Assessing the impact of market structure on innovation and quality

Driving mobile broadband in Central America

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Executive summary

Central America is lagging behind in mobile broadband adoption and deployment. Closing this gap requires the promotion of market structures that boost competition in investment and innovation, and public policies that take the entire digital ecosystem into account.

Over the last 15 years, mobile broadband adoption and deployment in Central America have lagged behind the rest of Latin America. The delay first became apparent with 3G and has spilled over to 4G deployment, where it has become even more pronounced. On average, 4G connections in South American countries account for 30% of all connections, and population coverage is about 70%. In Central America, these figures are only 5% and 35%, respectively. This is problematic as new technology cycles bring new and better services at lower prices.

To close this gap, authorities should aim to create an environment that promotes investment and innovation. Market structures must give operators the ability and incentives to invest as a way to intensify competition, which will also be stimulated by the offers of other convergent players. This requires operators to have sufficient scale, margins and expected return on investment, and efficiency in the use of spectrum. Recent studies have detected a trade-off between the number of operators and levels of investment and innovation.

This study examines the role of market structures in the development of the mobile sector in Central America. The market structures of Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama are analysed, exploring their impact on operator performance in investment and 4G networks. A comparative study of public policy in the region shows how policy can foster an environment in which operators acquire greater ability and incentives to compete in investment and innovation, to the benefit of consumers in the region.

Investment in mobile communications in Central America follows an inverted U relationship with the number of operators

The analysis confirms that operator investment in Central and South America is not necessarily higher in markets with a higher number of players. It reveals the existence of an inverted U, where operator investment is maximised when operators have an EBITDA margin of 32-38%. Operators whose profitability is below these levels invest less.

Inverted U relationship between operator investment and the competition intensity index
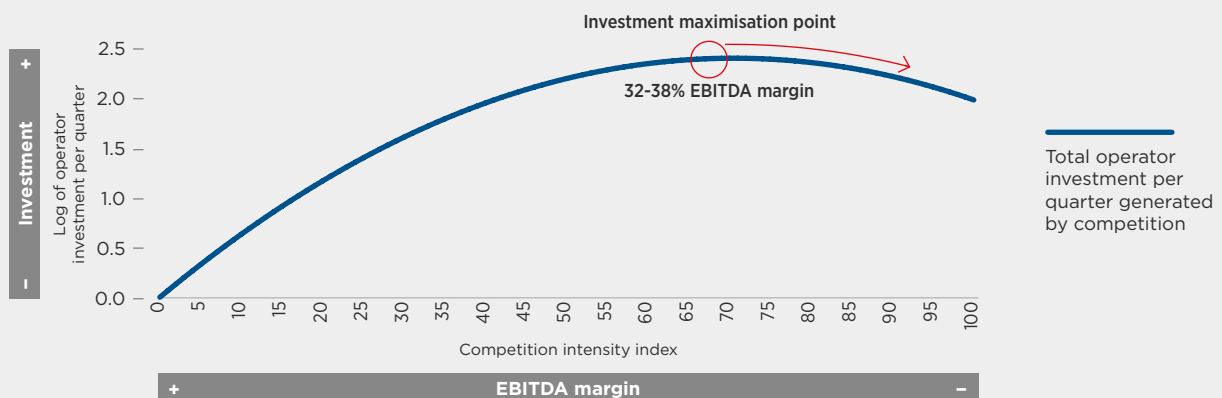
These findings come from an investment model based on data from 26 operators in 13 markets in Central and South America from 2001 to 2016.

Operators' 4G speeds in two-player markets are 40% faster than the Central American average and 10% faster in three-player markets

Analysis of speeds experienced by users of 4G networks in Central and South America consistently show similar results. The study finds (in its most conservative estimates):

- Operators in two- or three-player markets experience 4G download speeds that are up to 8 Mbps faster due to market structure. This means that users in these markets experience download speeds that can be around 40% faster than the Central American average.

- Operators in markets with four or more players record 4G speeds that are 2 Mbps slower due to the market structure. This means their users have download speeds that are 10% slower than the Central American average.

These findings were obtained from models of 4G download speeds estimated using Speedtest Intelligence™ data from 52 operators in Central and South America from 2013 to 2016 (based on consumer-initiated tests).

Public authorities in Central America have the opportunity to remedy the delay in 4G by promoting public policy that encourages innovation and investment

In light of the evidence provided in this study, public policy should promote the ability and incentives to invest, encouraging an environment with greater competition in innovation to deliver better products and services to users. This requires operators to have scale, margins, sufficient expected return and efficiency in the use of spectrum.

The study identifies three main needs for reform to achieve this:

PUBLIC POLICY RECOMMENDATIONS

MERGER REVIEW

Merger review should consider how efficiencies can stimulate players' ability and incentive to compete, using appropriate analysis criteria. Additionally, authorities should consider all the competitive pressures operators face in the digital ecosystem, particularly in the context of convergence. These recommendations apply to all the markets, although specific barriers have been identified in Panama, where specific legislation de facto has prohibited mergers for many years; and El Salvador, where efficiency arguments have not been accepted in merger review.

RETAIL AND WHOLESALE REGULATIONS

Retail and wholesale regulations limit operators' ability to compete. Three of the six markets have price caps (Honduras, El Salvador and Nicaragua), direct regulations on network quality (Costa Rica, Panama and Honduras) and constraints on price discrimination (Costa Rica, Panama and Nicaragua). Authorities should review the market and competition assessments that form the basis of these regulations.

SPECTRUM REGULATION

Spectrum regulation should promote efficient use by assigning sufficient amounts of spectrum in large blocks and high and low frequency bands. The study finds that Central America has assigned only 21% of the required spectrum recommended by the International Telecommunication Union for efficient and effective provision of mobile services. In this regard, Guatemala, Panama and El Salvador are significantly lagging behind.

1. Introduction

Delivering mobile broadband to the whole population is now central to the digital strategy of Central American governments. Digital government agendas have recently been launched in Costa Rica, Honduras, Panama and Guatemala.[1] However, the region is lagging behind the rest of Latin America as the delay in 3G deployment and adoption spills over to 4G, where it is even more pronounced. On average, 4G connections in South American countries account for 30% of all connections, and population coverage is around 70%. These figures are considerably lower in Central American countries, where only 5% of connections are 4G and coverage is just 35%.[2]

Deployment of networks with 3G technology and download speeds greater than 256 kbps enabled the development of mobile internet with the arrival of smartphones and the surrounding digital ecosystem. Using 4G networks, it is now possible to deliver a user experience at a level that is comparable and often superior to what fixed networks can provide. This is particularly important in Central America, where fixed broadband coverage is limited outside large urban centres. In Latin America, a 10 percentage point increase in broadband penetration is associated with a 0.9 to 0.16 percentage point increase in income per capita growth, mainly due to improved productivity (Katz et al. 2009; Czernich et al. 2011).

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1. In December 2010, Costa Rica launched its Digital Government Master Plan. In 2014, Honduras and Panama each launched a Digital Government Agenda. In February 2017, the government of Guatemala created its Digital Nation Agenda.
2. The South American average comprises Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela. The Central American average comprises Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama.

Table 1

Basic macroeconomic data (2016) and market data (Q4 2017)

	Population (million)	Income per capita (USD, current prices)	Mobile internet penetration	4G connections penetration
Panama	4.03	13,680	54%	7%
Costa Rica	4.86	11,825	55%	6.5%
El Salvador	6.34	4,225	50%	5%
Guatemala	16.58	4,150	36%	6%
Honduras	9.11	2,360	43%	5%
Nicaragua	6.15	2,150	55%	4%

Mobile internet penetration is measured as mobile internet subscribers as a proportion of total population. A mobile internet subscriber is defined as a unique user who has used internet services on their mobile phone during the corresponding period.[3] 4G connections penetration is measured as 4G connections as a proportion of total connections, excluding licensed cellular IoT.[4]

Source: World Bank and GSMA Intelligence

Mobile markets are subject to technology changes that require increasingly shorter investment cycles. This makes it possible to improve data speeds, introduce innovation and increase consumption of mobile services with a dramatic cost reduction. Because of this, innovation in mobile networks is a key driver of current and future consumer welfare, particularly in the context of rapidly growing demand for data.

Assessing the delay in 4G deployment and adoption in Central America requires an understanding of the role of market structures and the number of players in relation to quality, innovation and prices. International experience, economic theory and recent studies (including a GSMA 2017 report[5]) have detected a trade-off between the number of players in mobile markets and investment in mobile networks. While the entry of new players and lower market concentration have brought benefits to consumers since market liberalisation at the end of the 1990s,

the debate today is around the optimum number of players and level of market concentration.

There are several reasons why operators in markets with fewer players have more incentive and a greater ability to invest. These include greater scale for distributing costs, more financial strength, higher returns on investment and more efficient spectrum use. As a result, operators have access to greater resources allowing them to compete more intensely. Authorities also need to be aware that mobile operators now face competitive pressure that goes beyond infrastructure competition, due to service convergence and the increasing number of players in the digital ecosystem.

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3. Mobile internet services are defined as those that use mobile data (excluding SMS, MMS and cellular voice). Examples include browsing, email, social media apps, online video or music and online games.
4. Connections are based on unique SIM cards registered on the networks of a country's operators. Connections differ from subscribers in that a unique user can have multiple connections.
5. GSMA (2017), "Assessing the impact of mobile consolidation on innovation and quality". Available at <https://www.gsmaintelligence.com/research/2017/09/assessing-the-impact-of-mobile-consolidation-on-innovation-and-quality/643/>

Market structures are subject to three key aspects of public policy: merger review, retail and wholesale regulations, and spectrum regulations. These public policies seek low prices adjusted to costs to promote adoption in the short term, and aim to encourage investment as a driver of quality, innovation and significant cost reduction in the medium to long term. To achieve these goals, policy must be based on evidence on the relationship between market structure, investment and innovation.

This study addresses these issues by focusing on two areas:

- First, it analyses how the development of mobile communications is lagging behind in Central America (Chapter 2) and how market structures affect performance in quality, prices and network coverage (Chapter 3). The analysis focuses on how investment and network quality vary depending on aspects such as number of players, their market shares and market concentration indices. It establishes the importance of having market structures in which operators have sufficient scale, returns and margins, and efficient use of spectrum.

- Secondly, the study performs a comparative analysis of the public policies with greater impact on operators' scale, profitability, margins and spectrum use (Chapter 4). The analysis identifies key aspects and reforms in the region to promote investment and innovation for the development of 4G (still not fully deployed in the region) and, in the future, 5G.

