Effective Spectrum Pricing in Latin America: Policies to support better quality and more affordable mobile services

February 2018

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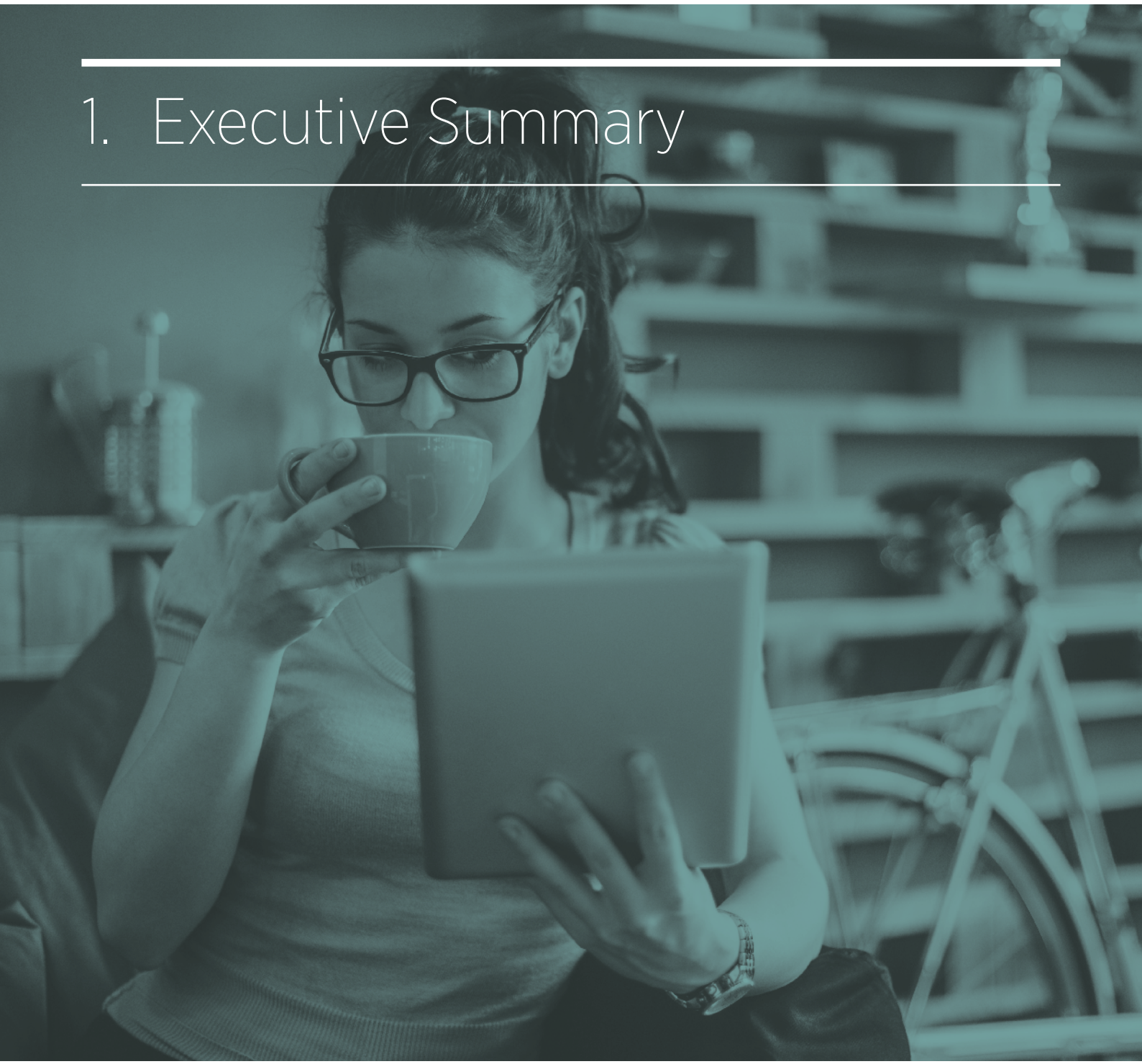


To deliver affordable, widespread, quality mobile broadband services, operators require fair access to sufficient radio spectrum. Careful spectrum management is central to the digital economy. This report highlights the damage done to consumers by policy decisions that artificially inflate spectrum prices. Put simply, higher prices are associated with more expensive, lower quality mobile broadband, slower deployment of next generation networks and irrecoverable losses in consumer welfare.

This report is one of a series of regional follow ups to the GSMA's global report on the impact of spectrum prices.[1] It investigates spectrum pricing trends in Latin America and their impact on consumers, and highlights cases of good and bad practice by policymakers. One finding is that median prices for capacity spectrum in Latin America are almost twice as high as in Europe, so there is reason to be concerned about policy.

There is a view that very high spectrum prices have no downside for consumers. Spectrum costs are categorised as 'sunk costs' and this has been interpreted as meaning they have no impact on operators' investment and pricing decisions. Thus auctions are sometimes viewed as a risk-free means of maximising state revenue. These spectrum pricing studies are part of the growing body of academic and industry research which refutes this thesis.

Statistical evidence presented here links high spectrum spend in Latin America with:

- **lower quality and reduced take-up of mobile broadband services; and**
- **higher consumer prices for mobile broadband data.**

High prices can often be traced to decisions by policymakers. In Latin America, the following three types of policy challenge are widespread:

1. **High annual licence fees that create disincentives for investment in networks and price competition;**
2. **Delays in making spectrum available and uncertainty over future supply; and**
3. **Direct awards at high prices (relative to global benchmarks), often coupled with inappropriate award rules and licence conditions.**

Many Latin America countries have a mixed track record of making spectrum available in a timely manner and making credible commitments regarding future releases. Approaches to setting reserve prices and award rules vary greatly, with examples of both good and bad practice. Spectrum scarcity is a common problem with the amount of spectrum allocated to mobile operators well below best practice allocations in Asia, Europe and North America.

This report makes four key recommendations for regulators in Latin America and beyond:

1. **Set modest reserve prices and annual fees, and otherwise rely on the market to determine spectrum prices;**
2. **License spectrum as soon as it is needed and provide road maps for future spectrum releases, so as to avoid artificial spectrum scarcity;**
3. **Avoid onerous licence conditions, such as coverage obligations not reflected in reserve prices or asset reversion clauses; and**
4. **Adopt best practice in award design, for example by using multiple round auction formats and avoiding beauty contest or sealed bid designs that prioritise revenues over efficiency.**

With 5G and advanced 4G technologies requiring ever-increasing amounts of spectrum, Latin American countries that do not make available spectrum in a timely fashion and/or inflate spectrum prices are not only damaging their broadband future, they are holding back their entire digital economies and likely slowing the bridging of the digital divide. Governments and regulators must fully appreciate their ability to maximise – or thwart – their digital futures when making policies that determine spectrum prices.

1 The global report, "Effective Spectrum Pricing", was published in February 2017 and is available at www.gsma.com.

2. The spectrum pricing fallacy: why high prices are not risk-free

Radio spectrum is used to carry information wirelessly for many vital services. This is especially relevant in Latin America, where many users do not have access to (or cannot afford) fixed broadband and rely on mobile networks to access the Internet. Demand for this precious national resource is so great that regulators take great care to ensure it is used as efficiently as possible. Efficient use helps to ensure that the socioeconomic benefits that spectrum enables can be maximised.

The main rationale for charging a price for spectrum, whether through upfront fees or annual charges (or both), is to promote its efficient use. The price is an objective means of distinguishing between different applications for spectrum. In this way, a well-designed auction will allocate spectrum to those who value it most and incentivise them to use it efficiently. Charging for spectrum also provides money for the state and where demand exceeds supply, this may be significant.

Following the huge revenues raised by some spectrum auctions in the new millennium, a critical question has arisen as to whether there is a trade-off between maximising revenues and maximising efficient spectrum use. Over time, does very expensive spectrum discourage efficient use and thus reduce the flow of welfare benefits?

On one point there is broad agreement. If spectrum is priced so high that it fails to sell, this does serious harm. Spectrum is a renewable resource, so when it is left unassigned for any prolonged period, welfare benefits that would have accrued to consumers, and society more widely, are lost forever.

But what if spectrum sells at a high price, is this risk-free? Historically, many mobile industry observers argued that because spectrum costs were 'sunk', no matter how high a price is paid, there should be no impact on network investment or higher retail mobile tariffs. The classic comparison is with investing in a piece of factory machinery which cannot be sold again. The upfront cost of the machine is sunk. Therefore, as it cannot be recovered, it should not influence future decisions regarding the price of the products created using the machine.

The global report highlighted recent academic work that contradicts this notion that firms ignore sunk costs when making decisions on investment and pricing (see box below). Far from being a distortion-free tax, the literature suggests that high upfront input costs can depress investment and reduce price competition, especially in settings when there are only a modest number of operators. This reinforces the point that regulators should take great care to avoid actions that could distort auction outcomes and lead to prices that exceed a fair market level. The financial upside, if any, for governments from higher revenues is offset by the risk of award failure and downstream inefficiencies. Those inefficiencies may result in lower network deployment, which in turn means more congestion and lower quality, more expensive services, factors that may have a disproportionate impact on low income users, who are more likely to depend on mobile for internet access.

