned the radio spectrum, allotting blocks of bandwidth for particular uses patterned after the FCC's Table of Frequency Allocations. It would then divvy blocks into individual licenses, establish rules of operation, and assign licenses to users. Foreign nationals were not allowed to apply for a license. The licensing process was not transparent and corruption emerged. The licenses were awarded free of charge,<sup>16</sup> but demand for licenses far exceeded supply. An extra-legal market for licenses arose whereby bribes and side payments matched demand with supply.

While the costs generated by the rent seeking for licenses may have been considerable, this analysis focuses on the regulatory constraints placed on the telecommunications market. By instituting central allocation policies used elsewhere, Guatemala limited opportunities for consumers to enjoy enhanced competitiveness in wireless services, for businesses to realize efficiencies in accessing enhanced telecommunications networks, and for entrepreneurs to invest in new technologies. The parsimonious allocation of spectrum, the slow issuance of licenses under the traditional

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are not reported to the government. The commercial radio market provides some evidence that *TUFs* are not heavily discounted, indicating that investors expect relative regulatory stability. The going market price for a *TUF* granting use of FM band frequency space in the Guatemala City area goes from \$600,000 to \$750,000, and can be leased at approximately \$4,000 per month. Assuming zero growth, this implies a discount rate of just over seven percent per annum.

<sup>15</sup> The "Dirección General de Radiodifusión y Televisión Nacional." An office with this name still operates, but it exercises only limited power over commercial radios and TV. Specifically, it manages the state radio station T.G.W., provides a register for radio announcers, coordinates radio and T.V. networks for official government comunicués, and oversees media content.

<sup>16</sup> Licensees purchased a nominal tax stamp (usually less than \$40) and posted a moderately-priced bond as a performance guarantee.

system, and the rigid, inflexible manner in which standard licenses limit innovative use of radio spectrum, all undermine economic efficiency.<sup>17</sup> (Hazlett 2001a).

The spectrum allocation system of Guatemala changed dramatically with the “Ley General de Telecomunicaciones of 1996.” Allocation of radio spectrum evolves from the bottom up, as individual applicants have the right to use unoccupied frequencies. Any person or company, national or foreign, may request any spectrum band not currently assigned to other users. When conflicts arise due to interference from signals of adjacent bands and/or intermodulation distortions, the first resort is a mediator. If private mediation fails, specified rules are enforced by the telecommunications regulatory body. Additionally, the injured party may sue for damages in existing courts.

### III. THE STRUCTURE OF GUATEMALAN REFORM.

First, an independent regulatory body was established, the Superintendent of Telecommunications (SIT). Under the previous state telecommunications monopoly, there were no private firms to regulate.<sup>18</sup> Alternatively, existing courts -- or a newly established Spectrum Court (with technical expertise) – could have enforced the new law.<sup>19</sup> The newly created body was conceived as an administrator to enforce specified rules. The broad political discretion of the public interest standard is not allowed the SIT, which – like law enforcement agencies or the courts – assumes a reactive role. Essentially, the SIT is constituted to respond to private claims and to adjudicate disputes over airwave rights.

Second, a registry of all uses of the communications spectrum was produced by the SIT. This computerized database is, by law, easily accessible to the public. This was a vital step in creating transparency for private wireless users (and potential users). It effectively displays information on telecommunications opportunities, easing entry into unoccupied bands.

Third, existing users were granted flexibility in the use of radio waves. Frequencies assigned to licenses may be employed according to market conditions so long as emissions are confined to the original bandwidth assigned. Since the state

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<sup>17</sup> Hazlett, *The Wireless Craze...*, op cit.

<sup>18</sup> Guatel, the state monopoly, was reorganized as Telgua in 1997. It was then sold to private investors in 1998. See *Communications in Guatemala*, National Economics Research Center (CIEN) (1999).

<sup>19</sup> Thomas W. Hazlett favored this alternative on the grounds that regulatory agencies are more susceptible to capture. Pablo Spiller argued that Guatemalan courts were not sufficiently neutral as to offer superior rights adjudication. However, Spiller now writes: “We believe the responsibility for adjudicating spectrum property rights should lie with the judiciary.” Spiller & Cardillo (1999, 73). The issue of how to shield dispute resolution from political pressures is a difficult one, needless to say, with implications far beyond telecommunications policy.

telecommunications monopoly, Guatel (now privatized under the name Telgua), was the dominant incumbent in Guatemala, this firm was grandfathered with over 900 frequency rights, as were radio and television broadcasters and the erstwhile cellular monopolist, ComCel.