2. Development of mobile broadband in Central America
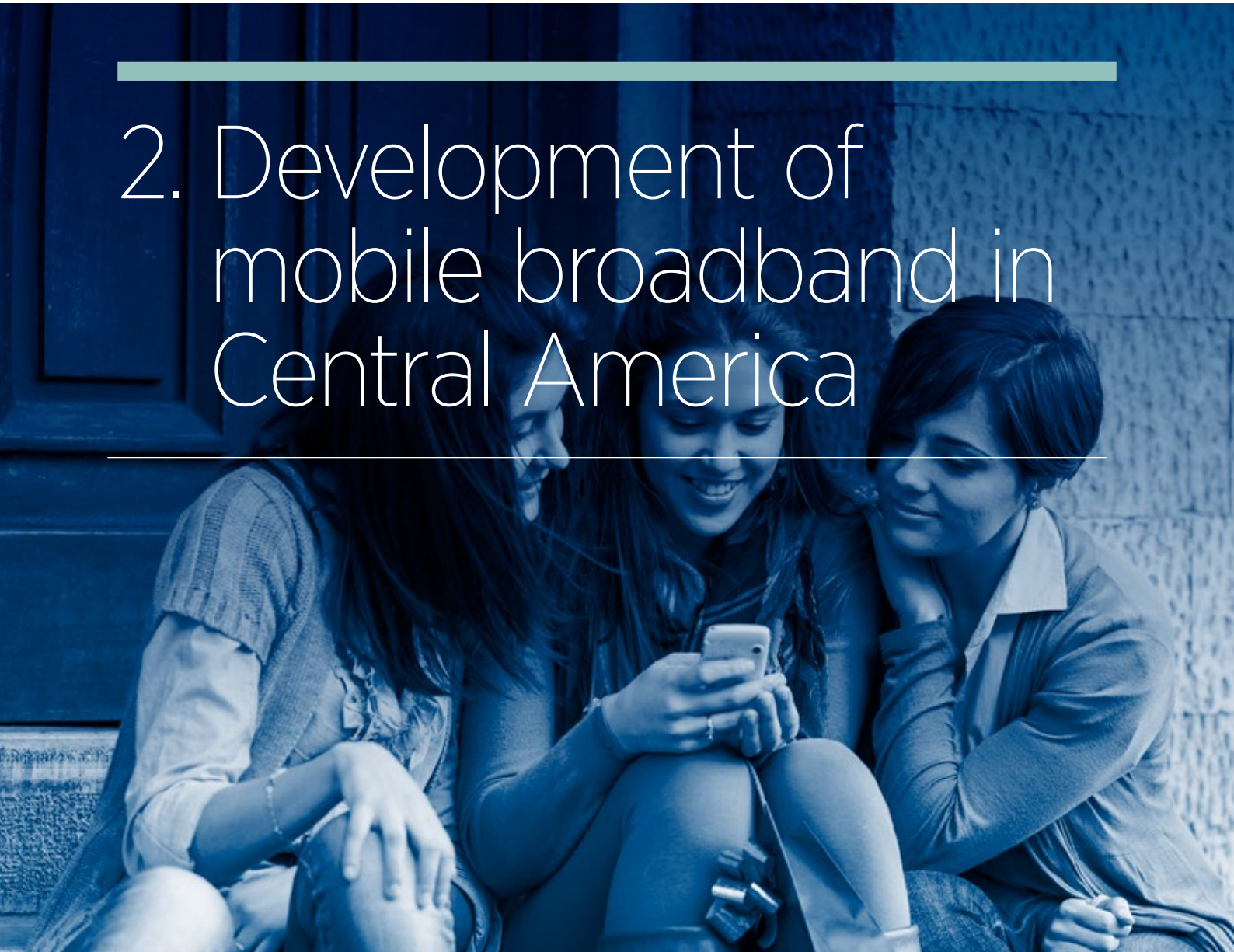
2.1 A lasting gap across the region

Mobile broadband development in Central America is lagging behind the rest of Latin America. Although mobile internet penetration rates are now close to levels in South America following operator investments in 3G deployment, 4G accounted for only 5% of all connections in 2017, a fifth of that seen in South America (Figure 1b). While growth in connections in South America is driven by growth in 4G, this technology is still very limited in Central America.

Figure 1

Mobile internet and 4G connections penetration in Central and South America
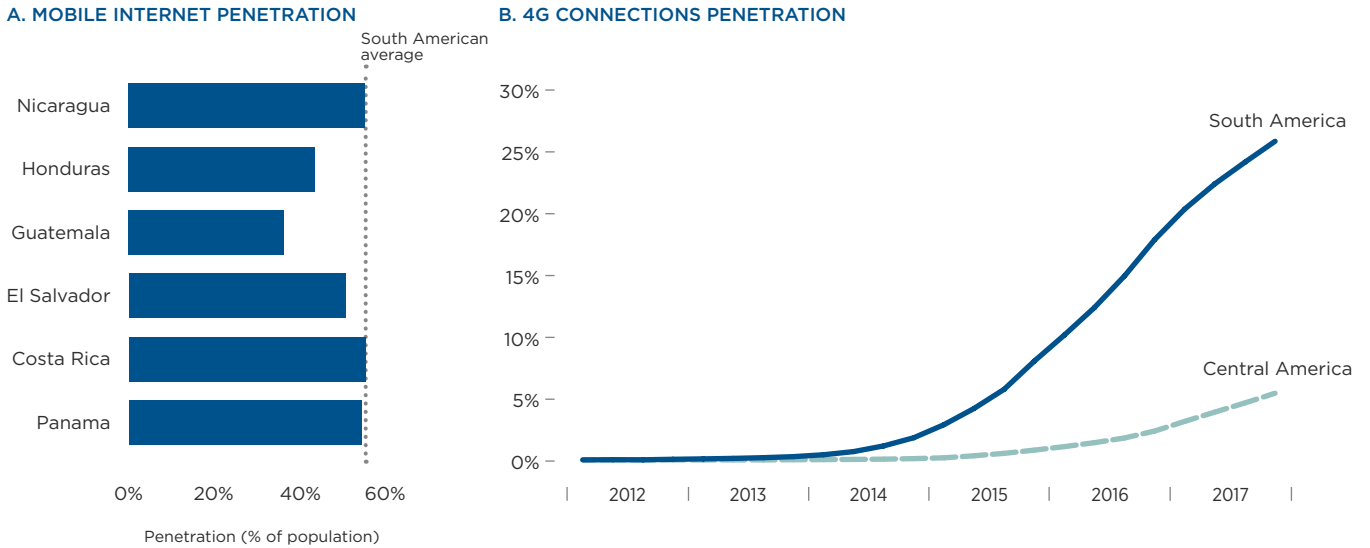
A. MOBILE INTERNET PENETRATION　　　　**B. 4G CONNECTIONS PENETRATION**

Mobile internet penetration is measured as mobile internet subscribers as a proportion of total population. A mobile internet subscriber is defined as a unique user who has used internet services on their mobile phone during the corresponding period.[6] 4G connections penetration is measured as 4G connections as a proportion of total 4G connections, excluding licensed cellular IoT.[7]

The South American average comprises Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela. The Central American average comprises Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama.

Source: GSMA Intelligence

The same delay occurred in the adoption of earlier generations of mobile technology (Box 1). Today this poses significant challenges for the region's governments, most of which recognise that broadband has the potential to promote economic growth. This is consistent with evidence showing that broadband increases productivity and competitiveness, encourages creation of companies and jobs, and boosts foreign investment and wage growth.[8]

In countries with limited deployment of fixed infrastructure, as in Central America, mobile broadband has a considerable impact. The World Bank (2009) and Czernich et al. (2011) found that a 10% increase in broadband penetration is associated with a 1 to 1.5 percentage point increase in GDP in countries with low and medium income per capita. Studies specific to Latin America have produced similar results: a 10% increase in broadband penetration contributes 0.16% to GDP growth (Katz 2009) and ICT capital accounts for almost 18% of growth in value added in Latin American countries (Katz 2015).

6.　Mobile internet services are defined as those that use mobile data (excluding SMS, MMS and cellular voice). Examples include browsing, email, social media apps, online video or music and online games.
7.　Connections are based on unique SIM cards registered on the networks of a country's operators. Connections differ from subscribers in that a unique user can have multiple connections.
8.　Studies that have addressed these questions include Forman et al. (2010), Atasoy (2013), Forman et al. (2012), Canzian et al. (2015), Kandilov & Renkow (2010) and McCoy et al. (2018).

Box 1: Delays in Central America

- Mobile subscriber penetration has historically lagged behind South America, particularly in countries with lower income per capita (Honduras, Nicaragua and Guatemala); e.g., Honduras and Nicaragua reached 5% subscriber penetration in 2003, more than four years later than the average for South America (1999).

- Adoption of mobile internet technologies (3G and 4G) has also lagged behind, as shown in Figure 2. In the case of 3G, all the Central American countries reached the initial 5% 3G connections penetration three to seven quarters behind South America. In 4G, a longer delay of at least two years is likely. Only Panama, Costa Rica and Nicaragua have recently reached 5% penetration, with a two-year delay, in Q3 2017.

Figure 2

Delays in Central America: number of years the region lags behind South America in reaching key milestones
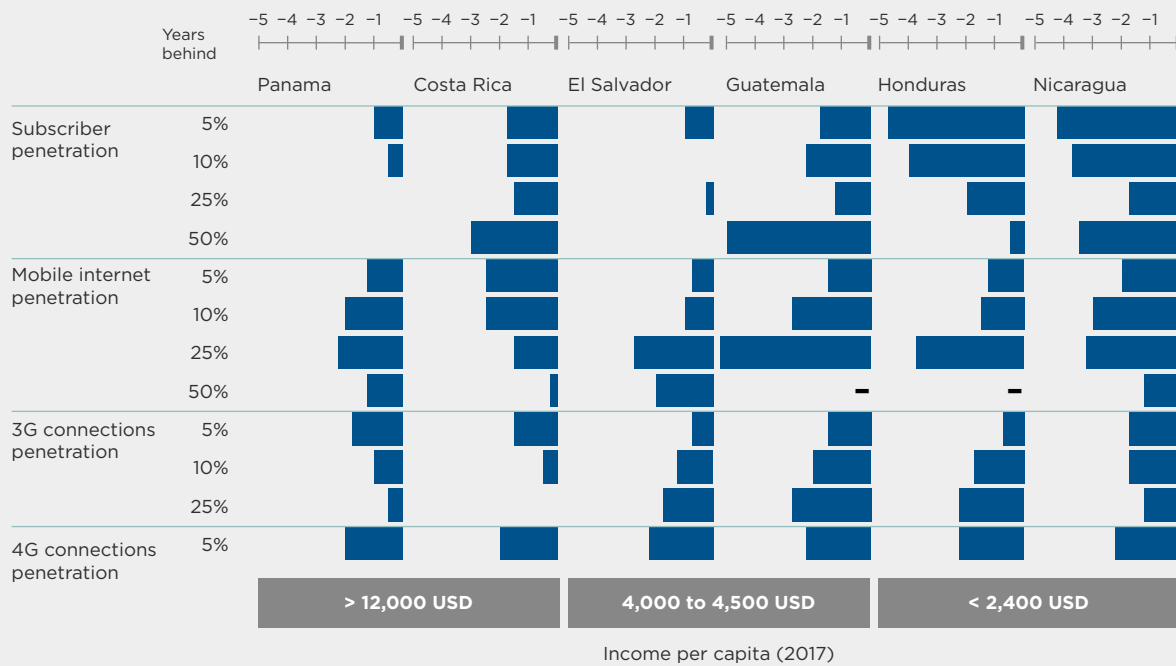
- Level not reached by Q4 2017

Subscriber penetration is measured as number of mobile subscribers as a proportion of total population. Mobile internet penetration is measured as mobile internet subscribers as a proportion of total population. A mobile internet subscriber is defined as a unique user who has used internet services on their mobile phone during the corresponding period (and may have one or more 4G connections).[9] Connections penetration is measured as connections with the relevant technology as a proportion of total connections, excluding licensed cellular IoT.[10]

Source: GSMA Intelligence

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9. Mobile services are defined as those that use mobile data (i.e., excluding SMS, MMS and cellular voice). Examples include browsing, email, social media apps, online video and music and online games.
10. Connections are based on unique SIM cards registered on the networks of a country's operators. Connections differ from subscribers in that a unique user can have multiple connections.

2.2 Consumer welfare in mobile markets

Consumer welfare depends on a range of features in the provision of mobile services, particularly coverage, quality and prices. Quality and coverage are increasingly important with the development of the digital ecosystem and the rapid growth in demand for data.

When markets require continuous investment in technology, there is a close relationship between investment, innovation and consumer welfare. Technology cycles drive new services, enhance the quality of existing services, and allow prices to be lowered through significant reductions in unit costs (see Table 2). These cycles are occurring over increasingly shorter time periods.

Table 2

Mobile investment cycles

	1G	2G	3G	4G	5G
	1980-1990	**1990-2006**	**2006-2011**	**2009-Present**	**Present - ?**
Innovation (new services)	Voice	SMS, MMS, limited browsing	High speed browsing, apps	Broadband browsing, video conference, mobile TV	Connected cars, telemedicine, IoT
Enhanced quality (speeds)	2.4-14.4 kbps	14.4 kbps	3.1 Mbps	100 Mbps	1 Gbps and greater
Improved prices (100% = price per MB in 1G)	100%	50%	10%	5%	N/A

Source: GSMA Intelligence. Price estimates based on unit costs derived by Telstra (2009).

The main factor that differentiates Central America from South America today is 4G coverage, which is lagging behind in all markets. Central America has an average of 60% coverage, compared to more than 80% in South America. Meanwhile, 3G coverage, quality and price levels in Central America are comparable to those in South America (Figure 3).