WHY DO HIGH SPECTRUM COSTS IMPACT INVESTMENT AND CONSUMER PRICING?

1. Hold-up problem	■ Spectrum awards are not one-off ■ If firms believe their expected returns will be extracted in successive auctions, they will change their investment strategy
2. Internal financing constraints	■ High spectrum spend may exhaust existing funds and require financing ■ Investment by multinational parents or external sources may be redirected towards more profitable markets or ventures
3. Observed pricing decisions	■ In sectors with naturally constrained competition, firms with high sunk costs may engage less in price competition ■ High spectrum spend may act as a signal for firms not to lower prices

3. How do rising spectrum prices impact Latin American consumers?

The global report included a series of empirical analyses of spectrum pricing trends worldwide and addressed the impact that high spectrum prices have on consumers. For this report, those investigations were mirrored using data from 15 countries in Latin America. This analysis identified an upward trend in the price for capacity spectrum and a number of high price outliers since 2014. As in the global report, a link between high spectrum prices and more expensive, lower quality mobile broadband services as well as higher consumer prices was identified.

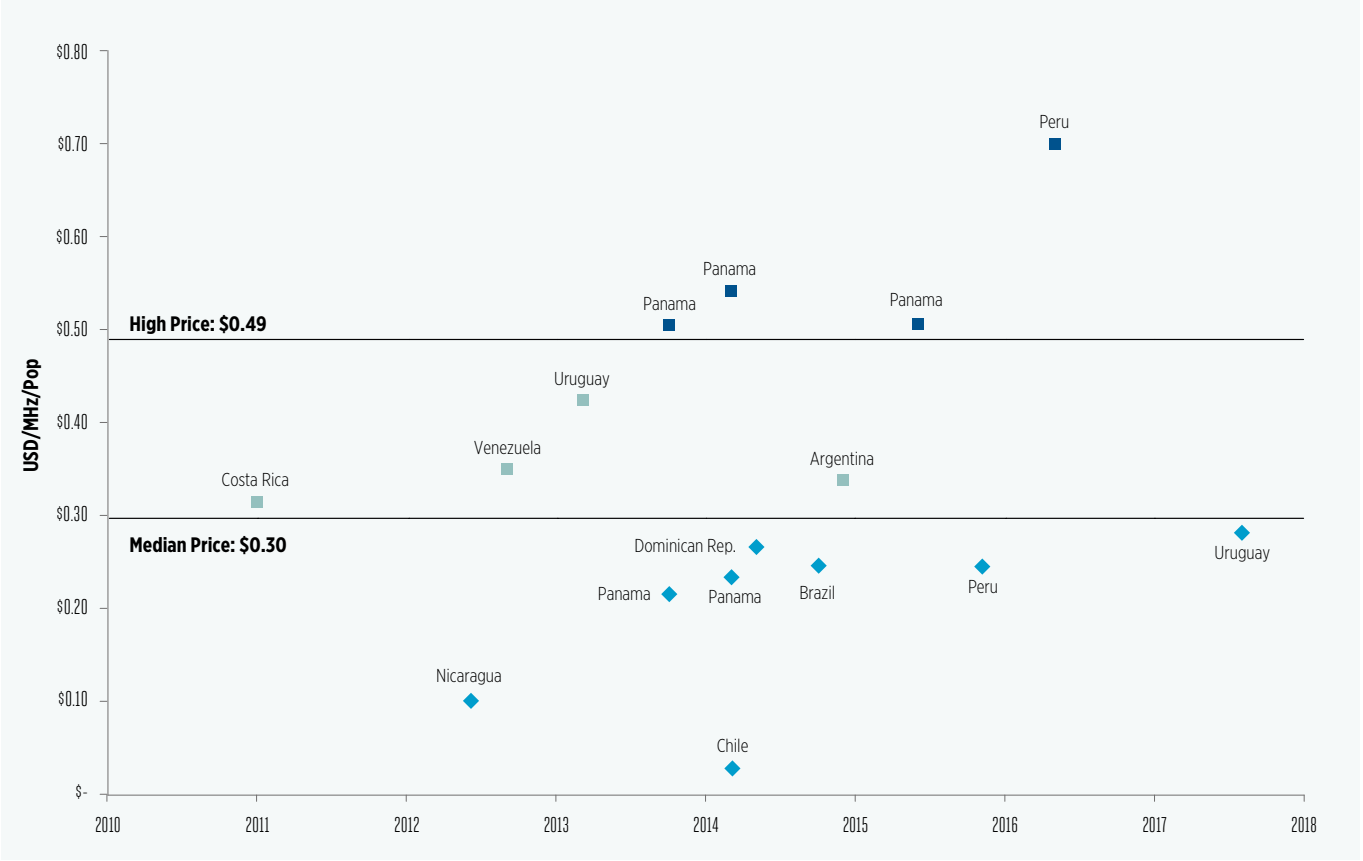
Rising spectrum prices

To explore the link between spectrum prices and consumer outcomes, the global report examined 325 awards of spectrum bands across 60 countries from 2000-2016. Over the 4G era (2008-2016), the average final price paid for spectrum sold increased 3.5 fold, while average reserve prices increased over 5-fold. Although the prices paid for many awards worldwide remain moderate, the upward trend was driven by a growth in the number of very high price auctions, including many where regulators or governments set reserve prices well above the global mean.

The Latin America study draws on a subset of these awards, covering 64 mobile spectrum band releases across 15 Latin American countries. In FIGURE 1 and FIGURE 2, the comparison shows the prices (combining upfront payments and annual fees) for bands awarded in Latin American countries for coverage and capacity[2] spectrum respectively over a seven year period from 2010 to 2017, which roughly corresponds to the 4G era in the region. To facilitate meaningful comparison across countries, prices have been converted into USD using purchasing power parity (PPP) exchange rates and adjusted to a common licence term of 15 years.[3] For illustrative purposes, countries with prices above the 75% percentile of the awards in Latin America are labelled as high prices. The award outcomes identified as outliers, in Panama for example, are ones where prices were so high that they would not be treated as plausible observations for comparative purposes in a statistical exercise.[4]

The analysis identifies an upward trend in prices in Latin America. Although there are fewer examples of extreme high price auctions in the region, when compared to the global report, such instances are again more common towards the end of the time period. This situation in Latin America would not be a concern if all instances of very high prices were attributable to strong competition between bidders with robust business cases. However, the research shows that many of these outcomes were due to policy decisions, not market forces.

FIGURE 1: COVERAGE SPECTRUM PRICES BY CATEGORY (2010-2017)



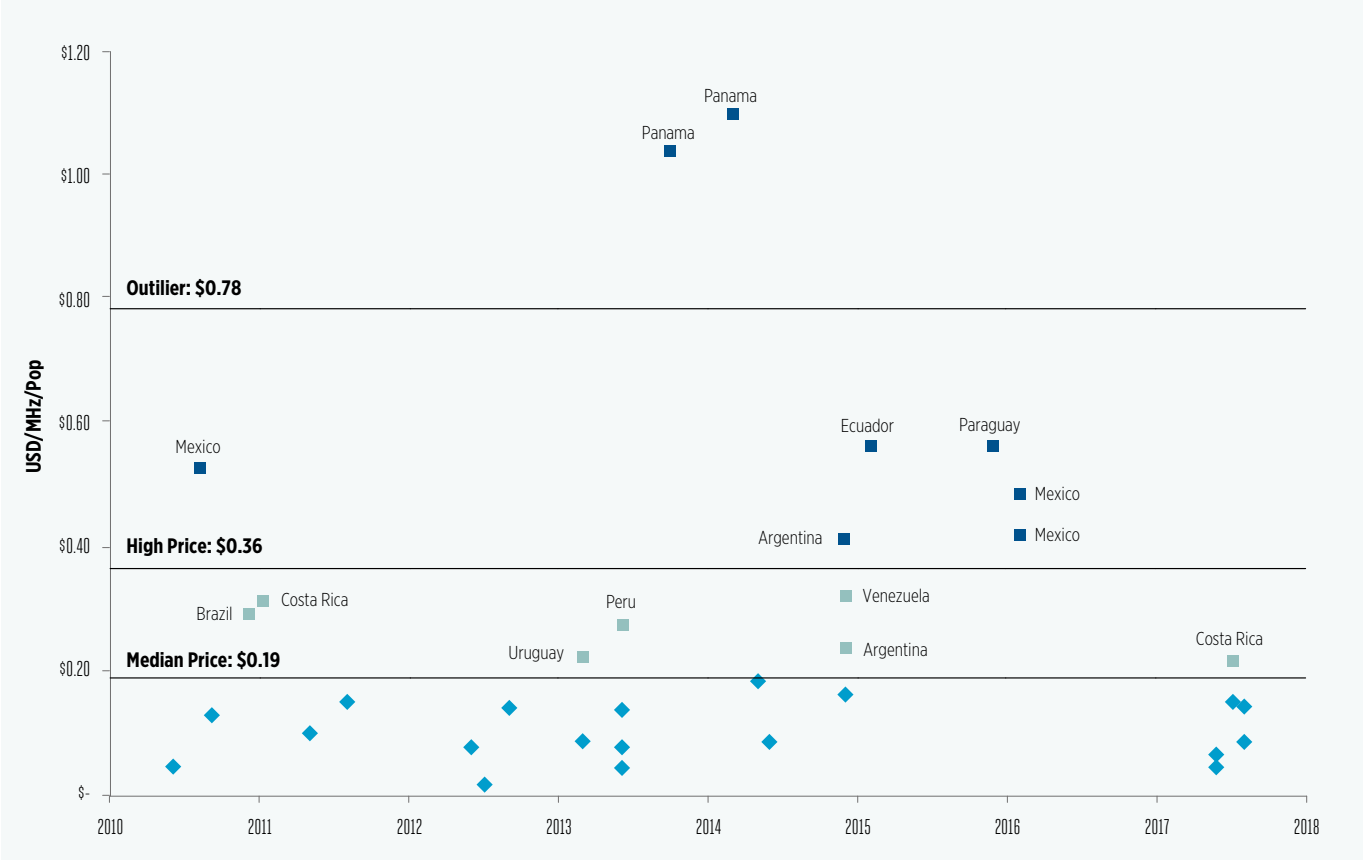
Source: NERA Economic Consulting. Notes: Latin American coverage spectrum bands include 700 MHz, 850 MHz and 900 MHz; prices are adjusted for PPP exchange rates, inflation and a 15-year licence duration, and include annual fees.