Fourth, entrepreneurs, firms, or organizations wishing to access frequencies are allowed to petition the *SIT* for the right to use any unoccupied bandwidth. The adjudication process contained in Article 61 of the law is quite simple and has been implemented in practice as follows:

- 1) An interested party surveys existing spectrum use in the spectrum registry of *SIT*.
- 2) The party applies to *SIT* for the right to use a frequency band as specified in the application form.
- 3) The application is evaluated by *SIT* which deems it accepted, incomplete, or rejected. *SIT* is required to answer within 3 days. Grounds for rejection include technical interference or request of reserved or radio amateur bands. Reserved bands are for government use only.<sup>20</sup>
- 4) If the application is accepted, public notice is issued. Parties objecting to the new use file formal complaints. Grounds for opposition are limited to technical interference.
- 5) Complaints are adjudicated via binding arbitration. The adjudication process cannot exceed 10 days.
- 6) Other interested parties are allowed to file competing claims to requested spectrum rights.
- 7) If no competing claims are filed, then the petitioner directly receives rights without auction *gratis*.
- 8) If competing claims are filed, then *SIT* must schedule an auction within 35 of the close of the opposition period.

The result of this law is observed in the wireless license itself. See Figure 1. Instead of merely authorizing particular “radio stations,” as in the U.S. license, the Guatemalan wireless operator explicitly controls the spectrum resource for a specified time period. The *TUF* is defined in a one-page form listing six basic variables:

- 1) frequency band
- 2) hours of operation
- 3) maximum power transmitted
- 4) maximum power emitted at the border of adjacent frequencies
- 5) geographic territory
- 6) duration of right (beginning and ending).

The back of the *TUF* (not shown) is for endorsements which are required whenever the instrument is negotiated for property transfer.

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<sup>20</sup> The law stipulates that the government may at any moment request *SIT* to transform reserved bands into regulated bands.

**No. Orden:**

**No. Registro:**

**LA SUPERINTENDENCIA DE  
TELECOMUNICACIONES DE GUATEMALA**

Con base en el Artículo 57 del Decreto 94-96

Otorga el Presente

**Título de Usufructo de Frecuencia**

A:

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*Banda o Rango de Frecuencias* :

*Horario de Operación* :

*Potencia máxima efectiva de radiación* :

*Máxima intensidad de campo eléctrico o*

*potencia máxima admisible en el contorno* :

*Fecha de Emisión* :

*Fecha de Vencimiento* :

Figure 1. A Guatemalan *Título de Usufructo de Frecuencia* (TUF.)

## IV. SIMILAR REFORMS IN EL SALVADOR.

Parallel developments in neighboring El Salvador led, not entirely coincidentally, to a 1996 spectrum liberalization nearly as sweeping as Guatemala's. The reform in El Salvador also allowed for open access to unoccupied radio bands, although users would not be given title. Their use rights did explicitly contain the right to subdivide and transfer control of specified frequencies, and to flexible use (any non-interfere service could be offered). While spectrum was treated generically in the law, the liberal regime governing bands used for broadcasting broke down almost instantly. When the regulator, obeying the law, assigned an FM radio license to a group affiliated with opponents of the ruling party, he was sacked. The free entry rules appear to have remained intact for non-broadcasting services, however, which allows us to double our "liberal" sample size when comparing the effect of regime switches on performance in the market for wireless communications.

## V. ADMINISTRATIVE AND ECONOMIC RESULTS.

The results of just over five years of liberal spectrum use in Guatemala and El Salvador constitute potentially important inputs into the debate over reform elsewhere. Proponents of reform argue that the market is capable of allocating radio spectrum to diverse uses in accord with consumer preferences, and that no special obstacles to market transactions exist. Opponents respond by arguing that spectrum is not subject to the standard laws of economics, and that government allocation is necessary both to prevent administrative chaos in determining rights (and subsequent airwave interference) and to promote competition in wireless services. Here we present preliminary evidence on the experience of markets in which spectrum liberalization has occurred to shed light on this debate.

a. *TUF* Assignments in Guatemala

Despite political pressures to protect incumbent interests, including government efforts to delay competition in mobile telephone markets while Guatel was being privatized (the more rapid new entry was permitted, the lower the price for state assets), requested *TUF*s have generally been issued. All told, 5,000 new rights were awarded under the spectrum reforms as of September 2001. See Table 1.

Table 1. Spectrum Rights Issued by Guatemalan SIT			
<i>Titulos de Usufructo</i>	<i>Telgua rights grandfathered</i>	<i>Independent non-competing rights</i>	<i>Rights issued by competitive bidding</i>
5000	930	918	3152
100%	18.6%	18.4%	63.0%

Source: SIT (September 2001).