Figure 3

Adoption and performance results compared to Central America (100% = South America), (Q1 2017)
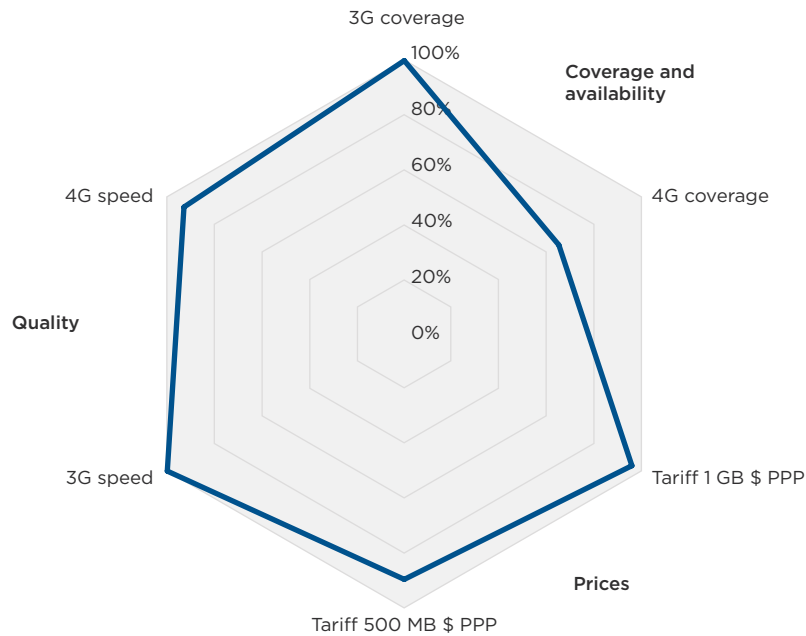
Values for price indicators are inverted: a score below 100% means that prices are relatively higher than in South America.

The South American average comprises Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela. The Central American average comprises Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama.

Source: GSMA Intelligence, Speedtest Intelligence and Tarifica

However, these aggregate results fail to show the variation among countries in Central America. The differences cannot be explained only by differences in income per capita and other demand-side factors such as available income, relevant content and awareness of digital technology.

- In the two markets with the highest levels of income per capita (Costa Rica and Panama), Costa Rica stands out for its performance in coverage and price. It is the leading market in the region by these measures, but shows the lowest performance in terms of quality. Meanwhile, Panama, with the highest income per capita, records an average performance in availability and quality, and the lowest result in price.

- At a lower level of economic development, El Salvador and Guatemala have average coverage levels. Guatemala is comparable to Panama in performance but has considerably lower income per capita. El Salvador has more competitive prices than Guatemala but its network quality is lower.

- Although Honduras and Nicaragua rank the lowest in terms of income per capita, they lead in quality and have average prices and coverage (with the exception of 4G coverage in Nicaragua). Figure 4 shows that, in some cases, these two markets have better results than countries with higher income per capita.

Figure 4

Comparative summary of mobile broadband in relation to average value in Central America (100% = Central America)
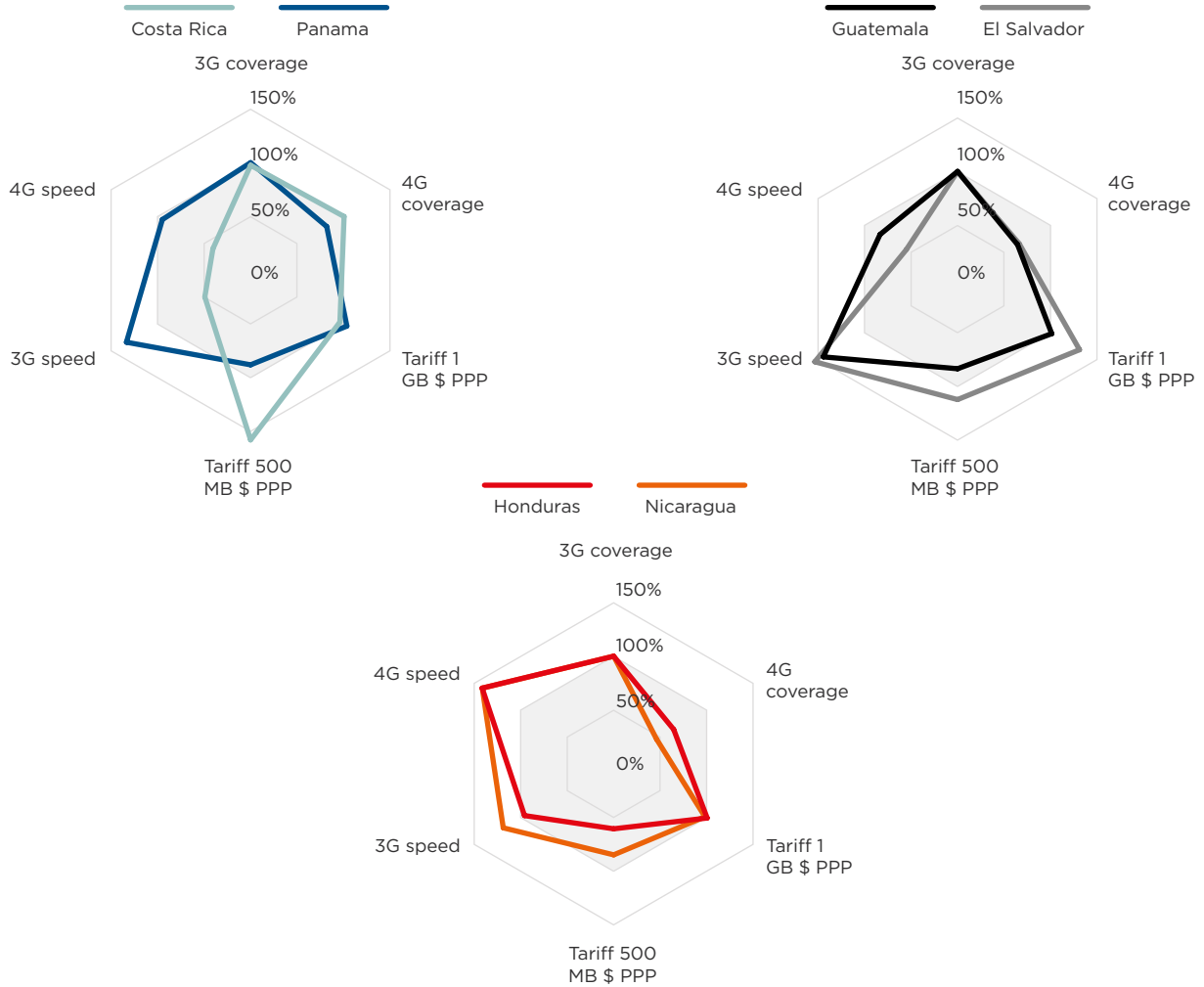
Values for price indicators are inverted: a score below 100% means that prices are relatively higher than the Central American average.

Source: GSMA Intelligence, Speedtest Intelligence and Tarifica. Coverage date of Q4 2017; quality and price data from Q4 2016.

The variations in availability, quality and prices cannot therefore be explained solely by demand side considerations (captured by differences in income per capita). Significant additional factors help explain mobile broadband development; these include market structure (Chapter 3) and market regulation (Chapter 4). Like the demand-side factors, these can affect availability, quality and prices.

3. The impact of market structure

The liberalisation of mobile communications markets delivered gains in consumer welfare. Competition among operators led to incentives to deploy 2G and 3G technologies, kept prices close to cost, and encouraged investment in new services. For these reasons, public authorities today tend to view market structures with more players and lower concentration indices as the main mechanism for delivering benefits to consumers.

However, the relationship between the number of players and performance in quality, innovation, prices and consumer welfare is unclear. Although lower concentration indices can result in incentives to improve prices and quality of service, concentration levels that are too low can generate dynamics that cancel out these positive effects. In particular, market structures with a higher number of operators can undermine operators' scale, push up average deployment costs, and decrease margins and returns on investment. This can reduce the ability and incentive to invest in improving network quality and innovation, and limit operators' ability to minimise costs.

This chapter provides a comparative description of the market structures in Central America (Section 3.1) and analyses the impact of the market structures in the region on innovation, quality and prices (Section 3.2). In particular, it conducts an empirical study into how different concentration levels affect operator investment and 4G download speeds. This is done using models of investment and 4G network quality, estimated from historical data of operators in Latin America.

The analysis concludes that having a higher number of players does not lead to better results in investment or network quality. The findings suggest that performance is greater in a competitive environment where operators have the ability to invest but are few in number, compared to a market structure that has many operators with weak ability to invest.

3.1 Market structures in the region

Taking into account operators with market shares higher than 3%, the countries in Central America can be grouped into markets with four players (El Salvador and Panama), markets with three players (Guatemala and Costa Rica) and markets with two players (Nicaragua and Honduras).

Four-player markets are among those with the lowest concentration in Latin America according to the Herfindahl-Hirschman Index (HHI).

El Salvador in particular is well below the South American average. Guatemala and Costa Rica have concentration levels slightly above this average, while Honduras and Nicaragua (with two operators) have the higher concentrations.

Figure 5

Number of mobile network operators (left) and HHI (right), Q4 2017

| MNOs (market share higher than 3%) | MNOs (market share less than 3%) | Country HHI | Average HHI in South America |
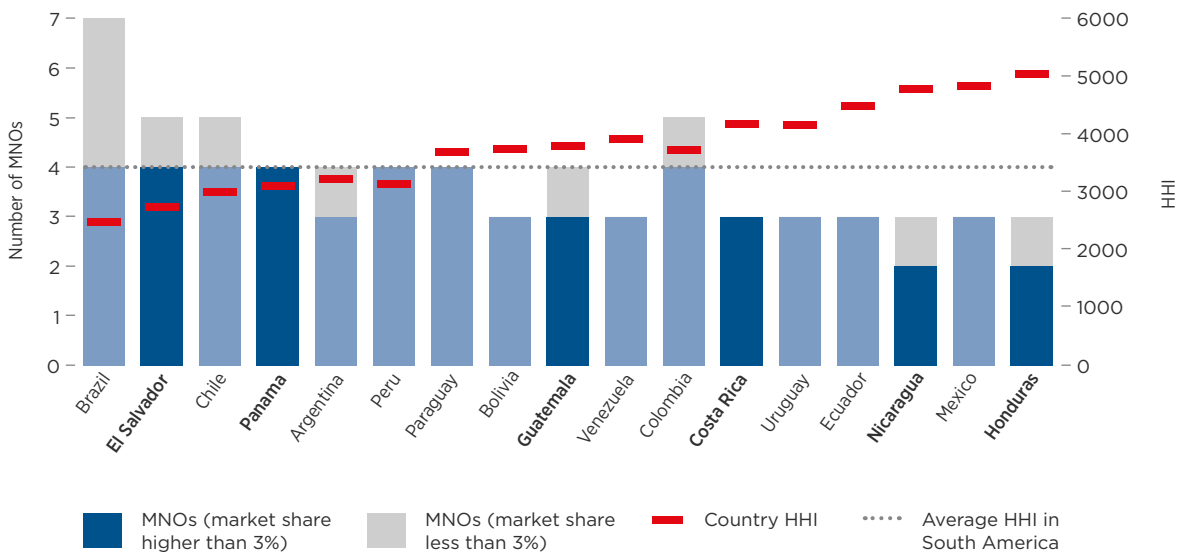
Market shares based on number of 4G connections, excluding licensed cellular IoT.

Source: GSMA Intelligence

Box 2: The HHI as a concentration index

The HHI is a measure of market concentration commonly used in competition analysis. It is calculated by squaring the market shares of the operators in a market and summing the resulting numbers. As a measure of competition, however, it has two shortfalls:

- The HHI calculation requires a market definition for the measurement of market shares. The market must be defined based on firms producing services that can be considered substitutes for each other (from the point of view of demand and supply). This is complex in markets such as telecoms, because services

are differentiated (e.g., operators offer different coverage, speed and bundled services) and defining substitution is not a simple task.[11]

- In mobile markets, when the HHI is calculated based on network infrastructure operators, the concentration indicator presumes that the competitive pressure perceived by an operator can come only from other network operators. However, if virtual operators, convergence trends and over-the-top (OTT) players are considered, this presumption can lead to an underestimation of the competitive situation.

Market liberalisation processes have led to a converging trend in HHI levels in Central and South America, as shown in Figure 6. By the end of the 1990s, markets had been liberalised in Guatemala (1997), Panama (1997) and El Salvador (1998). Other countries

followed at the beginning of the 2000s, with an increase from one to two operators in Nicaragua and Honduras, and from one to three in Costa Rica.