2 For the purposes of this study, we define coverage bands as those located in frequencies below 1 GHz and capacity bands as those located in frequencies between 1 GHz and 4 GHz.

3 Differences between real and adjusted revenues can be large. For example, in 2008, the Panama award of PCS raised USD 0.82 per MHz/pop unadjusted, which almost doubles to USD 1.58 per MHz/pop after adjusting for PPP and licence duration. However, purchasing power is only a rough proxy for differences in costs of access to communications services. In particular, such adjustments may be insufficient to address issues in some markets with large population groups that lack the income needed to afford basic communication services.

4 In order to identify outliers we used a standard statistical technique. The IQR is defined as the observations between the 1st and 3rd quartile. Outliers are classified as being above an "inner fence," and extreme outliers are classified as being above the "outer fence." Inner fence = 3rd quartile + 1.5*IQR. Outer fence = 3rd quartile + 3*IQR.

FIGURE 2: CAPACITY SPECTRUM PRICES BY CATEGORY (2010-2017)



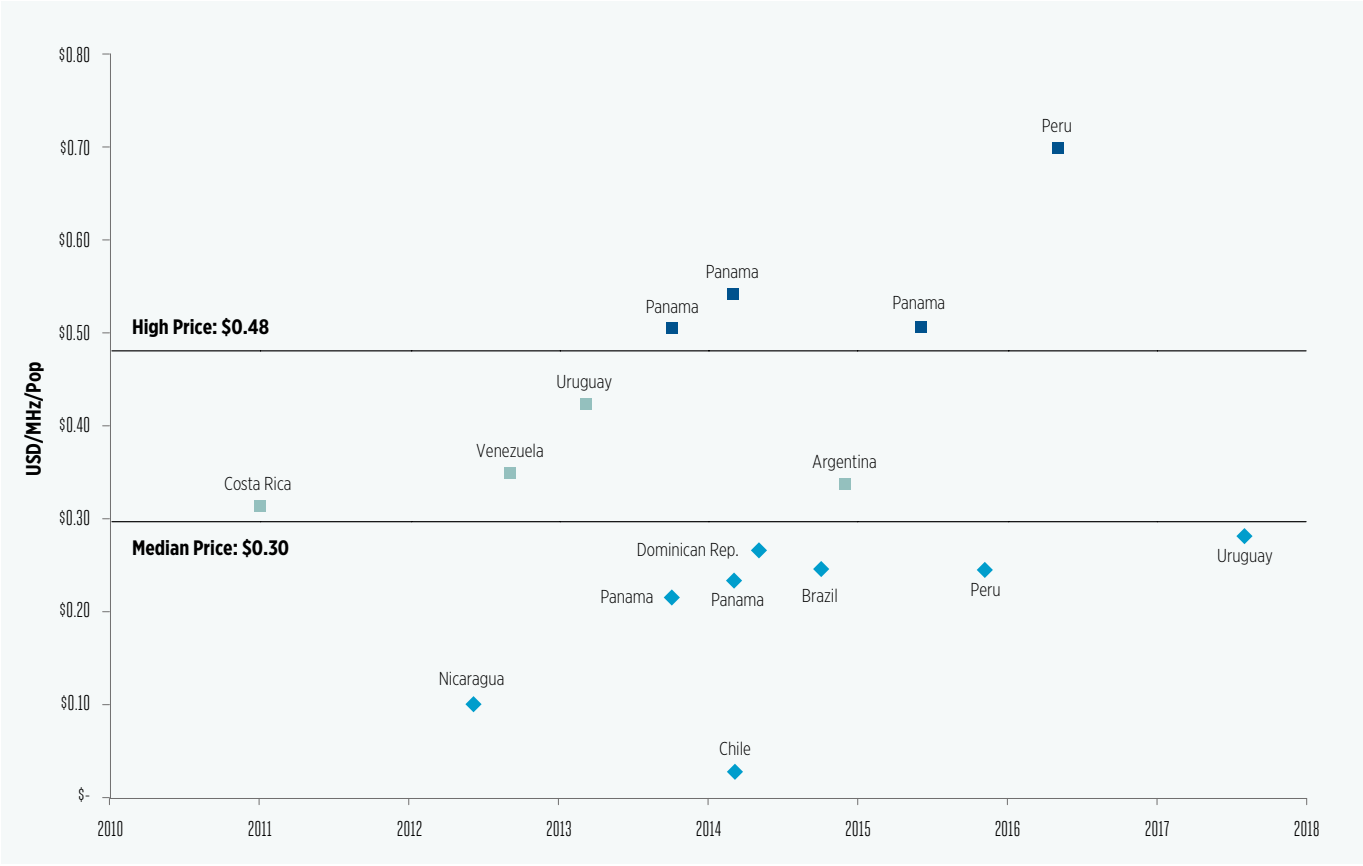
Source: NERA Economic Consulting. Notes: Latin American capacity bands include PCS, AWS, and 2600 MHz; prices are adjusted for PPP exchange rates, inflation and a 15-year licence duration, and include annual fees..

When compared to global price levels, higher price auctions in Latin America are particularly focused in capacity spectrum (e.g. AWS and PCS). Median prices for capacity spectrum are approximately 60% higher than in Europe. This can be attributed to two factors. Firstly, 2.6 GHz spectrum, which has generally fetched lower prices than PCS and AWS because of its higher frequency, has not yet been allocated widely across Latin America. Secondly, many of the awards included in our sample are beauty contests or direct awards of PCS and AWS spectrum where regulators effectively set the price for spectrum upfront. These awards were often conducted in an environment of spectrum scarcity and uncertainty regarding future availability of frequencies. Under such conditions, operators may take the view that they have no choice but to accept these prices as they need the spectrum to maintain long-term competitiveness and preserve enterprise value.