This compares favorably to the situation in the U.S. and other countries where license auctions have been instituted. Most importantly, the issuance of licenses has proceeded without administrative confusion or corruption. This is despite the exceptionally large shift in the law and the dramatic transformation in the nature of the rights being issued. In the United States, with a shift only in license assignment procedures, auctions have encountered considerable administrative confusion, with more than half of all monies bid in FCC auctions since 1994 proving (as of this writing) uncollectible.<sup>21</sup>

b. Auction Prices for Licenses and *TUFs*

Guatemala exhibits low entry barriers in the wireless market. There are no regulatory mandates for providers, such as the buildout or investment requirements commonly embedded in telephone company licenses elsewhere (including the U.S.<sup>22</sup>) And the property rights model instituted by Guatemala has, contrary to the “windfall” argument put forth by some,<sup>23</sup> resulted in relatively *low* values for wireless licenses. See Figure 2 (showing the low relative price of *TUFs* in the bands used for mobile telephony) and Figure 3 (indicating that low income does not appear to account for this). Despite explicitly granting much broader property rights than those afforded wireless licensees in other Latin American countries, *TUF* valuations are typically far below those associated with mobile phone licenses issued without property rights (in other countries). This could result either due to investor estimates of high risk in the Guatemalan market (discounting future cash flows at a relatively high rate), but evidence from the marketplace (including the 7% pay-out rate on FM radio licenses) is inconsistent with this explanation. Rather, it is likely the consequence of a liberal regime where current and potential competition offsets the profitability of enhanced, flexible, and legally secure rights bestowed on spectrum owners.

The importance of reducing entry barriers to telecommunications service providers is accentuated in a developing country where improved infrastructure is a major

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<sup>21</sup> The most serious problem has arisen in the issuance of PCS C Block licenses. Originally auctioned in 1995-96 for bids totaling over \$10 billion, with easy credit terms extended to firms qualifying as “small businesses” or “rural telephone companies.” Most large bidders declared bankruptcy and sought the protection of courts to avoid either paying for licenses or giving the licenses back to the FCC. See: Thomas W. Hazlett and Babette E.L. Boliek, *Use of Designated Entity Preferences in Assigning Wireless Licenses*, 51 FED COMM L J 639 (May 1999). The Commission held a re-auction of licenses in January 2001, this time netting \$16 billion in winning bids, but the original (bankrupt) bidders have generally won their suits. The litigation is being appealed to the U.S. Supreme Court, with the 30 MHz allocated to C Block disputed licenses unutilized.

<sup>22</sup> Again, economists have identified such rules as inefficient and have advocated abolishing them. See Peter Cramton, *Lessons from the United States’ Spectrum Auctions*, testimony before the United States Senate Budget Committee (10 Feb., 2000).

<sup>23</sup> J. H. Snider, *Who Owns the Airwaves? Four Theories of Spectrum Property Rights*, New America Foundation Issue Brief, Spectrum Series #3 (April 2002).

driver of economic progress. In 1996, for instance, Guatemala had below five percent per capita telephone penetration (under five lines per 100 persons). With deregulation of wireless, inadequate fixed line communications may quickly improve. According to Leslie Arathoon of Pyramid Research: “A wireless local loop (WLL) license in Latin America costs an average of \$0.005 per population per MHz. In Honduras, a WLL license was auctioned in late 2000 for \$0.0012 per population per MHz, one-fifth the average. In Guatemala, this same license costs a mere \$0.0006 per population per MHz, one-tenth the Latin American average and one-twentieth what was paid in Mexico.”<sup>24</sup> (El Salvadoran data are not included in the source available to us.)