Figure 6

Average HHI in the region over time and impact of market liberalisation
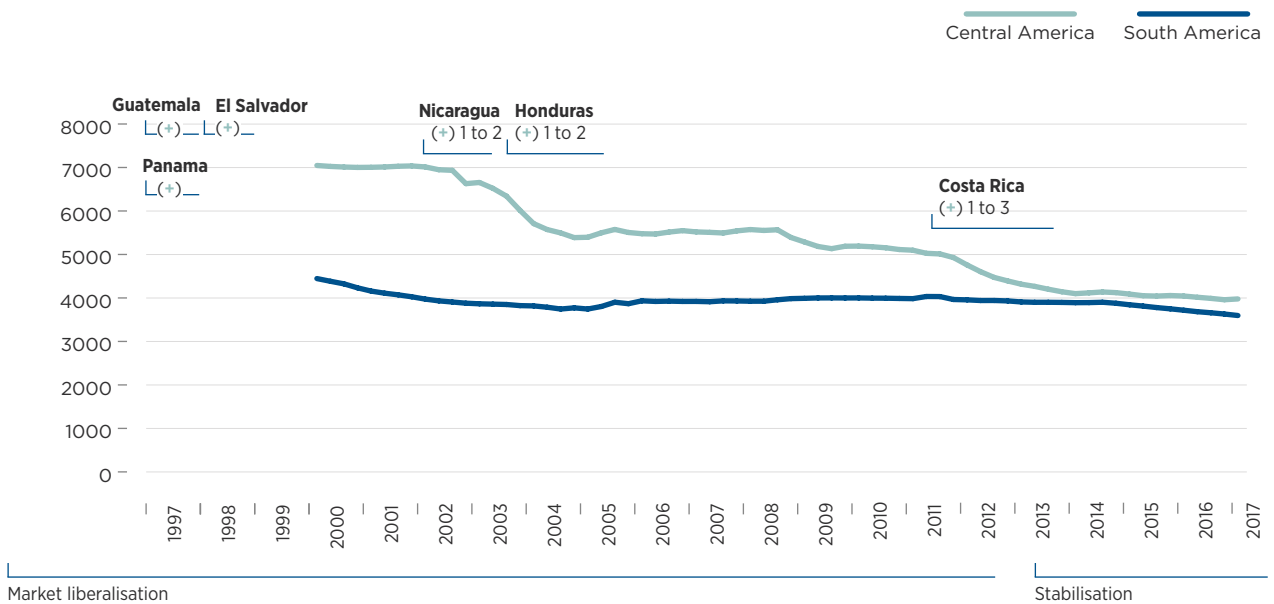
Market shares for HHI calculation based on number of 4G connections, excluding licensed cellular IoT.

Source: GSMA Intelligence

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11. In markets with differentiated products, firms are said to be at different levels of *closeness* depending on the extent to which products are close substitutes (i.e., seen by consumers as interchangeable).

Apart from market liberalisation processes, which have caused the most significant HHI changes in all countries, second-order changes have typically led to a further drop in concentration (see Annex 6.1 – tied to the Spanish version of this report). The total of *net* entries and exits is three.

- In El Salvador the number of operators increased from three to four in 2001, with a localised impact on the HHI over the following two years, after which concentration returned to the levels before the arrival of the new entrant (Digicel).

- The change from two to four operators in Panama in 2008, with the entry of Digicel and Claro, caused a considerable drop in the HHI. This was the most significant change in the region from 2000 to 2017 (without taking into account market liberalisation processes).

- The only net exit occurred in Guatemala in 2005, with a limited impact on the HHI. Another player entered later, but it remained with market share below 3%.

3.2 Impact on quality and innovation

Economic theory is ambiguous about the impact of market structure on investment.

On the one hand, markets with more players or lower concentration indices can provide higher levels of investment by strengthening the *incentive* to invest through increased competitive pressure. When investment enables a firm to differentiate itself from its competitors and increase prices, incentives to invest can be expected to be higher in markets with low concentration or low margins (this is known as the "Arrow effect" or "escape competition effect").

On the other hand, there are reasons why markets with a higher number of players or very low concentration levels can generate an opposite impact on quality and innovation, if it means that operators lose the *ability* to invest. This is known as the 'Schumpeterian effects' (see Figure 7).

Figure 7

Relationship between concentration, quality and innovation
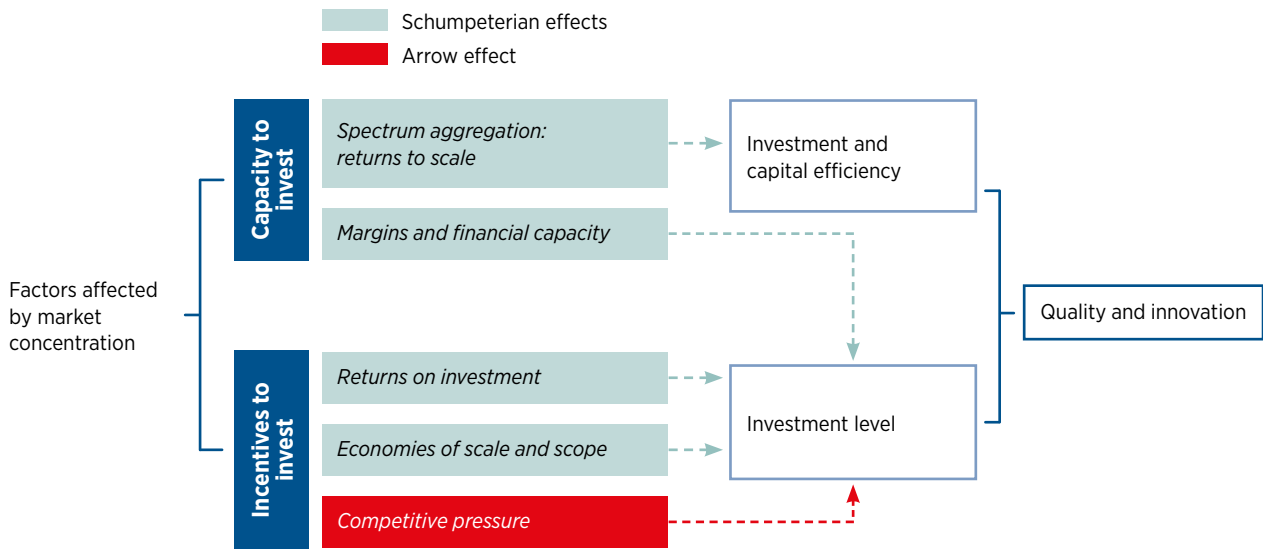
Source: GSMA Intelligence

First, markets with a higher number of players can result in less efficient investments and assets. Operators holding large amounts of spectrum, in diversified bands, achieve a more efficient combination due to the physical propagation characteristics of spectrum.[12] This allows operators to maximise the capacity they can offer from any given investment. As long as lower concentration indices mean greater fragmentation in the distribution of spectrum, operator assets may be used less efficiently in these types of markets.

Secondly, markets with lower concentration indices can lead to lower investment levels for three reasons:

- In these markets, operators expect *lower post-investment returns.* This weakens their incentive to invest, resulting in lower total investment levels than when expected returns are higher.

- More intense competition leads to a drop in *margins and financial resources,* undermining the availability of internal resources and creating a greater dependence on external financing. This typically results in higher capital costs.

- *Economies of scale and scope* are significant in telecoms markets. To deliver mobile services, operators have fixed and common costs regardless of the number of users; e.g., the costs of the spectrum used by the network, the network core, and certain administrative costs. Operators' average costs hence decrease as their consumer base increases, which can also reduce the long-run incremental costs (LRIC) for network expansion.[13] This makes operators more efficient, increases their returns and strengthens the incentive to invest.

The Arrow effect and Schumpeterian effects can coexist, in an inverted U relationship between market concentration and investment (Aghion et al. 2005). At high concentration levels, introducing more intense competition has a positive impact on quality and innovation. For example, markets that shift from a monopoly to multiple operators experience dynamics in which the advantages of lower concentration prevail. However, after a certain point, introducing further de-concentration can have a negative impact if it reduces margins, returns on investment and, more generally, operator scale.

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12. As indicated in WIK (2015, p. 33): "LTE requires a minimum amount of contiguous spectrum and connection speeds can be further increased with larger blocks of spectrum. Larger operators may also be able to realise a more efficient mix of spectrum in low frequency bands (for coverage) and spectrum in high frequency bands (for capacity). See also <https://www.ofcom.org.uk/__data/assets/pdf_file/0021/58314/2nd_condoc_annex_6.pdf> (par. 3.23).
13. As in other network industries, the costs borne by operators to increase their capacity by one unit (or marginal costs) are not stable. These costs drop close to zero once an operator has a certain capacity installed, and increase considerably when the operator reaches maximum capacity (dropping back to zero after investment to install further capacity). For each expansion phase, larger operators are able to distribute *fixed* costs over a larger mass of users, which means they can reduce the long-run incremental cost (LRIC).

Figure 8

Theoretical inverted U relationship between concentration, quality and innovation

Service quality and innovation

Advantages of lower concentration prevail

Disadvantages of higher concentration prevail

More concentration

Optimum concentration index

Less concentration
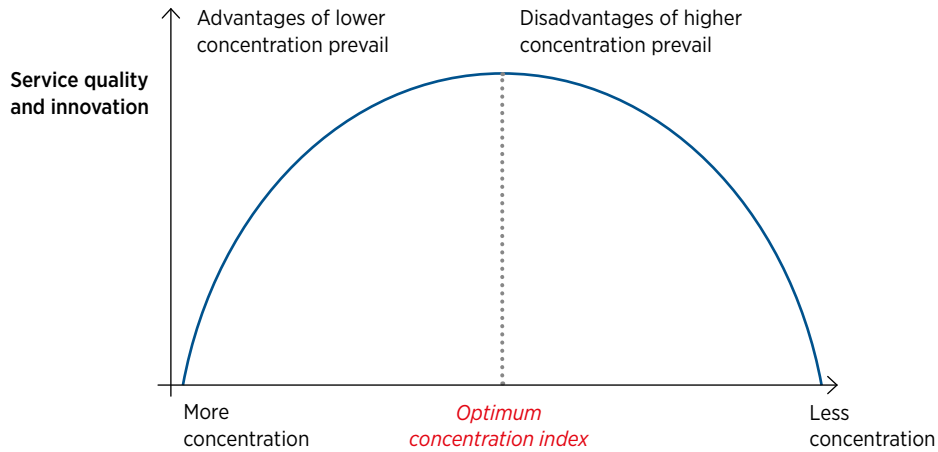
Recent studies have examined the impact of mobile mergers and market structure on investment. Focusing on developed markets, these studies have provided no evidence to presume that higher market concentration always reduces investment. In fact, it has been found that higher concentration always drives higher investment or that this happens unless the concentration level is above a certain threshold (Table 3).

Table 3

Findings on the effects of mobile concentration

Study	Measure of concentration	Effect of greater concentration on operator investment	Effect of greater concentration on total country investment
WIK (2015)	HHI	No effect	No significant effect
CERRE (2015)	HHI	Investment increases	No significant effect
Houngbonon & Jeanjean (2016a)	Number of players	Investment increases	N/A
Houngbonon & Jeanjean (2016b)	Lerner Index	Inverted U: investment maximised at 38% of EBITDA margin	N/A
HSBC (2015)	Lerner Index	Inverted U: investment maximised at 37-40% of EBITDA margin	N/A

3.2.1 Evaluation of investment

The evaluation of the impact of market structures on investment for Central and South America as a whole shows an inverted U relationship between competition intensity and investment. At relatively low competition levels, the overall effect of adding more competition intensity is positive. However, after a certain point, greater competition intensity results in lower operator capex.

Box 3: Methodology for investment model

Competition is measured in this analysis using the Lerner Index. This represents market power as the difference between prices and costs, estimated from EBITDA margins: the greater the difference, the lower the competition perceived by the operator. Considering this, a competition intensity index is calculated as the inverted Lerner Index. Unlike the HHI, the competition intensity index can measure the *closeness* of competition among operators and provides information at the operator level.[14]

To understand the impact of competition intensity on operator investment, an econometric investment model has been used. In this model, operator investment is determined from a range of supply- and demand-side factors in each market. In addition to the competition intensity index, the model considers how investment levels vary because of differences between markets in deployment costs and spectrum assignment. Demand characteristics are also taken into account, particularly willingness to pay and potential market size (see Figure 9).