Wide variation in reserve prices

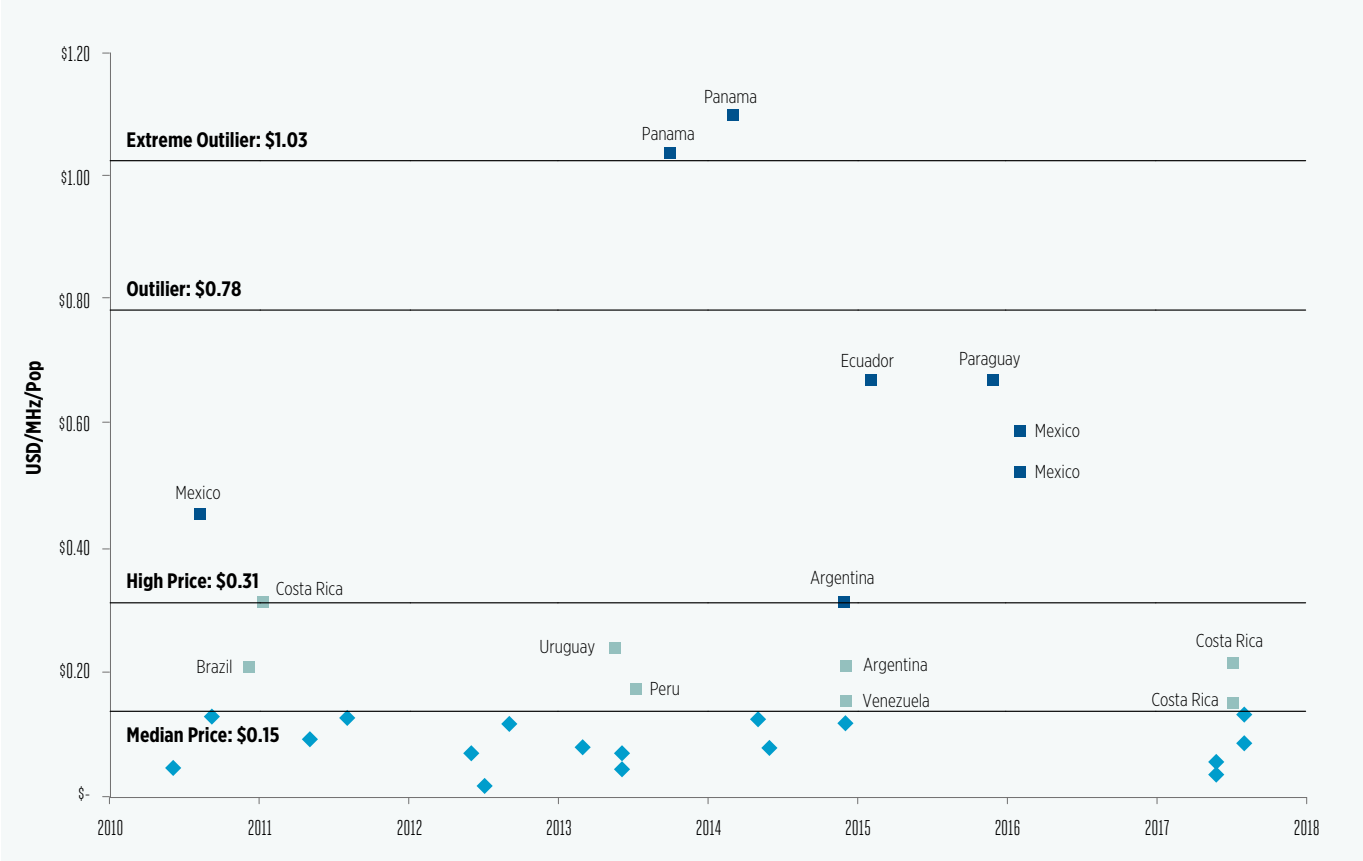
In the global sample, we identified an upward trend in reserve prices over the ten years from 2007 to 2017. In Latin America, we observe very wide variation in reserve pricing for both coverage and capacity spectrum, as illustrated in FIGURE 3 and FIGURE 4, respectively. This implies that local regulators are taking very different approaches to setting reserve prices. While some countries such as Chile price moderately, others such as Panama have apparently attempted to set prices at or above market value. We explore this issue further in the next chapter.

FIGURE 3: COVERAGE SPECTRUM RESERVE PRICES BY CATEGORY (2010-2017)



Source: NERA Economic Consulting. Notes: Latin America coverage spectrum bands include 700, 850 and 900 MHz; prices are adjusted for PPP exchange rates, inflation and a 15-year licence duration, and include annual fees.

FIGURE 4: CAPACITY SPECTRUM RESERVE PRICES BY CATEGORY (2010-2017)



Source: NERA Economic Consulting. Notes: Latin American capacity bands include PCS, AWS, and 2600 MHz; prices are adjusted for PPP exchange rates, inflation and a 15-year licence duration, and include annual fees.

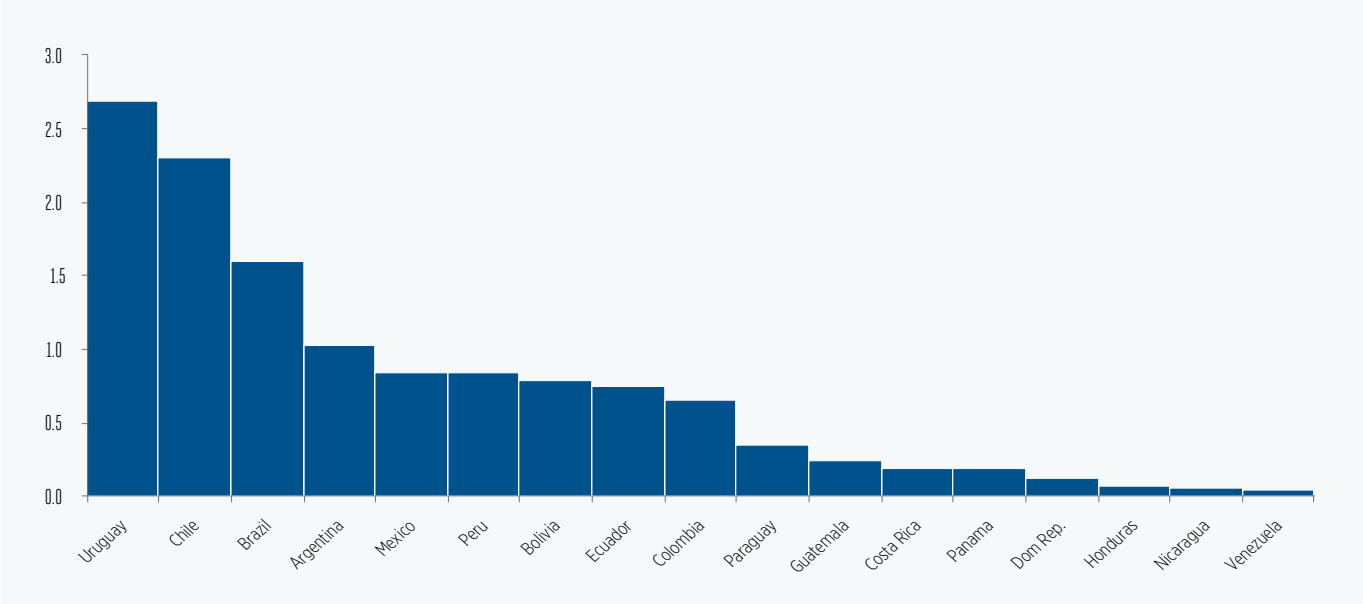
Spectrum prices and network investment

Network investment is a key enabler of fast mobile broadband services with good coverage. As such, there is a growing interest from governments and regulators in adopting policies that incentivise network investment by mobile operators. Recent academic research suggests that high spectrum costs reduce incentives for network investment. In the global report, to test this link, a 'wireless score' was created for each country in the sample, which measures service quality (i.e. average speed[5] and coverage[6]) and 4G uptake[7]. This score is a proxy for investment data, which is not widely published.

For this report, updated wireless scores were calculated for Latin American countries, using newly available data on network performance from February 2017. In addition, coverage data was collected from GSMA Intelligence rather than Open Signal as the latter is not available for all countries in our sample.[8]

In comparison to the global report, countries in Latin America appear to have much lower wireless scores. This is largely a result of slow 4G take up in the region. 4G subscriber share ranges from a high of 31% (Uruguay) down to 2% (Venezuela).

FIGURE 5: WIRELESS SCORE BY COUNTRY



Source: NERA Economic Consulting with data from speed data from OpenSignal.com, 4G subscriber data from Telegeography GlobalComms database and 4G coverage data from GSMA Intelligence. The wireless score is calculated as coverage (%) * 4G subscriber (%) * Average speed (Mbps).

Across Latin America, there are significant differences in the uptake of 4G services and the coverage and speeds experienced by users. Wireless scores in Latin America are typically lower than other regions in part because of relatively low income levels in many countries. This is a result of two factors: differences in launch dates of services; and the obvious fact that consumers in higher income countries have greater ability to pay for and to use next generation mobile data services.

5 The average download connection speed that users in each country experience while on a 3G or 4G network, as measured by Open Signal (February 2017).

6 4G Network coverage by population, as measured by GSMA Intelligence (Q4 2016).

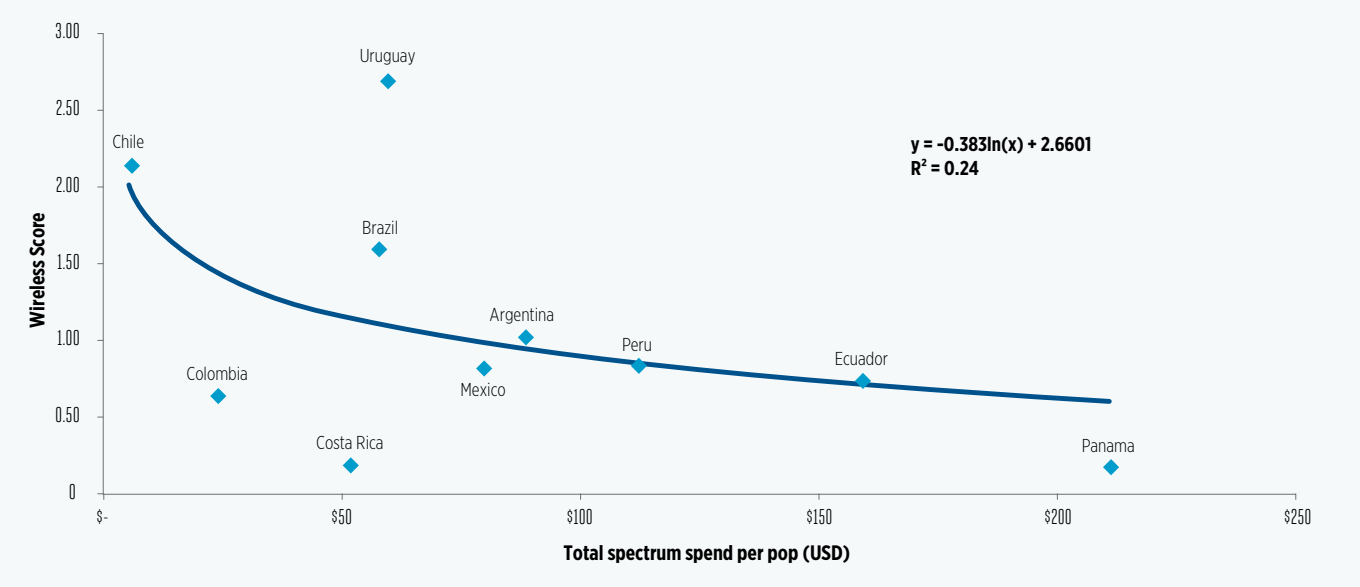
7 The percentage of total subscribers by country with access to 4G services, as measured by Telegeography (December 2016, accessed 4 May, 2017).