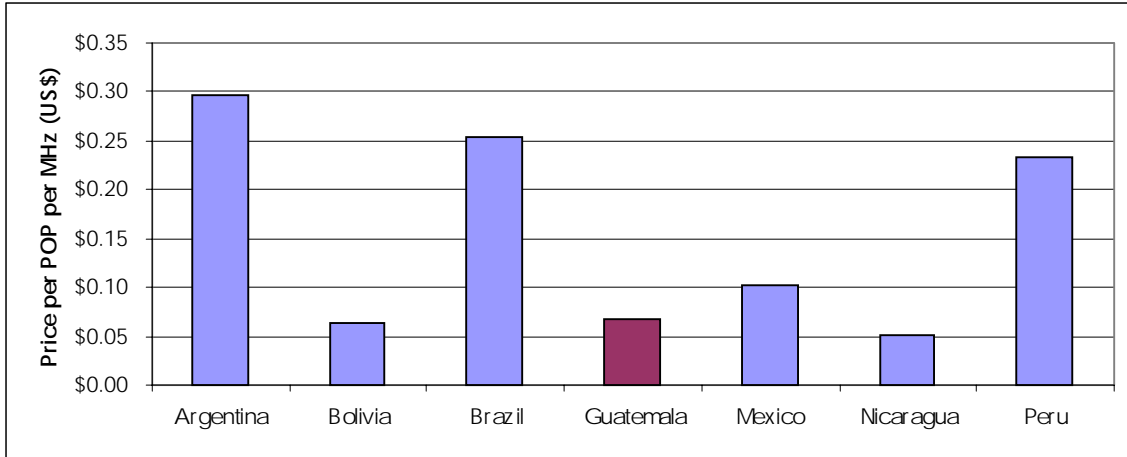


Figure 2. License Pricing for Mobile Phone Operators (2001)<sup>25</sup>

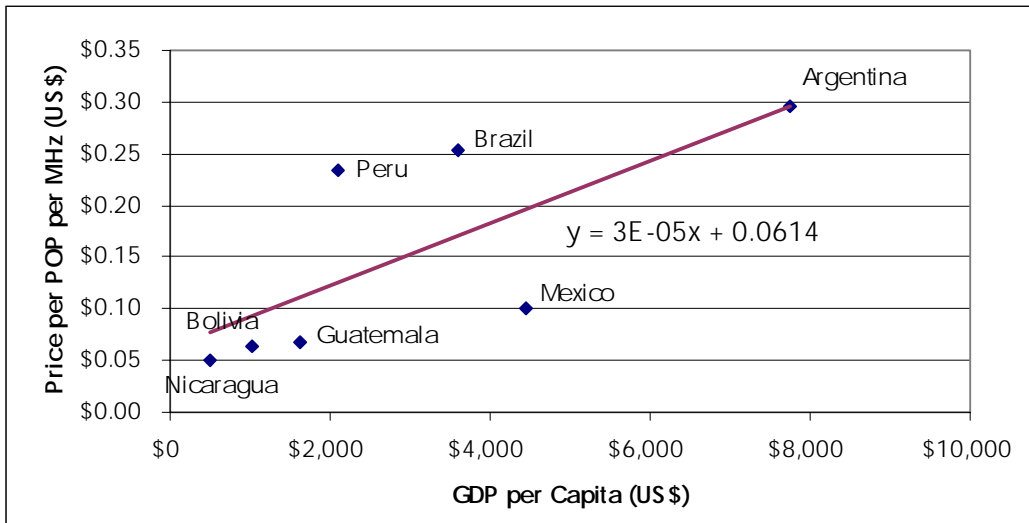


Figure 3. Wireless License Prices vs. GDP/capita (2001)<sup>26</sup>

<sup>24</sup> Leslie Arathoon, *Central America: Small Markets, Big Returns*, Pyramid Research (Jan. 2002).

<sup>25</sup> Source: Pyramid Research.

c. Interference Disputes in Guatemala

The SIT monitors the radio spectrum through its technical unit and a number of receiving and control stations. Half of SIT's radio spectrum inspections originate from the call of an affected private party. The other half originate internally. Twenty-eight inspections took place in 2000 and 38 in 2001. Of special notice in 2001 were the inspections in the FM band. The increasing interest in this band last year was probably due to the emergence of community radios throughout Guatemala. Unofficially, SIT engineers indicate that there are probably 400 community radios operating without *TUF*'s, while reporting just 83 cases publicly. See Table 2.

Operators monitor themselves and their neighbors using equipment readily available such as the IC-PCR1000 a small unit that turns a computer into a worldwide communications receiver with modulation analysis capabilities. If an operator encounters interference signals, the issue is brought up to the Cámara de Radio Difusión de Guatemala, a private association of broadcasters, which has established its own private arbitration office. The Cámara itself has acquired sophisticated equipment to monitor the airwaves. The interference problems that remain unresolved are those caused by pirate radio stations ("community radios") that *SIT* and the government have been unable, or unwilling, to close.

Commercial radio operators claim that the current government has pressured the SIT to tolerate illegal community radios until the next election in exchange for political support. Roberto Bocalleti, President of the Cámara de Radio Difusión de Guatemala, recently issued a call for the government to turn its attention to the interference problems caused by community stations. This has been the most publicized and politicized interference problem in Guatemala since the enactment of the 1996 Telecom Law. The problems of unlicensed operations are not exacerbated by the liberalization, however, but likely moderated (due to the low cost of obtained lawful access to radio waves). Many other countries, including the United States, see pirate radio stations operating outside the law. The number of reported interference problems is relatively small considering the number of *TUF*'s issued by the SIT and the large number of competitors and different technologies in use. See Table 2.

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<sup>26</sup> Source: Pyramid Research.

Table 2: Official Number of Interference Conflicts <sup>27</sup>	
<i>Type of Conflict</i>	<i>No. of cases reported</i>
Commercial radios operating without usufruct title	83
Administrative proceedings	83
Administrative appeals presented to date	4
Administrative proceedings with fines	68
Fines charged to date	1
Collection actions by the state	3
Cases pending suit filing	27

Note: Data from enactment of the 1996 Telecom Law up to March 8, 2002.

By limiting authority of the SIT the 1996 Law makes it worthwhile for right holders to incur the costs of negotiating between themselves as a first recourse. There are two private arbitration courts in Guatemala. Of these, one (the Centro de Arbitraje y Conciliación [CENAC]), reports 6 disputes involving interference claims in 2001 and 2002. If private negotiations or arbitration fail, the affected party may present a complaint to the SIT. The technical officers of SIT then study the matter and decide whether an interference problem does exist. Even if they determine that a problem exists, the SIT usually asks the private agents to try to negotiate once more. If this action fails also, the SIT files an administrative proceeding addressed to the head of the Ministerio de Comunicaciones y Obras Públicas (MICIVI). The MICIVI may then determine that a fine must be paid by the interfering party. These may be appealed. Whenever the interfering party does not pay the fine, the SIT initiates a collection action.