Figure 9

Factors included in the investment model

Supply-side factors			Demand-side factors
DEPLOYMENT COSTS	**SPECTRUM ASSIGNMENT**	**MARKET STRUCTURE**	**DEMAND CHARACTERISTICS**
Market population density	Total spectrum assigned to operator	*Competition intensity index perceived by operator*	*Per capita income in the market (willingness to pay, digital technology skills)*
Market geography*			*Adult population in the market (potential market size)*
Technological progress in the region**			

Operator capital investment

* Factor included based on market fixed effects, as detailed in Annex 4 (tied to the Spanish version of this report).
** Factor included based on temporary effects in the region, as detailed in Annex 4.

Source: GSMA Intelligence

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14. See Houngbonon & Jeanjean (2016b) and HSBC (2015) for the associated literature. The Lerner Index is described in Annex 4 (tied to the Spanish version of this report).

The analysis is based on quarterly investment data for 26 operators in 13 markets in Central and South America from 2001 to 2016.[15] Investment is measured as investment in capital assets, or capex per operator. This captures operator investment in tangible assets but does not include investments made to purchase spectrum. In the period from 2006 to 2017, operators' investment efforts in Central America have been similar to those in South America. In this period, investments as a share of market revenue have increased from 15 to 22% (Figure 10).

Figure 10

Capex as a proportion of revenue
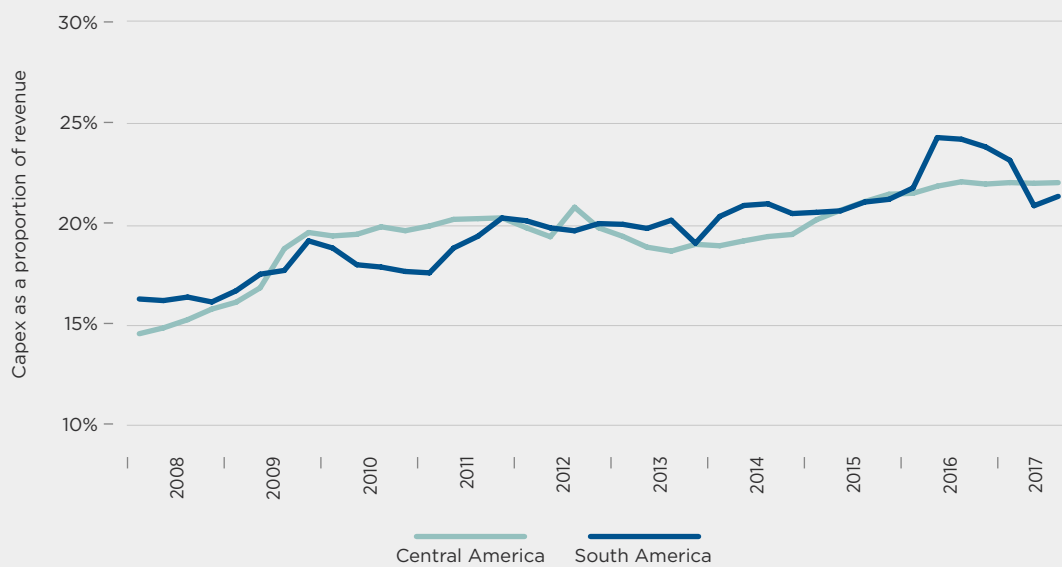
Source: GSMA Intelligence

15. Due to the limited availability of data on capex and EBITDA margins, this study included the markets in Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, El Salvador, Mexico, Panama, Paraguay, Peru, Uruguay and Venezuela. Coverage from 2001 to 2016 varies with data availability.

The model shows that operator investment is maximised when the competition intensity index reaches 62 to 80 points (Figure 11). This corresponds to an EBITDA level of 32-38%, depending on how the model is constructed. If an operator has margins below these levels, operator investment drops compared to a situation where margins are higher. All of these are average values and can be higher or lower in practice depending on the specific conditions of each market.

Figure 11

Inverted U relationship between competition intensity and investment

Average estimates for markets in Central and South America
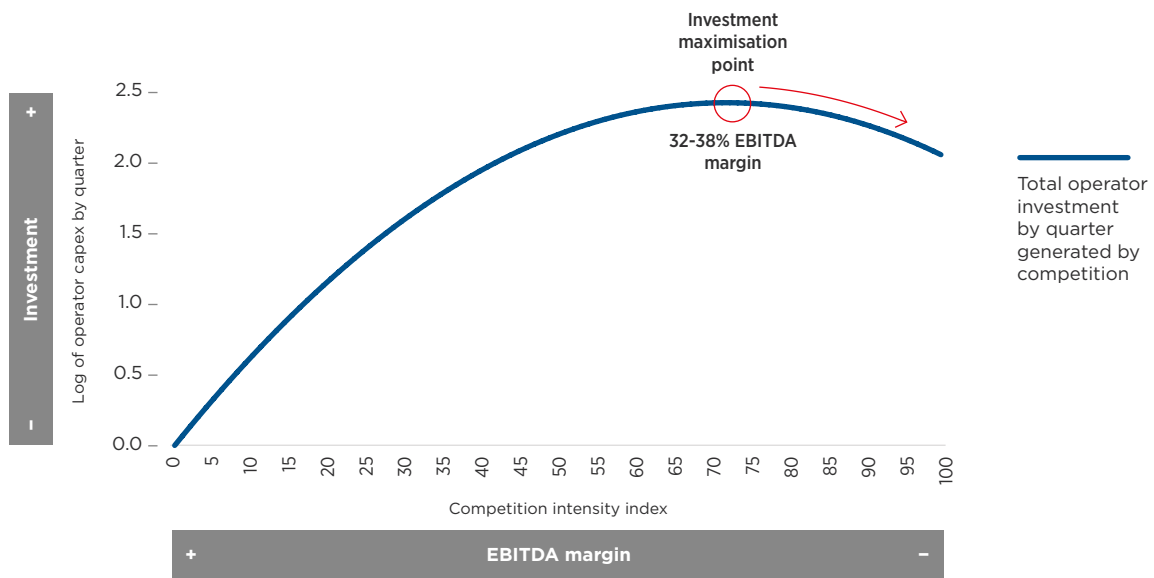
'Total operator investment by quarter generated by competition' shows the total contribution of the 'competition intensity index' variables to operator capex based on the results of column 3 in Table 4. It is the total of the coefficients found for the competition intensity index variables and the quadratic term of the competition intensity index, interacted with the competition value corresponding to each point.

The findings confirm that, in Central and South America, markets with a higher number of players can be penalised in terms of the investments operators can make. Greater competition has a positive impact when it strengthens operator incentives to retain and gain users by competing in quality, but a market environment with too many operators undermines operator scale, and ability and incentive to invest.

Box 4: Results obtained in investment models

The results used for Figure 11 are based on the estimates summarised in Table 4. The analysis in columns 2 to 4 shows that although the competition intensity index variable has a positive impact, the second instance (quadratic term) has an inverse sign. This means that there is an inverted U relationship. In these estimates, the competition intensity index has an overall negative impact after 32-38% EBITDA, depending on the control factors included. These results are confirmed when capex is measured as operator investment per subscriber (see Annex 4.3 tied to the Spanish version of this report).

Table 4

Summary of the results from the investment models for Central and South America, using instrumental variable estimation

	Log capex			
	(1)	**(2)**	**(3)**	**(4)**
Competition intensity index	-2.384*** (0.722)	8.806*** (2.394)	5.975** (2.351)	7.734** (3.230)
Competition intensity index (squared)		-6.575*** (2.347)	-4.784** (2.028)	-5.654** (2.501)
Log of population density				-35.02* (18.26)
Log of income per capita			1.366*** (0.379)	1.374** (0.540)
Log of adult population				18.04 (13.41)
Amount of spectrum				0.000769 (0.000992)
EBITDA of investment maximisation	**N/A**	**33%**	**38%**	**32%**
Observations	791	791	791	780
R-Squared	0.812	0.734	0.776	0.778
Country and time fixed effects	Yes	Yes	Yes	Yes
Robust standard errors	Yes	Yes	Yes	Yes
Instrumental variable diagnostics				
Exogeneity test	Not passed	Passed	Passed	Passed
Weak identification test	Passed	Passed	Passed	Passed
Under-identification test	Passed	Passed	Passed	Passed

Errors robust to heteroskedasticity and autocorrelation are within clusters (country)
*** p<0.01, ** p<0.05, * p<0.1

3.2.2 Evaluation of 4G network quality

Operator investment is an *indirect* measure of how market structures impact quality of service. Regardless of higher levels of investment, operators in markets with higher concentration indices can channel investment more efficiently, particularly because of the efficiency resulting from spectrum aggregation. Therefore, with the same levels of operator investment, consumers in markets with higher concentration indices can have access to better quality networks. This means it is important to more directly measure the impact of market structure on indicators that capture user-perceived network performance.

In Central and South America, a positive relationship is seen between concentration levels and 4G download speeds (Figure 12). However, this relationship could be affected by factors other than concentration levels. For example, the countries analysed show differences in the use and possible saturation of their networks; although all countries in Central America have low 4G penetration rates (as seen in Section 2), there are significant differences compared to South America. Similarly, the countries differ in network deployment costs (due to population distribution or geographical features) and consumer willingness to pay, among other factors that can affect download speed results. To take these factors into account, this study has produced an econometric analysis.

Figure 12

HHI and download speeds (Q4 2016)

Source: Speedtest Intelligence and GSMA Intelligence

Box 5: Methodology for download speed models

To measure the impact of market structure on 4G network quality, a network quality model has been used. In the model, download speeds are determined by a range of supply- and demand-side factors: spectrum available for 4G, income per capita, population density, demand for mobile internet (as a variable for saturation and/or potential market) and 3G speeds (as a technology substitute). Other factors were also taken into account, such as the emergence of more efficient devices. See Annex 5 (tied to the Spanish version of this report).

Network quality is measured using Speedtest Intelligence data provided by Ookla®. This is based on consumer-initiated tests on the Speedtest® app.[16] The dataset covers the average 4G network performance of 52 operators in 16 countries in Central and South America from 2013 to 2016.[17] Market structure is measured through the number of players (making it possible to measure the average impact of changes to players, regardless of market share[18]) and the HHI.

The evaluation of the impact on 4G performance of a change in the number of players confirms that operators in markets with a higher number of players experience slower speeds than they would with more concentrated structures. According to the estimates made using data from 2013 to 2016, an increase of one operator in the market causes an average drop of 3-4.4 Mbps in 4G download speeds. Consistent with this, reductions in the HHI generate reductions in 4G speeds: a 1,000-point reduction in the HHI causes a 2-2.7 Mbps reduction in speed.

In the analysis of operators in markets with a specific number of players, similar results were found:

• Operators in markets with two or three players experience increases in 4G download speeds over operators in the other markets, due to the role of market structure. The increases are 8.4-12.6 Mbps for operators in two-player markets, corresponding to a 40-60% increase over the average 4G performance in Central America.[19] Operators in two- or three-player markets experience increases

of 2-3.5 Mbps, or 10-17% over the average speed in Central America. The results are similar when speeds are measured across all networks.

• Meanwhile, operators in markets with four or more players experience speeds 2-3.5 Mbps slower than operators in the other markets, due to the role of market structure. This is 10-17% of the average speed in Central America. The results are also similar when the average speeds are measured across all networks.

The range of these results depends on how download speed models are estimated (see Box 6). The findings in the most conservative range are shown in Figure 13.