8 There is a difference in the methodologies used by GSMA Intelligence and Open Signal to measure coverage: the former measures population coverage whereas the latter measures coverage of actual users with the Open Signal app.

In the global report, countries are divided into different income groups. Owing to the small sample size for Latin America, it is infeasible to create separate groups based on income. Therefore, the analysis focuses on ten "medium income" countries with GDP per capita between US$5,000 and US$16,000.[9] Reliable data was gathered on two other countries, Honduras and Nicaragua, but these are "lower income" countries with GDP per capita below US$2,500 so it may be inappropriate to compare their investment performance directly with the other countries.

The relationship between spectrum costs and wireless score is reported in FIGURE 6. There is a correlation between lower total spend on spectrum from 2007-2017[10] and higher wireless scores. These results mirror the findings of our global report, and support the hypothesis in the academic literature that high input costs may suppress investment. They contradict the more simplistic hypothesis that licence costs do not affect investment because they are sunk costs. Although spectrum cost is one of a number of factors that cause differences between countries in network investment, the results reinforce the previous conclusion that they are an important factor.

FIGURE 6: RELATIONSHIP BETWEEN TOTAL SPECTRUM SPEND AND WIRELESS SCORE IN LATIN AMERICAN COUNTRIES



Source: NERA Economic Consulting with data from OpenSignal, GSMA Intelligence and Telegeography GlobalComms database. Prices are adjusted for PPP exchange rates, inflation and a 15-year licence duration, and include annual fees. We exclude five countries (for which we had data) with GDP per capita under US$5,000. We also exclude the Dominican Republic and Venezuela: the Dominican Republic has released insufficient spectrum since 2008 (less than 100 MHz) to allow comparison with other countries; and Venezuela is excluded owing to the difficulty of benchmarking a country with exceptionally high inflation.

9 GDP per capita (2016) in this group ranges from $6,021 in Peru up to $15,748 in Uruguay. There are no countries that would be considered high income countries in the global report.

10 To calculate aggregate spend on spectrum across operators in each country, we summed the total of upfront payments and relevant annual fees for spectrum in the 700, 850, 900, PCS, AWS and 2600 MHz bands for awards between 2007 and 2017.

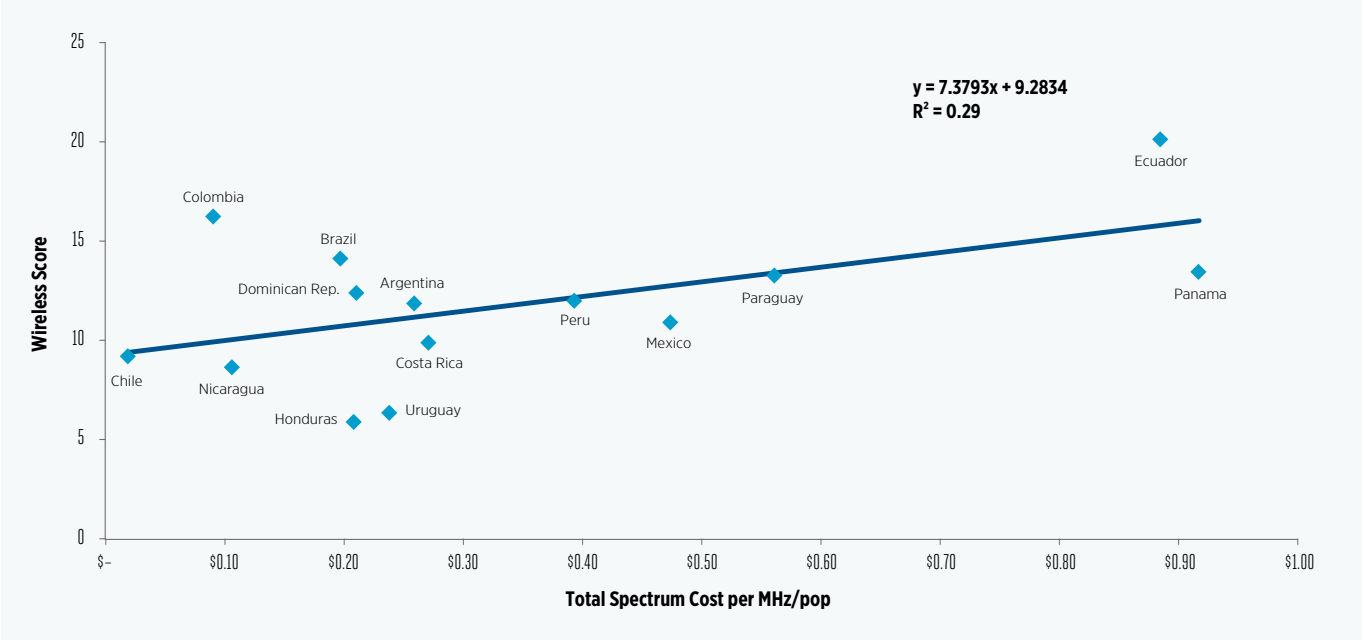
Spectrum prices and the cost of mobile data

The need for affordable mobile broadband access is undeniable and is a primary focus for all telecom regulators, especially those in medium- and low-income countries as in most of Latin America. Empirical evidence from behavioural economics research suggests that firms with high sunk costs are more reluctant to engage in price competition. The implication is that high upfront fees for spectrum licences could lead to higher consumer prices.

To test whether this relationship holds, the global report compared total spend on spectrum, inclusive of upfront and annual fees, and observed prices in June 2017 for wireless data by country. This required creating a 'representative plan' for 5 GB of data for every mobile network operator within a country.[11] For this study, the same exercise is repeated for 15 Latin American countries, using price data collected in June 2017.[12] To facilitate a better comparison with the global report, the results are calculated using a 5 GB representative package[13].

FIGURE 7 plots the relationship between total spend on spectrum and the price of data. As with our global report[14], there is a correlation between lower spectrum costs and lower consumer prices for data services. These results support the hypothesis that high input costs may suppress incentives for price competition. This suggests that high spectrum prices may in part be being passed on to consumers through higher prices for mobile data.

FIGURE 7: RELATIONSHIP BETWEEN THE PRICE OF DATA AND TOTAL SPECTRUM SPEND IN LATIN AMERICAN COUNTRIES



Source: NERA Economic Consulting. Spectrum prices are adjusted for PPP exchange rates, inflation and a 15-year licence duration, and include annual fees. Price per GB is calculated from a representative 5 GB plan. We exclude three countries from our sample: In Bolivia, we found no reliable information on spectrum allocations; Guatemala is excluded as there have been no spectrum awards in the last 15 years; and Venezuela is excluded because of rapidly changing mobile prices owing to high inflation. In Nicaragua and Honduras, as the prices for mobile services were quoted in USD, the price per GB for these countries has not been adjusted.

11 For more information about our methodology for determining the price of data, please see Chapter 2.3 of the global report.

12 As 4G uptake is generally much lower in Latin America than in higher income countries, we identified plans with at least 5GB of data rather than 10GB.

13 We replicated our analysis using 2GB data packages and found the correlation remained – although it was slightly weaker.

14 A linear function fits the Latin America data better than the exponential function we used in the global report. There are no hard facts on what the functional form of the relationship should be. In any case, we are more interested in the existence of a correlation, so we use a linear function here

4. Challenges in spectrum pricing

In the analysis of Latin American awards, as with the global report, a number of awards are identified that generated prices well above average levels. The variations in price are simply too great to be explained by differences in local mobile market conditions, such as market penetration or revenues per user. Sometimes, high prices may simply be the result of strong competition between current and aspiring mobile operators. This should not generally be a concern for regulators. However, in Latin America as elsewhere, high spectrum prices are more often linked to decisions by local policymakers. This in turn implies that many countries are implementing pricing policies that discourage roll-out of next-generation mobile services, constrain consumer welfare and delay the closing of the digital divide.