### c. Output Trends in Wireless Telephone Service

Mobile phone penetration in Guatemala is today higher than that of fixed lines. Fixed lines penetration has increased from 4.1% at year end 1997 to an estimated 6.4% at year end 2001 at an annual compounded growth rate of 9%. On the other hand, mobile subscriptions have grown from 0.6% of total population (year end 1997) to an estimated 9.5% (year end 2001), an annual growth rate of 73%. Four operators are now licensed and operational. These are BellSouth (U.S.), ComCel (the former monopoly wireless provider), Telgua (the privatized wireline telecommunications provider), and Telefonica (Spain).

El Salvador similarly has four head-to-head rivals now providing mobile wireless telephone service: Telemovil, Telefonica, Personal, and Digicel. In either country, the competition has proven robust as measured by the best proxy for productivity gains: output. Over the 1997-2001 period, both countries saw wireless telephone traffic (total minutes of use) grow by over one hundred percent annually. Only one of seventeen Latin

<sup>27</sup> Source: SIT Memo (March 8, 2002).

American countries saw greater increases. See Figure 4. While substitution for poorly deployed wireline infrastructure is an important component of the demand for wireless, neither Guatemala nor El Salvador witnessed deteriorating wireline service relative to other Latin American countries. Hence, the growth in wireless appears to reflect an unambiguous increase in productive activity.

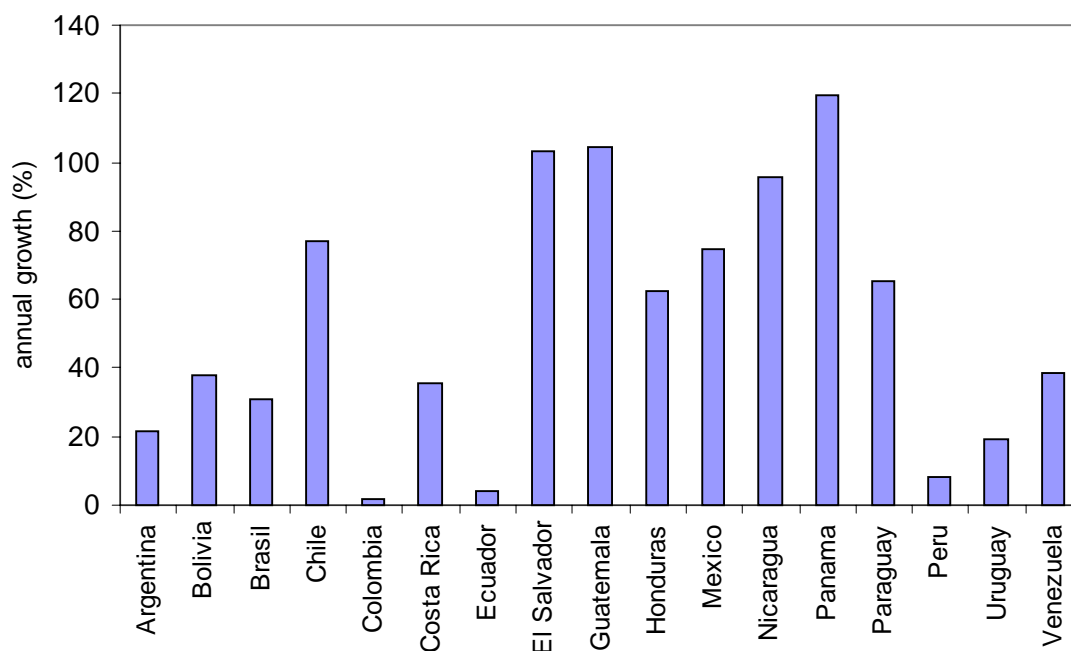


Figure 4: Annual growth in total wireless minutes (1997-2001)

This is borne out by estimating reduced form multivariate regression equations. Using, alternatively, both the penetration rate for wireless subscribership and the total minutes of wireless traffic as dependent variables, we included the following right-hand side variables: the price of fixed line service, the price of wireless service, growth in GDP per capita, GDP, total GDP, and a dummy for liberalization (= 1 if Guatemala, El Salvador; = 0 otherwise). Four specifications were estimated with data from seventeen Latin American countries over the 1997-2001 period; where data were not available from the World Bank database, the year and country in question were omitted. As seen in Table 3, the coefficient on the liberalization dummy is positive and highly significant across each regression.<sup>28</sup> The results strongly suggest that the spectrum reform programs pursued by Guatemala and El Salvador are associated with substantial increases in wireless telecommunications usage.