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16. Via the Speedtest app, mobile service users test mobile network performance using information about parameters such as download speeds, upload speeds and latency. The results of these tests are gathered and aggregated after applying a filter and normalisation process. See Annex 5.2 (tied to the Spanish version of this report) for more details.
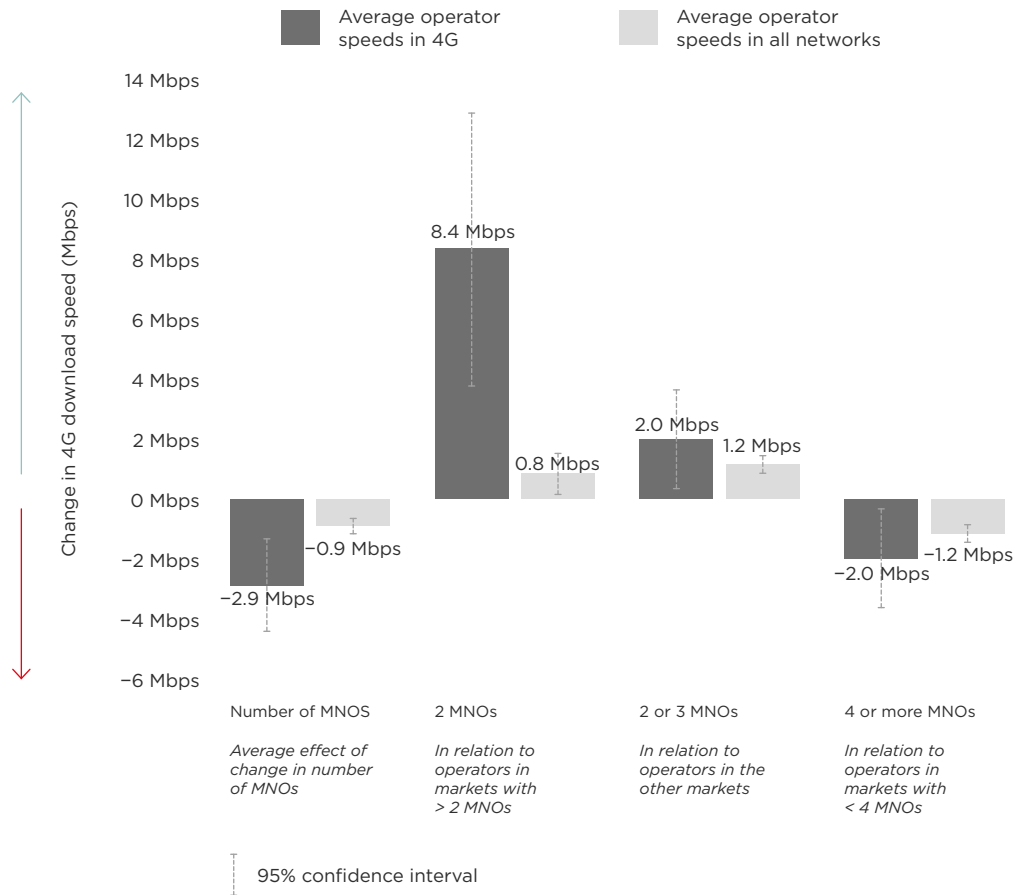17. The countries are Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela.
18. Number of players with a market share above 3% (by number of connections, excluding licensed cellular IoT).
19. Central American markets had an average 4G speed of 21 Mbps in Q4 2016.

Figure 13

Average marginal effects of number of mobile network operators (MNOs) on download speeds

Legend:
- ■ Average operator speeds in 4G
- ▢ Average operator speeds in all networks

Y-axis: Change in 4G download speed (Mbps)

Categories (x-axis):

Number of MNOS	2 MNOs	2 or 3 MNOs	4 or more MNOs
Average effect of change in number of MNOs	In relation to operators in markets with > 2 MNOs	In relation to operators in the other markets	In relation to operators in markets with < 4 MNOs

Values:
- Number of MNOS: −2.9 Mbps (4G), −0.9 Mbps (all networks)
- 2 MNOs: 8.4 Mbps (4G), 0.8 Mbps (all networks)
- 2 or 3 MNOs: 2.0 Mbps (4G), 1.2 Mbps (all networks)
- 4 or more MNOs: −2.0 Mbps (4G), −1.2 Mbps (all networks)

┊ 95% confidence interval

The changes in speeds were obtained from two comparisons (taking into account the factors in Box 5): the speed differences associated with the change in number of players from 2013 to 2016 in Central and South America, and the speed differences associated with the comparison of operators in markets with different numbers of players. The marginal effects are based on the simulations detailed in Annex 5 tied to the Spanish version of this report (models that include mobile internet penetration).

The analysis of 4G upload speeds is consistent with these results. The study also found that, as a proportion of average speeds, the effects are similar in magnitude. This is because, although the effects are lower in terms of Mbps, average performance in upload speeds in Central and South America is below that of download speeds (as happens in most markets).

Analysis of speed determinants confirms that the amount of spectrum is a key factor. The study has found that a 1 MHz spectrum increase results in an increase in download speeds of approximately 0.11 Mbps. Assigning two 20 MHz blocks to an operator leads to an increase of 4.4-5.6 Mbps, representing an increase of 21-27% over the average performance in Central America in Q4 2016 (average of 21 Mbps).

Box 6: Results obtained for download speed models

The changes in 4G download speeds shown in Figure 13 are based on the estimates summarised in Table 5. Column 1 shows the negative coefficient associated with the variation in number of players from two operators onwards (2 to 3, 3 to 4 players, etc.) and columns 3 to 5 show the impact coefficients associated with unique variables capturing the number of players. Annex 5 (tied to the Spanish version of this report) explains these results, including the results in the upper ranges.

Table 5

Results from 4G speed models for Central and South America

	Operator 4G download speeds (Mbps)				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Number of MNOs	-2.901*** (0.796)				
HHI		0.00203*** (0.00058)			
4 MNOs			-1.987** (0.833)		
2 or 3 MNOs				1.987** (0.833)	
2 MNOs					8.356*** (2.321)
4G spectrum	0.113*** (0.0159)	0.114*** (0.0158)	0.111*** (0.0159)	0.111*** (0.0159)	0.106*** (0.0157)
Mobile internet penetration	24.57*** (6.358)	32.16*** (5.450)	30.63*** (5.893)	30.63*** (5.893)	24.64*** (6.119)
3G download speed	3.003*** (0.322)	2.816*** (0.353)	3.023*** (0.327)	3.023*** (0.327)	3.094*** (0.301)
Log of income per capita	-3.650*** (1.295)	-4.830*** (1.141)	-5.331*** (1.149)	-5.331*** (1.149)	-3.449*** (1.288)
Log of population density	2.136** (1.062)	2.146** (0.953)	2.735*** (1.056)	2.735*** (1.056)	2.973*** (0.956)
Constant	40.64*** (9.046)	32.81*** (10.51)	43.26*** (9.134)	41.27*** (9.411)	23.32** (11.54)
Observations R-Squared	492 0.328	492 0.327	492 0.318	492 0.318	492 0.329

Sub-regional fixed effects by quarter. Robust standard errors in brackets
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The additional models developed suggest that the changes in speed associated with the number of players (shown in Figure 13) depend on market share distribution. On the one hand, the positive effect perceived by operators in two- or three-player markets can translate into increases of 6 and 8 Mbps when they have similar market shares. On the other hand, operators with similar market share distributions in four-player structures perceive a negative effect that can reduce speeds by 8 Mbps.

These findings confirm that optimum market structures must achieve an appropriate combination of *ability* and *incentives* to compete.

3.3 Impact on prices

Competition authorities typically expect that at higher concentration indices, operators will lose incentive to lower their profit margins or reduce costs to be more efficient. However, lower concentration indices can *reduce operator scale*, which can result in operators with less ability to distribute their fixed costs, meaning higher average costs. Because greater market fragmentation can cause inefficient spectrum distribution, this can also result in higher costs per bit transmitted.[20]

A greater number of competitors in the market can also lead to higher price levels through *reduced investment*. This is important, because the mobile industry has a high rate of technological progress that causes dramatic changes in cost structures.[21] In fact, the rate of technological progress in the mobile industry is so high that network performance doubles every year (Houngbonon & Jeanjean, 2016a).

The downward trend in average cost per MB associated with new generations of technology has been considerable: the average cost per MB with LTE is less than 5% of the cost per MB with GPRS (Figure 14). A recent study on changes in unit costs of mobile data over time in France found that the introduction of 4G was responsible for more than 50% of the fall in prices from 2011 to 2014 (Nicolle et al. 2018).

Figure 14

Average cost per MB as a percentage of cost under GPRS technology
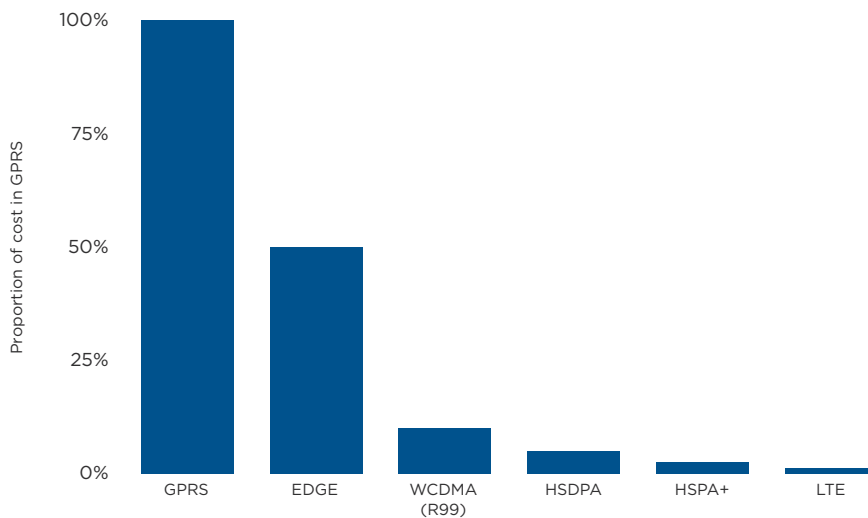
Unit costs derived by Telstra. Source: Telstra (2009), "Building the Business Case for Mobile Broadband: The HSPA Evolution Path". Accessible at <https://www.gsma.com/spectrum/wp-content/uploads/2012/03/22092009182239.pdf>

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20. In this context, inefficient spectrum distribution refers to spectrum assignment in small blocks and with poorly diversified holdings.
21. It is important to note that the mechanisms through which lower concentration can lead to lower prices are limited to existing cost and technology structures. Existing cost and technology structures limit profit margin reductions that can be expected and the extent to which companies can lower their costs. In contrast, price reductions resulting from investment are unlimited and increase with the level of technological progress. Because telecoms markets are characterised by regular innovation, the potential to lower costs through investment is particularly important in mobile markets.

Economic studies that have specifically examined the role of concentration have reported contrasting results: some found no significant impact; others found opposing effects (see Table 6). The contrast in results can be explained, above all, by differences in how prices are measured (see Box 5). Studies focusing on price per MB found that higher concentration is a key factor in a drop in unit prices, while those that have looked at baskets of services have found mixed results.

Table 6

Findings on the impact of concentration on prices: evidence from developed countries

Study	Measure of price	Concentration or consolidation	Effect of higher concentration on prices	
Frontier (2015)	ARPU	Concentration in general	No impact	=
CERRE (2015)	Baskets of services	4 to 3	Rise	⬆
DG Comp (2015)		4 to 3[22]	Rise	⬆
RTR (2016)		4 to 3[23]	Rise	⬆
DG COMP (2015)		5 to 4[24]	Drop	⬇
Houngbonon (2015)	Unit prices	4 to 3[25]	Data: Drop	⬇
HSBC (2015)		4 to 3[26]	Data: Drop	⬇
Jeanjean (2015)		Concentration in general	Data: Drop	⬇

Source: GSMA Intelligence

Box 7: Measures of prices and impact of concentration

Economic studies investigating the effects of concentration on prices have used different price indicators. In general, using unit prices rather than baskets of services typically has some advantages:

- Measuring prices with baskets of mobile services involves defining a specific mobile data allocation. Once this is established, the tariffs closest to the allocation are observed. Comparing these prices over time creates a bias because operators progressively offer tariffs with higher data allocations (while the allowances in the basket are kept constant). With this bias, a recent study concluded that the basket methodology does not permit observation of the impact of new technology networks on prices (Nicolle et al., 2018).

- Meanwhile, the unit price methodology looks at the cost of providing the same *unit* of a service over time (e.g. the cost per MB or per minute of voice). This method is often accompanied by estimates that also take into account price differences due to improvements in quality of service over time.

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22. Evaluation of the 2007 T-Mobile/Orange merger in Holland
23. Evaluation of the 2012 Hutchison/Orange merger in Austria
24. Evaluation of the 2006 T-Mobile/Tele.ring merger in Austria
25. Evaluation of the 2012 Hutchison/Orange merger in Austria
26. Evaluation of the 2012 Hutchison/Orange merger in Austria

Figure 15 shows market performance in Central America, indicating the average price in market structures with higher or lower levels of concentration (taking into account the current average HHI in the region).[27] Tarifica's 2017 comparison of 500 MB and 1 GB tariffs does not lead to definitive conclusions about the role of market concentration in pricing. At 500 MB, prices adjusted by purchasing power parity (PPP) in the more concentrated markets are significantly lower, but this is inverted in the more intensive usage basket (although the difference is smaller).