The most common policy challenges identified in Latin America differ from those that were observed more globally. In particular, three broad policy challenges are identified and discussed in detail below:

Inappropriate licence fee regimes	Artificial spectrum scarcity	Inappropriate award rules
High annual fees: ■ Distort the market by discouraging interest in licences ■ Reduce incentives to invest and make price competition more risky	**Holding back spectrum from the market:** ■ Artificially inflates demand for spectrum and raises and spectrum prices ■ May reflect a failure to licence enough spectrum for mobile services, or use of spectrum caps or set-asides that create artificial scarcity for a subset of operators	**Onerous or short licence terms, such as:** ■ Inappropriate coverage obligations that reduce value of licences, discourage licence acquisition and/or lead to disputes over fulfilment of obligations ■ Short licence terms that discourage investment in network infrastructure ■ Inclusion of asset reversion in licence terms that discourage investment and innovation
	Failing to provide a roadmap for future spectrum releases: ■ Artificially inflates demand for spectrum because bidders do not know when future opportunities to acquire spectrum will arise	**Lack of transparency in award processes and award formats that do not allow for price discovery, such as:** ■ Use of first-price sealed bid auctions that frustrate price discovery, leading to uneven price outcomes and potential inefficient allocation ■ Use of direct awards or beauty contests with unduly high reserve prices

4.1. Excessive reserve prices or annual fees

Approaches to setting reserve prices in the 4G era have varied across Latin America. For example, as illustrated in FIGURE 3, reserve prices for 700 MHz on a PPP basis range from a low of $0.03 MHz/pop in Chile (2014) to a high of $0.54 in Panama. Notwithstanding this variation, few Latin America countries have set reserve prices for 4G spectrum so high that they have choked off demand. In part, as we discuss in the following section, this may reflect the fact that regulators have often been slow to release new spectrum bands, so established operators that do not buy spectrum when it comes available would be putting their future competitiveness and enterprise value at risk.
Operators also expressed concerns about approaches used to set annual fees:

- **High annual fees. In some countries, high annual fees, often set by inflexible legal statute, make it difficult to set reserve prices for new spectrum awards. When fees are high, minimum upfront fees in auctions should be reduced accordingly to prevent award failure. In the worst case, regulators may be left with no flexibility to price spectrum appropriately.**
- **Fees linked to performance and investment. Annual fees for spectrum in some Latin Americans states are linked to market and network performance metrics. Depending on their magnitude, such fee structures may create potential disincentives to invest and compete in downstream markets and may distort demand for spectrum.**

Figure 8 highlights some examples of these issues: in Mexico, where annual fees as a proportion of total spectrum cost are unusually high; and in Ecuador, Peru and Venezuela, where fee structures for spectrum licences risk distorting local mobile markets. These examples may be contrasted to the situation in Chile, one of the region's most successful mobile markets, where reserve prices have been set at low levels.

FIGURE 8: EXAMPLES OF APPROACHES TO SETTING RESERVE PRICES AND ANNUAL FEES

Mexico AWS (2016)

Annual fees comprised approximately 85% of the total cost of an AWS licence. Only two of three incumbents participated in the auction and one block of spectrum went unsold. Local operators tell us that the high fees deterred them from bidding for spectrum. They further argue that fee levels, which are set by government and legal statute not the regulator, are unsustainable given the need of operators to hugely increase holdings of spectrum over coming years to meet growth in demand for mobile broadband.

Ecuador, Peru and Venezuela (annual fees)

In each of these countries, annual fees for spectrum are linked in some form to investment or market performance:

- Ecuador: fees are based on the number of base stations and the amount of spectrum used.
- Peru: since 2012, fees have been based on the number of active users. The calculation formula caused a large increase in annual fees and is currently under review.
- Venezuela: fees are linked to overall annual revenues and make up 2.3% of gross income tax.

In each of these cases, fees linked to spectrum also reduce the returns from expanding networks and winning new customers. This diminishes the incentive of operators to invest and compete.

Chile 700 MHz auction (2014)

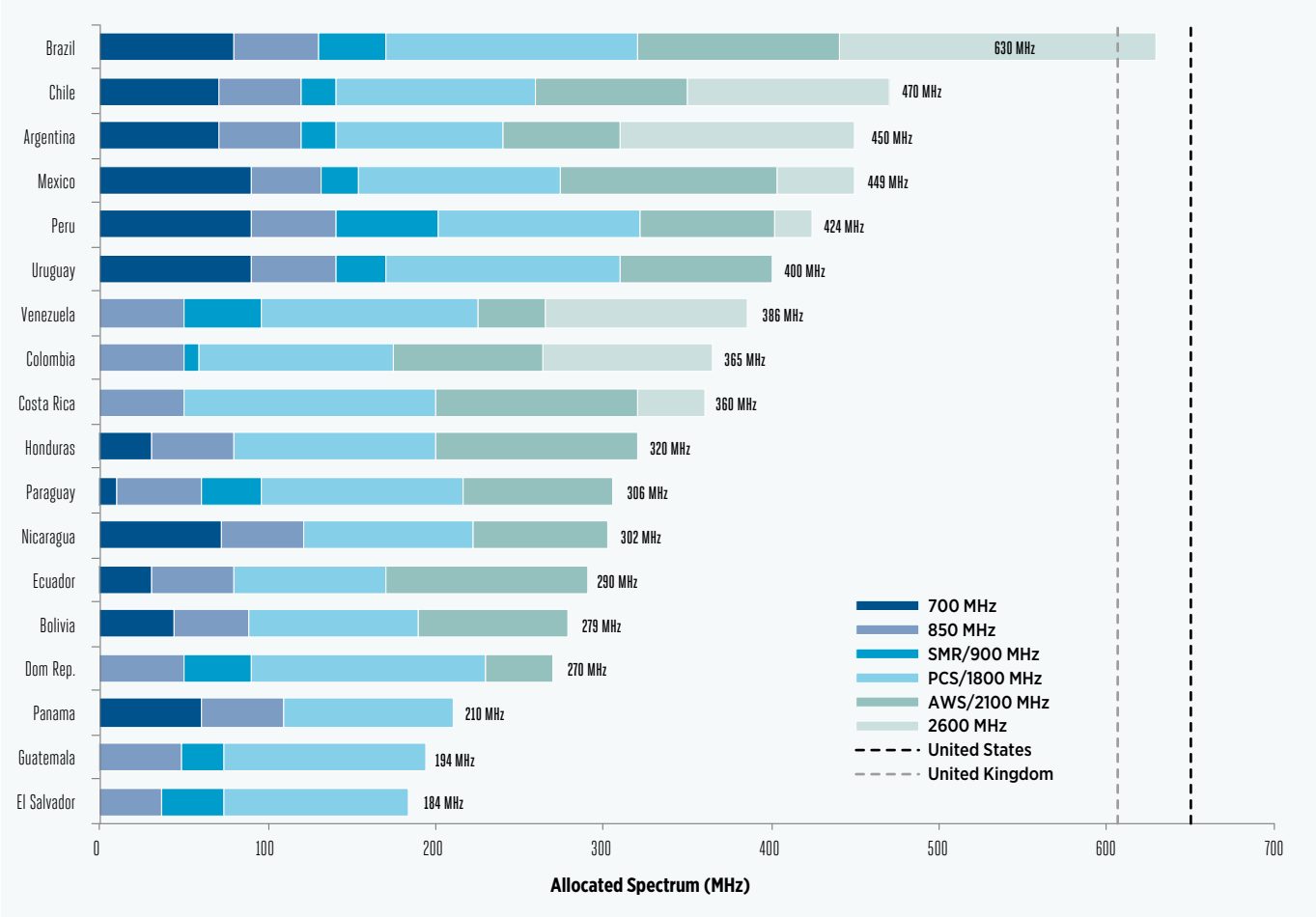
Chile has a track record of pricing spectrum conservatively. In 2014, it was one of the first countries in the region to award 700 MHz, selling two blocks of 2x10 MHz and one block of 2x15 MHz. These were secured by the three incumbents for prices ranging between $0.002/MHz/pop and $0.024/MHz/pop. In return for low prices, operators took on certain obligations regarding coverage and service quality, but these were uncontroversial given low reserve prices.

4.2. Artificial scarcity of spectrum

Many European countries have an admirable track record for tiSpectrum scarcity is one of the key factors holding back the mobile sector in Latin America. Most countries in the region have been slow to allocate new bands such as 700 MHz and 2.6 GHz, and the overall pace of spectrum release lags well behind more developed markets in Europe and Northern America.

FIGURE 9 provides an overview of the bands that have been released for mobile usage as of August 2017. With the exception of Brazil, all countries in the region lag well behind the United States and the United Kingdom (used as an example of a typical Western European country). Moreover, the performance across the region is very varied, with 9 of 18 countries still having released less than 350 MHz.