<sup>28</sup> Results for identical specifications changing only the dependent variable (to subscriber penetration rate for wireless) yielded similar results and are not displayed.

Table 3. Liberalization and Wireless Growth Across Latin America (Dependent Variable is Growth Rate of Total Wireless Traffic)				
<i>RHS Variables</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>
Fixed Line Price of Local Call (3 min)	-597.28 (1.17)	-1013.7 (1.66)	-185.63 (0.43)	-246.07 (0.54)
Growth of GDP per capita	-3.26 (1.39)	4.767 (0.66)	-2.90 (1.19)	-5.176 (1.10)
Average Price of Wireless service (US\$/min)	-2091.6 (6.92) <sup>a</sup>	-2161.2 (7.28) <sup>a</sup>	-2196.6 (7.34) <sup>a</sup>	-2133.9 (6.40) <sup>a</sup>
Liberalized Spectrum	1411.8 (7.80) <sup>a</sup>	1669.3 (6.04) <sup>a</sup>	1454.7 (7.94) <sup>a</sup>	1368.3 (5.56) <sup>a</sup>
Lag Level of Fixed Line Penetration	-40.49 (3.28) <sup>a</sup>	-23.03 (1.21)	-43.23 (3.50) <sup>a</sup>	-46.40 (3.18) <sup>b</sup>
GDP (billion US\$)	0.149 (1.35)	0.372 (1.73)		
GDP per Capita (PPP US\$)		-104 (1.18)		0.027 (0.55)
R-Squared	0.973	0.971	0.972	0.973
No. Observations	30	30	30	30

Notes: Panel data estimation with country fixed effects. Corrected for 2<sup>nd</sup> order autocorrelation using Cochrane-Orcutt Iterative process. t-statistics in parenthesis. a= 99% confidence level; b = 95 % confidence level; c= 90% confidence level.

#### d. Competition in Wireless Telephony

While the increase in wireless traffic may be the best measure of enhanced competitiveness, a direct measure of rivalry is often employed. The Hirschman-Herfindahl Index is the sum of the squares of the market shares of all firms in a given market. The maximum value is 10,000 (= 100<sup>2</sup>), and the minimum is zero. The lower values are associated with a greater dispersion of suppliers in the market, and more choice for consumers. The HHI is used by, among others, the United States Department of Justice and the U.S. Federal Trade Commission in determining whether or not to challenge mergers under the antitrust laws.<sup>29</sup>

<sup>29</sup> The DOJ provides a brief summary of the the Hirschman-Herfindahl Index online: <http://www.usdoj.gov/atr/public/testimony/hhi.htm>.

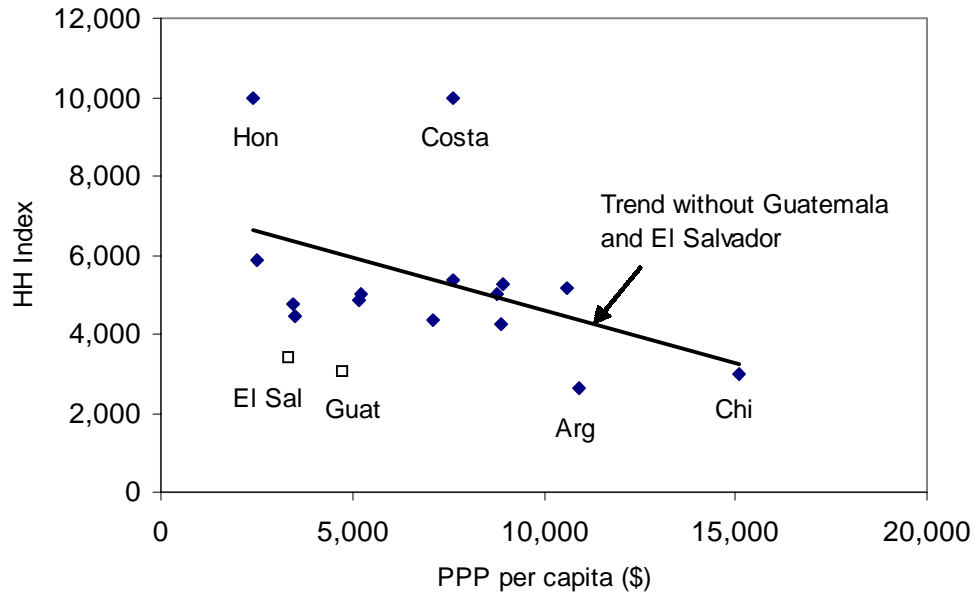


Figure 5. HHIs in Latin American Wireless Telephone Markets

Among Latin American countries, only Argentina and Chile have concentration ratios as low as those seen in the wireless sectors of El Salvador and Guatemala. This is a significant victory for competition policy in the small Central American nations, as the far larger populations and per capita incomes in Argentina and Chile presumably make entry by multiple firms more economic. As seen in the trend line (excluding El Salvador and Guatemala), there is a strongly negative correlation between per capita income and HHI. There is, not surprisingly, a strong correlation between the liberalization variable (assigning a 1 value to El Salvador and Guatemala, 0 to all other countries) and the HHI in Latin American wireless markets. See estimated regression results in Table 4.