Figure 15

Relative performance by concentration of baskets of services in Central America, 2017
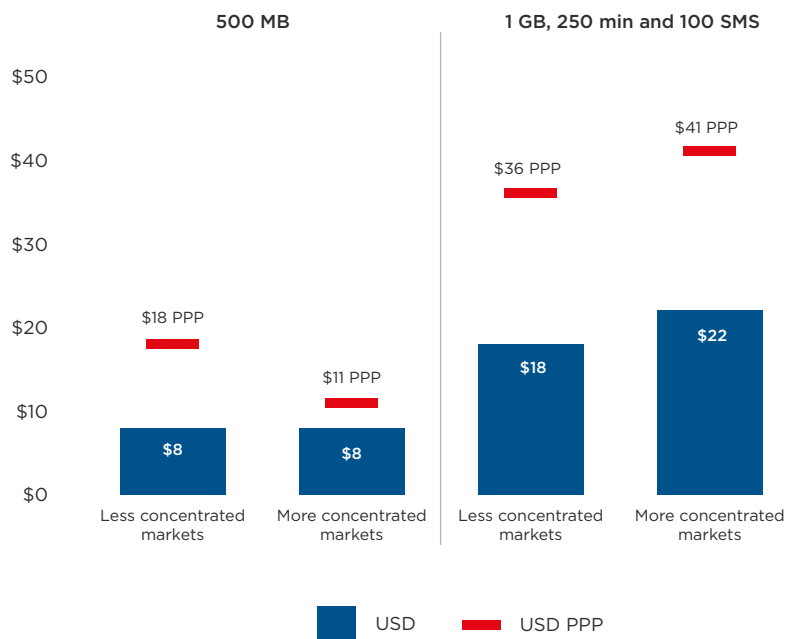
Less concentrated and more concentrated markets are based on countries with HHI levels lower or higher than 3900 points. The tariff prices included for each country in each basket may be prepaid or postpaid. For each market, the lowest tariff that complies with the allocation for the basket is taken into account, regardless of the payment method.

Source: Tarifica and GSMA Intelligence

Trends from 2012 to 2015 for 500 MB prepaid and postpaid tariffs (reported by the International Telecommunication Union) also show inconclusive evidence on the relationship between market concentration and retail prices (Figure 16).

For prepaid, groups from less and more concentrated markets have similar prices in 2015. For postpaid, the groups have followed similar trends.

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27. The benchmark used to distribute the countries by more/less concentrated is based on 3900 HHI points. This is the approximately average value at present, which has been adjusted to bring it into line with the average value for 2012 to 2017. This was done to minimise the time points in which countries move from one group to another, according to their HHI trends; i.e., to obtain two stable groups of countries.

Figure 16

Relative performance by concentration in baskets of services in Central America, 2012 to 2015
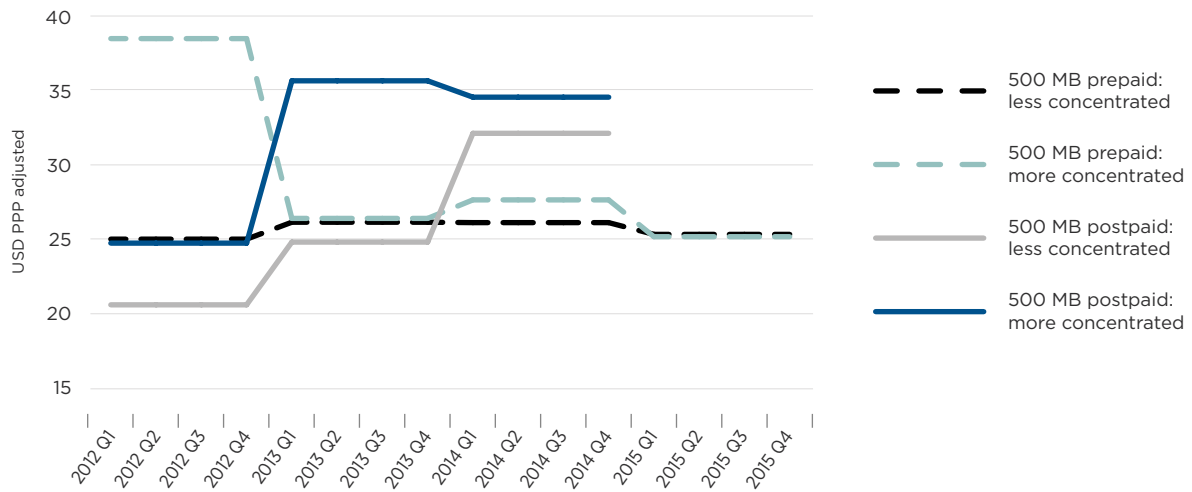
Less concentrated and more concentrated markets are based on countries with HHI levels lower or higher than 3900 points.

Source: ITU

4. Key issues for public policy in Central America

Chapter 3 shows that there is an inverted U relationship between the number of players (or market concentration index) and investment; and that operators in markets with relatively few players in the region tend to exhibit better performance in 4G networks. In turn, the technology turnover brought about by higher concentration indices results in significant cost reductions. As indicated, this occurs through a range of mechanisms that boost incentives and the ability to invest (including operator scale, profitability, margins and/or optimisation of spectrum use).

Public authorities attempt to reconcile various goals when forming policy in mobile markets. On the one hand, they aim to ensure low prices adjusted to costs, to maximise the use of mobile services in the short term. On the other hand, they must create an environment that encourages investment; i.e., innovation, network quality and significant cost reductions in the medium and long term. Authorities need to strike the right balance to adequately promote a high level of technological progress.

Authorities typically use two types of instruments to pursue these goals. The first of these is competition law, which is applicable to all industries and is generally organised into two areas: merger review and prohibition of anti-competitive practices. The second instrument is sector-specific regulation: a set of regulations specific to an industry, intended to ensure the efficient functioning of the market when public authorities consider there is a lack of competition.[28]

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28. Apart from the sector where they apply, competition law and regulation differ in the nature of the intervention (ex ante or ex post) and the duration of the intervention (ongoing or limited). Competition law is intended to *correct and sanction* a particular action, with the scope of its effects being limited to a specific firm(s). Meanwhile, regulation attempts to transform the functioning of a market, to *prevent* inefficient outcomes driven by anticompetitive behaviour, rather than to *correct and sanction*.

This chapter outlines three key elements of competition law and regulation (see Table 7). The three elements were assessed based on the competition laws (including merger review practice in Honduras and El Salvador) and regulatory laws in each country (Box 8).

Table 7

Summary of key elements

ELEMENT 1: MERGER REVIEW CONSISTENT WITH DYNAMIC MARKETS

ELEMENT 2: RETAIL AND WHOLESALE REGULATIONS DESIGNED TO PROMOTE INVESTMENT

ELEMENT 3: *SPECTRUM REGULATIONS DESIGNED TO PROMOTE EFFICIENT USE*

Consolidation among operators has been a feature of mobile markets over the last decade. Considering the findings in Section 3, mergers can be an important mechanism for boosting investment and quality. Because of this, merger review must recognise that investments are a key determinant in competition and consumer welfare (i.e., dynamic markets): this has implications for *relevant market definition, market analysis, entry barriers* and consideration of *efficiencies.*

Regulation of spectrum assignments is a determinant of operator efficiency. When spectrum is fragmented and assigned in small amounts, operators have less capacity and coverage for the same investment in infrastructure.

Most countries in Central America still have regulations on prices and/or quality, under the assumption that the markets are not competitive. These regulations, mostly intended to keep prices down in periods immediately following market liberalisation, may not foster market structures consistent with promoting investment because of their focus on the short term.

Box 8: Regulation and competition laws

The evaluation of regulatory frameworks using these three elements is based on a comparative analysis of regulation and competition law in Central America.

Central American countries have only recently passed competition laws, led by Costa Rica in 1996 and followed by others in 2006, compared to United States antitrust laws, which were first passed at the beginning of the 20th century, and the European Union competition laws, which were first passed in the 1960s. Guatemala is the only country in the region

without a specific law on competition, although discussion on a competition bill began in 2017.

In most Central American countries, telecoms regulatory laws were passed at the same time as market liberalisation processes occurred. In most cases, these laws give regulatory authorities powers in competition policy, primarily in relation to controlling anti-competitive practices. This is the case in Costa Rica (where the regulating body is also responsible for merger review), Honduras, Panama and Nicaragua, as shown in Table 8.

Table 8

Regulation and competition law in Central America

	Regulation	**Competition policy**	**Interaction**
	Regulatory law – Regulatory authority	*Competition law - Competition authority*	*Regulatory authority with powers in competition policy*
Panama	Telecommunications Law (1996) - ASEP	Competition Law Regulations and other measures (2006), Commission on Free Competition and Consumer Affairs	Regulatory authority with powers in controlling anti-competitive practices[29]
Costa Rica	General Telecommunications Law (2008) - SUTEL	Law for the Promotion of Competition and Effective Consumer Protection (1995), Commission for Promoting Competition	Regulatory authority with powers in merger review and controlling anti-competitive practices[30]
El Salvador	Telecommunications Law (1997) - SIGET	Competition Law (2004), Superintendency of Competition	N/A
Guatemala	General Telecommunications Law (1996) - ST	No specific competition law[31]	N/A
Honduras	Telecommunications Sector Framework Law (1995) - CONATEL	Law for the Defence and Promotion of Competition (2006), Commission for the Defence and Promotion of Competition	Regulatory authority with powers in controlling anti-competitive practices[32]
Nicaragua	General Telecommunications and Postal Services Law (1996) - TELCOR	Law on the Promotion of Competition (2006), Pro-Competition Commission	Regulatory authority with powers in controlling anti-competitive practices[33]

Source: GSMA Intelligence, based on analysis of telecommunications regulatory laws and competition laws and their corresponding regulations.

29. In Panama, provisions on mergers and their assessment come under the competition law and the competition authority, although regulators also have certain powers to sanction anti-competitive practices.
30. In Costa Rica, the regulatory law for the sector has a special title (Title III of the 2008 General Telecommunications Law) which lays down specific regulations on the control of mergers between operators and gives the regulatory authority the power to decide whether to allow or prohibit mergers. The regulatory law includes a specific list of anti-competitive practices that are also sanctioned by the regulatory authority.
31. In Guatemala, competition regulations comprise general principles on competition contained in the Constitution, the Code of Commerce and the Criminal Code; e.g., the Constitution indicates that the State must encourage free trade and prevent excessive practices that lead to a concentration of goods, protect consumers and users (Article 119), and prohibit monopolies and privileges (Article 130). The Code of Commerce (Article 361) and the Criminal Code (Articles 340 and 341) contain references to monopolies.
32. In Honduras, provisions on mergers and their assessment come under the competition law and the competition authority, although regulators also have certain powers to sanction anti-competitive practices.
33. Competition law states that regulatory bodies are authorised, and have exclusive competence, to investigate, hear and rule on anti-competitive practices, unfair competition, concentrations and in general any other practice, action or conduct defined in the law as harmful and which could be intended or is intended to limit, prevent or restrict free and healthy competition among economic agents in markets subject to regulation.

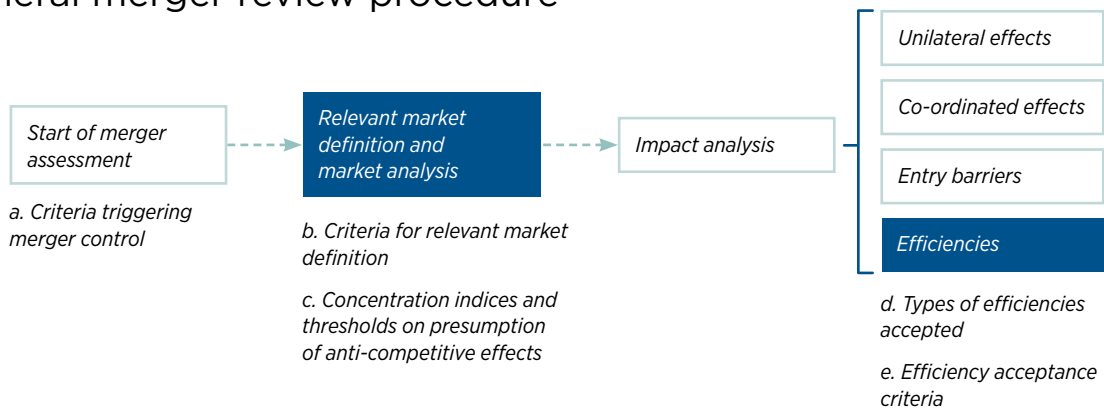# 4.1 Merger review consistent with intense competition in innovation

Consolidation among operators has been a feature of mobile markets over the last decade. This is due to a series of factors that have caused lower profitability, such as the entry of new operators, competition from internet platforms in communications services and social media, data commodification, and the need to invest in technology upgrades over shorter cycles. Most countries in Europe now have two or three network operators, or a maximum of four. In the United States, India and Brazil, consolidation is under discussion.