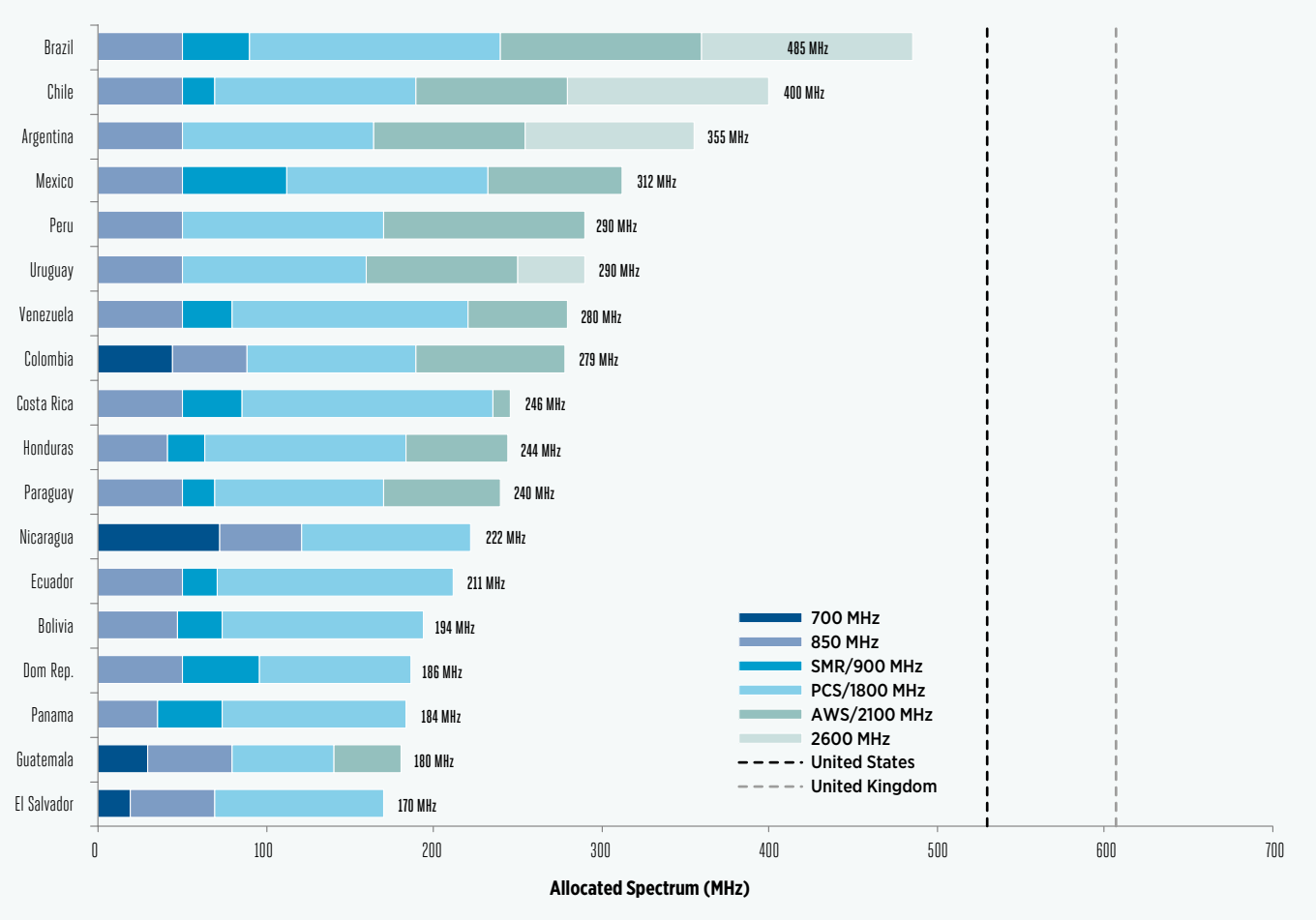
FIGURE 9: SPECTRUM ASSIGNED TO MOBILE OPERATORS, AUGUST 2017



Source: NERA Economic Consulting supplemented by data from Telegeography Global Comms Database and regulator websites. Notes: Data is reliable to the best of our knowledge, but there may be discrepancies as some regional regulators do not publish full information about mobile spectrum holdings and some private sources conflict. Includes currently usable spectrum held by mobile network operators at the time of writing of this report. The following spectrum bands that are not yet usable owing to immaturity of the device ecosystem are excluded: AWS-4, AWS-3 TDD and H block (United States) and 2100 MHz TDD, 3.4 GHz and 3.6 GHz (United Kingdom).

It should be noted, however, that the current situation still represents a huge improvement since end-2013, as illustrated in FIGURE 10. At that time, no country in the region had released more than 485 MHz, and 15 of 18 countries had released less than 350 MHz.

FIGURE 10: SPECTRUM ASSIGNED TO MOBILE OPERATORS, END-2013



Source: NERA Economic Consulting supplemented by data from Telegeography Global Comms Database and regulator websites. Notes: Data is reliable to the best of our knowledge, but there may be discrepancies as some regional regulators do not publish full information about mobile spectrum holdings and some private sources conflict. Includes currently usable spectrum held by mobile operators that was allocated before 2014. If the allocation occurred during or after 2014, the spectrum allocated is excluded. The following spectrum bands that are not yet usable owing to immaturity of the device ecosystem are excluded: AWS-4, AWS-3 TDD, and H block (United States) and 2100 MHz TDD, 3.4 GHz and 3.6 GHz (United Kingdom).

In Figure 11, we highlight examples of some of the issues that countries in the region have encountered with spectrum release. Guatemala is a particularly interesting case. In the early 2000s, it was a regional pioneer in spectrum release and liberalisation, and led other Central American economies in take up of mobile services.[15] However, it is 15 years since it last had a spectrum award, and the country now has the second smallest base of mobile spectrum in the region. Argentina is a happier case; here too, operators suffered a long period of setbacks and uncertainty over release of new spectrum, but this has been substantially addressed through major awards in 2014 and 2017, albeit amidst controversy over high reserve prices and onerous coverage obligations. Brazil is the regional leader in making spectrum available, but the country is facing challenges in clearing the 700 MHz band.

The slow release of spectrum for 4G means that the region is likely to lag North America and Europe in mobile data performance for the foreseeable future. Unless regional governments can identify ways to release more spectrum, more quickly and at affordable prices, they can be expected to also lag behind in the transition to 5G technology after 2020.

FIGURE 11: EXAMPLES OF SPECTRUM SCARACITY CHALLENGES IN LATIN AMERICA

Guatemala

Guatemala was one of the first countries in the world to release spectrum in small, tradable blocks, starting 1997. Hazlett et. all report that, as of 2004, Guatemala ranked second in spectrum released among 16 Latin American countries. During the period from 1997 to 2001, the World Bank reports that mobile service penetration in Guatemala grew at a much faster rate than Latin American peers while average retail prices for mobile services were approximately half that of peer countries.

Unfortunately, Guatemala has not allocated any new spectrum to mobile operators in the last 15 years. Its market performance has correspondingly declined, and it now ranks 11 out of 19 countries in wireless score. Although a process to allocate the AWS band and 700 MHz band has been discussed since 2015, the award has been delayed by court proceedings and other regulatory issues.

Brazil 700 MHz band clearance

Brazil was one of the first countries in Latin America to award 700 MHz spectrum, with an auction in 2014. However, there was a catch – the spectrum is not usable until cleared of television broadcasting. Operators also had to commit to covering the costs of re-tuning broadcast equipment. The clearance process, which is staggered on a regional basis, only began in October 2016 and is not expected to be completed until December 2018 at the earliest. That is a long period in which operators have paid for spectrum that they cannot use fully.

Argentina award delays

In Argentina, there was a gap of nearly 15 years between the award of 3G and 4G spectrum, and – during this period – operators had to manage with only 40-50 MHz each. During this time, two operators that merged in 2004 (Movistar and TCP) were required to return over 30 MHz of spectrum but this was not reallocated until after 2012. Although the 2014 multi-band auction has greatly increased access to spectrum, operators had to contend with high reserve prices, onerous coverage obligations and uncertainty over future spectrum availability.

15 World Bank Group, Guatemala, an Early Spectrum Management Reformer, June 2015.
Available at: http://documents.worldbank.org/curated/en/760871467994581047/pdf/102956-WP-Box394845B-PUBLIC-WDR16-BP-Guatemala-an-Early-Spectrum-Management-Reformer-Garcia.pdf.

4.3. Inappropriate award rules

Prices in spectrum auctions reflect the conditions under which bidders are competing for the scarce resource. If those conditions are distorted, then the price may deviate from the fair market level. In the global report, a range of policies, award rules and licence conditions were identified that create risk for bidders and distort award outcomes.

In Latin America, mobile operators frequently face the following issues:

- **short licence terms and renewal uncertainty;**
- **onerous licence conditions, including coverage obligations not reflected in the reserve price; and**
- **poor choice of award format, including lack of transparency regarding the award process and use of first-price sealed bid auctions or beauty contests with high reserve prices.**

Short licence terms and renewal uncertainty

Spectrum licence costs and network investments are recouped over long time periods. Short or uncertain licence durations increase risks for operators and may reduce the incentives to invest. In Europe, this has led to the European Union advocating licence terms of 25 years[16], compared to an average of 16 years across Latin America.

In several countries, short licence terms make it particularly difficult to value spectrum:

- **In Paraguay, licences are generally awarded for only 5 years. Although operators have a high expectation of renewal, the short initial terms create a significant risk as return on investment depends on renewal.**
- **In Ecuador, licences are structured such that access to newly awarded spectrum is included in the original 3G wireless contract terms, which has an initial term of 15 years. For example, additional AWS and PCS spectrum was awarded in 2015, but added to the 3G licence starting 2008. As the original licence term was not increased, access to 4G spectrum is only guaranteed for 8 years, too short to generate adequate returns.**

Where governments provide longer licence terms and greater certainty over renewal, the value of spectrum increases and operators have stronger incentives to invest.