The steep rise in wireless usage in Guatemala and El Salvador is correlated with competitive entry under the new law, and is likely caused by it. Neither market would be so open were regulators allowed more discretion. Indeed, only one other Central American country has as many as three cell-phone competitors -- Nicaragua. Panama has two providers, and Costa Rica and Honduras continue to maintain monopoly wireless telephone systems. Where spectrum rules have been liberalized, competition has flourished.

Table 4. Correlation Between Liberalization and HHI (Dependent Variable is Level of HH Index)	
<i>Right-Hand Side Variables</i>	<i>Estimated Coefficients</i>
Fixed Line Price of Local Call (3 min)	-24549 (2.12) <sup>b</sup>
Liberalized Spectrum	11553 (5.04) <sup>a</sup>
Level of Fixed Line Penetration	-94.88 (0.75)
GDP (billion US\$)	12.282 (4.39) <sup>a</sup>
GDP per Capita (PPP US\$)	-1.087 (2.24) <sup>b</sup>
R-Squared	0.838
No. Observations	43

Notes: Panel data estimation with country fixed effects. Corrected for Heteroskedasticity and autocorrelation using Newey-West robust covariance matrix. . t-statistics in parenthesis. a= 99% confidence level; b = 95 % confidence level; c= 90% confidence level. Data on 17 Latin American countries from [World Development Indicators \(database of the World Bank\)](#), and Pyramid Research.

#### e. Wireless Phone Rates.

While the strong growth in wireless output seen in both El Salvador and Guatemala suggests that competition has driven prices down, the data are actually mixed. Guatemala has achieved the lowest prices of any country in Latin America; average price per minute of wireless is sixteen cents. Yet the picture is considerably different in El Salvador, where prices are more than twice as high. While several countries have yet higher prices, it is unclear why El Salvador – with robust competition and rapidly expanding subscribership and use – faces such high reported prices. See Figure 6.

The mystery actually thickens when we explore Figure 7, which displays the relationship between market concentration (measured by the HHI) and market prices. There is, ostensibly, no relationship; highly concentrated markets appear to charge no more, and deconcentrated markets no less, than elsewhere. This counters the strong experience over time in the United States, which has seen prices fall dramatically with the entry of additional wireless service providers. One source of confusion may be that certain monopoly wireless providers, for instance the government-owned supplier in Costa Rica, cross-subsidize services. There may also be quality dimensions unaccounted for in the prices reported. High quality service would offset high prices, of course, and vice versa. Further study is warranted.

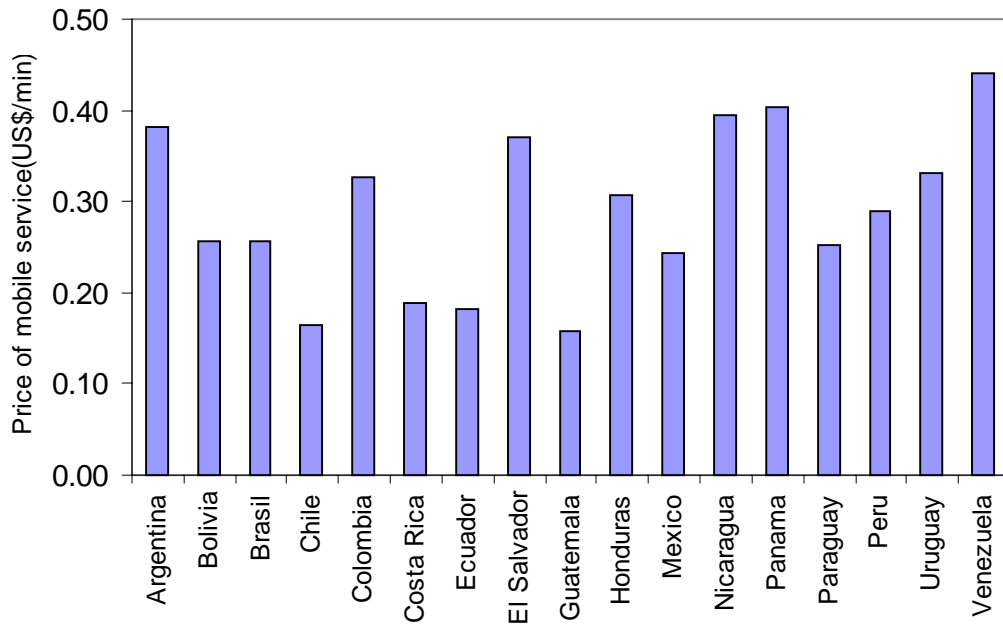


Figure 6. Average Price of Wireless Service (US\$/min)