16 European Commission, COM/2016/0590, 14 September 2016. Available at: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=comnat:COM_2016_0590_FIN

Onerous licence conditions, including coverage obligations and asset reversion

Spectrum licences in Latin American countries are often awarded with licence conditions that affect operator decisions on building their networks. Such obligations are not necessarily a problem if they are well articulated, feasible and reflected in the price of the spectrum. However, in a number of cases, they have combining with relatively high reserve prices to create a financial burden on operators that will constrain their ability to invest and compete in downstream markets.

Tough coverage obligations have been popular with regulators running spectrum auctions across Latin America. This may reflect the fact that many countries in the region have mountainous geographies, making them challenging environments for roll out of mobile services outside urban areas.

Chile stands out as a case study in best practice for managing such obligations. In the 2014 700 MHz auction, it required winning bidders to provide LTE services to 98% of the population and cover over 800 kilometres of roads. Recognising that these obligations were commercially onerous, it adopted low reserve prices, as previously highlighted. It also followed international best practice and allowed each operator to fulfil their coverage obligation using any spectrum band, rather than attaching the obligation to specific bands in the award. This approach appears to have been successful, with Chile having amongst the highest levels of 4G coverage in the region.

Chile's success may be contrasted with the challenges and controversy associated with similar efforts in Brazil and Argentina:

- **Brazil's 2012 spectrum allocation included strict rural coverage obligations on 2.6 GHz licences – a band that is not suitable or economically viable to provide rural coverage. Anatel, the regulator in Brazil, later had to revise the coverage obligations attached to 2.6 GHz to also include 700 MHz spectrum allocated in 2014.**
- **For the 2014 auction of 700 MHz and AWS spectrum, Argentina required winning bidders to cover all cities with a population over 500 (equivalent to approximately 98% of the population) within 5 years as well as approximately 26,000 km of roads. Unlike Chile, the coverage obligation was not offset by low reserve prices. Although all of the spectrum was sold, the revenues of $2.23bn were only modestly above the reserve price, and the new entrant Arlink subsequently failed and defaulted on its spectrum licence. Argentina did follow best practice of allowing operators to use any frequency band to fulfil the coverage obligation.**

An even more difficult situation involving network asset reversion has cast uncertainty over the Colombian mobile market for many years. As part of the original concession contracts for mobile services signed in 1994, operators were required to return all network assets to the state following the conclusion of the concessions, including network infrastructure and spectrum. Laws passed after the concessions (Law 422 of 1998 and ICT Law of 2009), however, state that once a mobile licence expires, operators are only required to return spectrum to the state. We understand that the original licensees, America Movil and Telefonica, believed that the law revisions applied to them. However, a court ruling in 2013 ordered the reversion of assets for licences signed before the 1998 law.[17] After an arbitration hearing in 2017, America Movil and Telefonica were required to pay compensation totalling approximately COP 4.8 trillion (USD 1.6 billion) to meet the asset reversion conditions.[18]

The compensation that America Movil and Telefonica must pay equates to an enormous increase in the cost of their original spectrum licences; for reference, the compensation is approximately equal to four times the total sum of upfront payments for the 2013 Colombian 4G spectrum auction.[19] This can be expected to have the same impact on their future ability to invest and compete as would a highly over-priced award of essential spectrum. Whatever the merits of the legal case, it is apparent that the historic decision to require network asset reversion (even though no longer applied) has cast a long shadow over the local mobile industry. Spectrum licence terms in Colombia are also unusually short (10 years), a further source of uncertainty for all mobile operators as they roll out their 4G networks.

Lack of transparency and poor choice of award format

For the recent wave of spectrum auctions in Latin America, a majority of countries have shifted to using multi-round auction formats. For example, both Costa Rica and Uruguay used open, multiple round formats for spectrum awards in 2017. Such approaches are generally popular with bidders, provided that reserve prices are modest and licence terms are not onerous. They provide a fair and reasonably transparent process for awarding spectrum, and – if the auction is competitive – bidders benefit from price discovery over the course of the bidding rounds.

Some Latin American countries continue to use beauty contests or direct awards instead of spectrum auctions, despite concerns about their outcome efficiency, transparency and vulnerability to legal challenge. In certain situations – such as Chile in 2014, where the reserve price was set low and tough licence obligations predictably limited competition for licences – beauty contests

17 OECD, OECD Review of Telecommunication Policy and Regulation in Colombia, 2014. Available at: http://www.oecd.org/internet/colombia-telecom-review.htm

18 Telegeography Global Comms database, Claro, Movistar fined USD 1.6bn for breach of mobile licence contracts, 28 July 2017. Available at: https://www.telegeography.com/products/commsupdate/articles/2017/07/28/claro-movistar-fined-usd1-6bn-for-breach-of-mobile-licence-contracts/

19 2013 Colombian spectrum auction revenues from: OECD, OECD Review of Telecommunication Policy and Regulation in Colombia, 2014. Available at: http://www.oecd.org/internet/colombia-telecom-review.htm

may be acceptable to the industry. However, in other cases, they appear to have been used as a way of imposing high prices and onerous licence terms on incumbent operators. For example, operators in Panama have been obliged to renew spectrum licences from 2013 to 2015 at prices based on the results of a high-price spectrum auction in 2008.

Another controversial practice is the use of first-price sealed bid auctions to allocate mobile spectrum licences. These auctions are strategical complex for two reasons:

- **Without any scope for price discovery, such auctions fail to address common-value uncertainty and may thus lead to an inefficient outcome. A large proportion of the valuations of all bidders are driven by the same uncertain factors (demand forecasts, handset availability, likely reaction of incumbents to new entry, etc.). In a competitive sealed bid auction, the winning bidder knows that it will most likely have been too optimistic in its estimate of the common value and thus have overpaid. Bidders therefore have an incentive to reduce their bids but this could lead to an inefficient outcome if bidders with the highest private valuations reduce their bids too much.**
- **They are strategically complex for bidders as they must decide how much to shade down their bid below valuation. Bidders decide on their bid amounts based on their expectation about other bidders' valuations. If these expectations are incorrect, the bidder with the highest valuation may shade its bid by too much leading to an inefficient allocation. Bidders are also exposed to paying very different prices for the same spectrum, which can create needless financial asymmetries.**

Examples of sealed bid auctions with rules that appear to prioritise revenues over outcome efficiency include:

1. **Panama PCS (2008) – Panama used a first-price sealed bid tender for two lots of 2x15 MHz PCS spectrum. Under a highly unusual rule, in case there were only two bids submitted in the auction, the second highest bidder was required to pay the highest bid price in order to receive a concession. Claro and Digicel were the only auction participants, and Digicel submitted a bid that was approximately US$13 million more than Claro's bid. To be awarded a concession, Claro was required to match Digicel's price.**
2. **Peru AWS (2013) – Peru auctioned two 2x20 MHz lots of AWS spectrum in a sequential first price sealed bid tender. Participants were required to submit two bids, one for Block A and one for Block B, but could win only one block. The bids for Block A were opened first and Telefonica (the largest operator) was awarded the first concession. The auction then proceeded to Block B, with two possible winners, America Movil (second largest) and Entel (third largest). The block was won by Entel, which had increased its bid relative to Block A, whereas America Movil had reduced its bid. It is impossible to judge from this outcome whether the result was efficient, as it is clear that America Movil must have shaded its bid. The price outcome was also highly asymmetric, with Telefonica paying 44% more than Entel for an equivalent licence.**

In both these cases, transparent, multi-round auction formats would likely have delivered more certainty regarding efficient allocation and fairer prices.

5. Spectrum pricing policy best practice

The goal of pricing policies should be to award spectrum to those who will use it most efficiently to deliver maximum benefits for society. This Latin America-focused study reconfirms the conclusion from our global report that policy decisions that distort market-based spectrum awards discourage efficient use and destroy consumer welfare. Particular issues in Latin America include artificial spectrum scarcity, high reserve prices and annual licence fees, short licence terms, inappropriate coverage obligations and uncertainty about renewals and new awards.

With 5G and advanced 4G technologies requiring ever increasing amounts of spectrum, those countries that do not address these issues are reducing broadband access, impeding closure of the digital divide and stifling their digital economies. As such, Latin American governments and regulators need to carefully assess how their policies impact the price and availability of spectrum.

Latin American regulators have a mixed track record with respect to policies that impact spectrum allocation, including many examples of best practice but also some glaring policy failures.

Looking forward, this report offers the following four key policy recommendations:

#1 SET MODEST RESERVE PRICES

- Set reserve prices well below expected market value
- Ensure annual fees are never more than a modest proportion of spectrum costs

#2 BRING SPECTRUM TO MARKET IN A TIMELY MANNER

- Release usable spectrum in anticipation of need
- Provide a roadmap for future spectrum availability, so operators understand their options

#3 AVOID ONEROUS LICENCE CONDITIONS

- Ensure licence terms are long enough and bidders have appropriate renewal guarantees so that they can realise adequate returns on investments in network infrastructure
- Set realistic coverage obligations and adjust reserve prices to reflect costs.

#4 ADOPT BEST PRACTICE IN AWARD DESIGN

- Embrace transparent award processes and designs that prioritise efficiency not revenues
- When auctions are used, consider open multi-round formats that allow for price discovery

Latin American countries which artificially inflate spectrum prices are damaging broadband access and their digital economies.

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