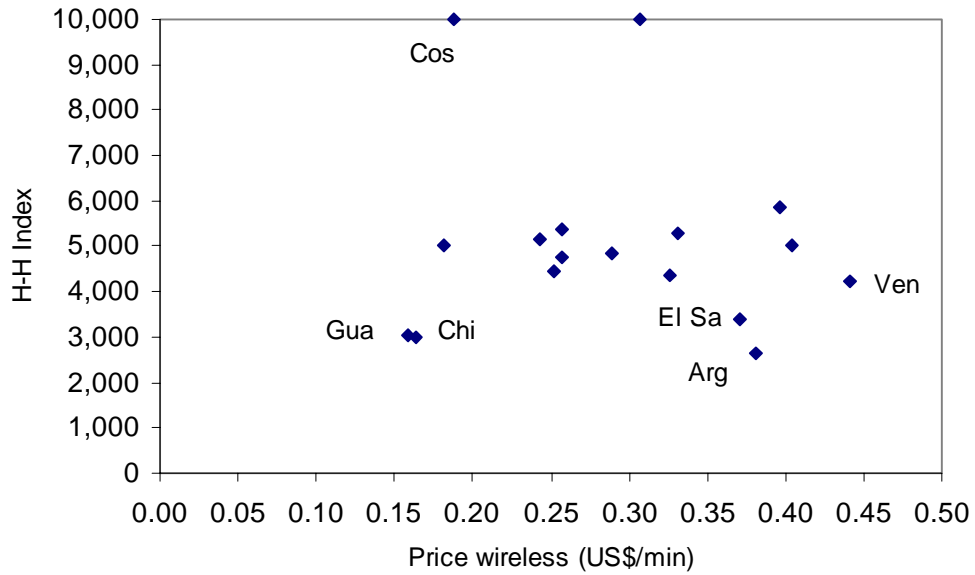


Figure 7. Average Price of Wireless Service (US\$/min) and HHI

## VI. CONCLUSION.

The demonstration effect of a country that steps out of the traditional policy mold can be powerful. Arguments for and against reform can then be evaluated by reference to the actual experience of that observable experiment. The uncertainty surrounding implementation of innovative methods diminishes.

We are well positioned to learn from ongoing market developments in two countries that have opened access to radio spectrum in ambitious policy reforms. In Guatemala private property rights have been explicitly established for the use of radio waves. In El Salvador spectrum property rights have not been created per se, but the system of regulation now allows private parties to request and gain access to unoccupied airwaves via licenses that are very broadly defined. Hence, both countries allow wireless operators the flexibility to respond to market incentives, and entrepreneurs are given free entry into wireless markets.

There are four basic levels on which to evaluate the reforms to date. First, do open access rules seem to work? Administratively, rights should be fashioned without chaos, and investors should be able to assess the regime shift as a viable set of rules under which to make the requisite commitments to providing service. With changing rules, the cost of uncertainty is, of course, a primary consideration.

The answer to this question is in the affirmative. The liberalization of rights has not been associated with increasing transactions costs. The reforms have evidently encouraged investment by service providers, indicating that neither administrative confusion nor conflicting property rights (and airwave interference) are anticipated to be problematic. The most sensitive aspect of the reforms involves the interference dispute resolution mechanisms thrown to the market in Guatemala, and these have produced orderly developments rather than chaos.

The second question is: Has output increased? As a proxy for productivity, the single most important economic impact of the reform is whether it has enabled more customers to get more service. On this score, the liberalization in Guatemala and El Salvador appears highly successful. Either country has seen its wireless subscribership grow sharply, and the two nations rank among the top three markets in Latin America for wireless growth in the 1997-2001 period. It does not appear that this growth is caused by a decline in the value of the substitute service, wireline telecommunications, but by rampant competition in the wireless industry.

Which brings us to a third question: Has competition materialized? Indeed, the two reform markets arguably see the most robust competition in Latin America, rivaling much higher income, and larger, countries (Argentina and Chile) in the range of consumer choice now available. Four side-by-side wireless rivals compete for customers in Guatemala and El Salvador, and the free entry policy is surely the cause of this.

Finally, have prices for wireless services declined? For Guatemala, which boasts the lowest mobile telephone rates in Latin America, the answer is affirmative. For El Salvador, which has much higher prices, the evidence is mixed. The co-existence of extremely high subscriber and usage growth, on the one hand, and relatively high prices, on the other, should be subjected to further investigation.

Overall, the results of this inquiry are highly supportive of the case for spectrum liberalization. Additional research, and increased attention to these ongoing experiments, could prove fruitful as policy makers grapple with intensifying demands from wireless users and entrepreneurs for access to radio spectrum while constrained by a bureaucratic allocation system limiting the economic productivity of this essential natural resource.