Investment and innovation are key elements of competition in dynamic markets such as mobile. Consistent with the evidence that higher concentration levels can lead to higher operator investment and enhanced levels of network quality (Section 3), mergers can be an important mechanism to improve operators' competitive capacities, resulting in higher competition intensity. However, in some cases, barriers restrict or even prohibit mergers:

- Barriers can be *direct,* where mergers are prohibited by default. This is the case in Panama, where the Telecommunications Law distinguishes between Type A (mobile telephony) and Type B (fixed telephony and others) licences, establishing a limit on the number of Type A licences. In addition, concession contracts state that Type A operators cannot merge.[34]

- The merger review exercised under each country´s competition policy framework can act as an *indirect* barrier. This occurs when merger reviews adhere to tools underestimating competition and strict procedures in relation to efficiencies. Some key issues include the criteria triggering merger review, the relevant market definition, the tools used to analyse competition in the market, and the assessment of efficiencies. These aspects are shown in Figure 17.

Figure 17

General merger review procedure

Start of merger assessment

a. Criteria triggering merger control

Relevant market definition and market analysis

b. Criteria for relevant market definition

c. Concentration indices and thresholds on presumption of anti-competitive effects

Impact analysis

Unilateral effects

Co-ordinated effects

Entry barriers

Efficiencies

d. Types of efficiencies accepted

e. Efficiency acceptance criteria

To evaluate merger review procedures, the competition law of each country was reviewed in relation to the items highlighted in Figure 17. In addition, the two most recent mergers were examined, revealing differences in the analysis of four-to-three mergers: the merger accepted in Honduras (2011) and the merger rejected on two occasions in El Salvador (latest assessment in 2012).
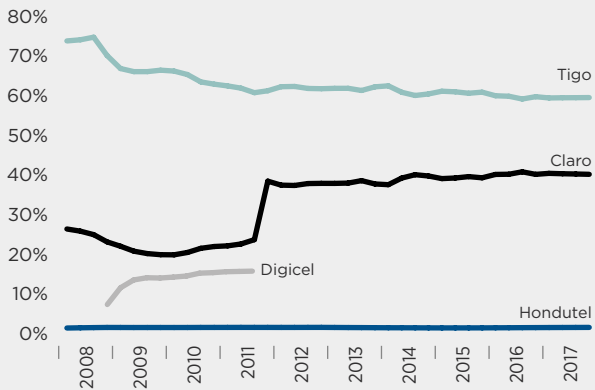
34. A merger is actually possible between Type A and Type B operators. A bill in progress is intended to ease this regulation to allow mergers of mobile operators. It acknowledges the need for new investment in infrastructure and accepts that a structure that allows four-to-three consolidation can enable economies of scale and strengthen incentives and capacity to invest (Bill 479, 2017).

Box 9: Mergers in Honduras and El Salvador

CASE STUDY 1: FOUR-TO-THREE MERGER APPROVED IN HONDURAS	CASE STUDY 2: FIVE-TO-FOUR MERGER REJECTED IN EL SALVADOR

Figure 18

Market share distribution in Honduras

Source: GSMA Intelligence. Market shares calculated by number of connections.

Figure 19
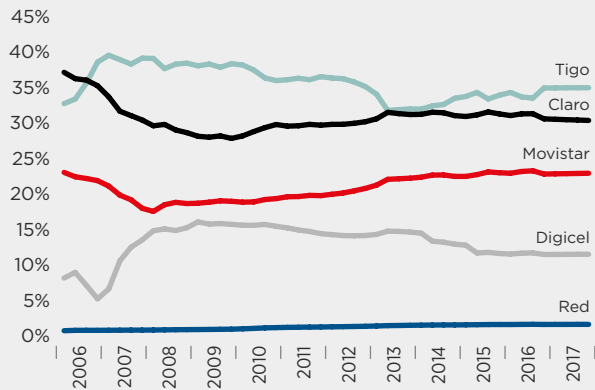
Market share distribution in El Salvador

Source: GSMA Intelligence. Market shares calculated by number of connections.

In 2011, the Honduran Commission for the Defence and Promotion of Competition approved the Claro/Digicel merger, which consolidated the second and third largest players in a four-operator market. After the merger, Claro's market share increased from approximately 20% to 40% (Figure 18). Claro retained its place as second competitor after Tigo, with a 20-point lower market share, but the gap was reduced between the top two players.

In 2012, El Salvador's Superintendency of Competition refused, for the second time, to authorise the purchase of Digicel by Claro. This was a four-operator market (market share above 2.5%), and the merger was between the second and fourth largest players. The resulting operator would have increased its market share from 30% to 45% (similar to the case in Honduras, where the new operator had 40%), ten points above the leading operator at the time in El Salvador (Tigo).

PUBLIC POLICY RECOMMENDATIONS FOR MERGER REVIEW

1. Market definition must take a forward-looking approach to competitive pressures in the digital ecosystem

Market definition frameworks are fairly consistent in Central America, both in competition law and in the merger review practice evaluated in Honduras and El Salvador. Market definition evaluates services that can be considered substitutes in terms of the mobile services supplied by the merging operators. Substitutes are considered on the demand side (services that consumers regard as substitutes) and the supply side (alternative suppliers that could provide the service).

However, in markets subject to intense innovation, it is important that competition authorities take a forward-looking approach to substitutability; i.e., a broader market definition, taking into account substitution in the future (CET.LA[35] 2017). With the emergence of OTTs, the substitution roles of these providers on both the supply and the demand side must be considered. This is particularly relevant in light of studies showing that OTTs generate considerable competitive pressure: a recent analysis estimated that in 2014, OTTs captured 24% of messaging revenue globally and that this figure could reach 40-60% in 2018 (McKinsey 2017).[36] Adding these services to the market definition could have significant implications; e.g., in market share calculations.

35. *Centro de Estudios de Telecomunicaciones de América Latina* (Latin American Telecommunications Studies Centre)
36. See McKinsey's report in this regard: <https://www.mckinsey.com/industries/telecommunications/our-insights/overwhelming-ott-telcos-growth-strategy-in-a-digital-world>

2. Market analyses must avoid using biased indicators of market power and competition

The number of players, market shares and concentration indices are typically considered when analysing possible loss of competition intensity. These factors are included in the competition laws of the countries in the region, although there are no absolute thresholds to determine when mergers should be prohibited (see Annex 1.1 tied to the Spanish version of this report) and practice differs considerably between Honduras and El Salvador (see Box 10).

Although these indicators are informative, their level of utility for measuring market power or competition intensity is highly relative, especially in markets where innovation is a key determinant of competition.

• Merger reviews assume that a lower number of operators results in a loss of competition intensity. However, this is not necessarily a direct conclusion in markets that require heavy investment; a high number of operators can undermine operators' ability to invest. A lower number of competitors can therefore actually result in higher competition intensity – as shown in Section 3 of this report.

• In markets where players compete in quality to gain clients, high and stable market shares can indicate competitive efforts rather than a *lack* of competition. Given that operators can obtain high market shares by being innovative and offering better quality, the study of market shares alone does not provide conclusive implications on competition intensity in a market.

• Concentration indices like the HHI always rise after a merger, based on simple aggregation of market shares.[37] This means that the calculation does not capture the possibility of merged operators gaining competitive ability, leading to higher competition intensity in the market. Unlike the HHI, other indices such as the Dominance Index (DI) depend on the relative size of concentrated firms and the particular market structure. The DI does not increase when relatively small firms are concentrated (it can actually decrease), but it does increase in concentrations of relatively large firms. Because of this, the DI is said to have greater predictability in relation to the level of substantial power resulting from economic concentration.[38]

Box 10: Mergers in Honduras and El Salvador: use of concentration indices

After first confirming that the transactions passed the thresholds requiring merger review and then defining the market, the competition authorities in Honduras and El Salvador calculated different concentration indices.

• In El Salvador, the concentration index calculations analysed the HHI trend only with regard to the number of users, concluding that the transaction could harm the competition process according to the thresholds used in the United States and Spain (shown in Annex 3 tied to the Spanish version of this report).

• In Honduras, however, both the HHI and the DI were calculated based on operator revenue and users. Using the HHI, the analysis concluded that (both in number

of users and in revenue) the merger could result in competition-restricting concentration according to the thresholds of the United States and Spain. But the Commission found that the merger would reduce the DI in both variables and therefore was unlikely to have a negative effect on the process of free competition.

In Honduras, the DI decreased because the merger was between two relatively small operators compared to the market leader. This illustrated that the merger of the second and third largest operators could provide benefits by giving the second operator greater ability to compete with the leading operator, thus intensifying the competitive process.[39]

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37. This is because the HHI is the result of adding the squares of market shares.
38. See *Guía para el control de las concentraciones económicas* (Guide for the control of economic concentrations - in Spanish), by the Commission for Free Competition and Consumer Affairs (Panama) for an example of the DI, at <http://siteresources.worldbank.org/INTCOMPLEGALDB/Resources/501.pdf>
39. As stated in Resolution Number 19-CDPC-2011-AÑO-VI of the Commission for the Defence and Promotion of Competition (Honduras): "This (*the fall in the Dominance Index*) indicates that when small economic players are concentrated, they can compete with the dominant market players under less unequal conditions, because they are better able to defend themselves from the practices of competitive displacement that the dominant agent or agents may exercise".

3. Entry barriers must be assessed taking into account the innovation inherent to the ecosystem

Competition laws in the region include entry barrier analysis to assess whether a merger can be offset by the competitive pressure caused by the entry of a new player. Laws in the region and the practice examined in Honduras and El Salvador include the assessment of similar legal, technical and financial barriers, such as spectrum availability, existing economies of scale and investments already made by operators.

However, this study finds that these analyses are not consistent with a series of key features of mobile markets. If these features are not taken into account, the competitive situation may be underestimated. These aspects have also been indicated in CET.LA (2017).

• Entry barriers should be assessed in relation to the possibilities of disruptive innovation. In markets subject to technological advances, innovation is an important mechanism for overcoming entry barriers. For example, disruption by OTTs has occurred in voice and data, despite the existence of entry barriers. Authorities must therefore qualify entry barriers according to future innovations, taking into account not only when innovations occur but also factoring in *expected* disruptions.

• Rivalry exists in various forms, with different entry barriers. The barriers commonly examined by competition authorities focus on the entry of a player equal to the incumbent. However, telecoms markets have diverse modes of entry; e.g., those not necessarily associated with the use of physical infrastructure and which significantly reduce the entry costs associated with the industry. Examples of players with different modes of entry include mobile virtual network operators (MVNOs) and OTTs.

• Entry barriers must be considered in accordance with market size and growth expectations. As indicated in CET.LA (2017), entry is simpler in growing markets or in markets where sources of growth are expected. The mobile data market in Central America is still in expansion phase, particularly in mobile broadband.

4. Efficiencies should be analysed with flexible criteria, in light of empirical evidence

Although competition laws in Central America recognise that mergers can create a range of efficiencies such as producing the same amount at a lower cost, reduced costs if more services are produced together, and fewer administrative costs (see Annex 1.1), efficiency assessment ultimately depends on the merger review practice in the country. This accounts for the substantive differences in the mergers proposed in Honduras and El Salvador, as shown in Box 11. Analysis criteria therefore need to be sufficiently flexible.

A recent evaluation of a four-to-three merger in Austria concluded that it led to a significant improvement in innovation and quality (GSMA 2017). This was not limited to the operator subject to consolidation; indirectly, it intensified competition in these factors across the market. Two years after the merger, it was found that Hutchison's 4G population coverage was 20-30 percentage points higher than it would have been if the merger had not taken place. The merger also significantly increased Hutchison's 4G upload and download speeds by approximately 7 Mbps and 3 Mbps, respectively. Merger spillover effects to rivals A1 Telekom and T-Mobile were found in the form of significant improvements in both 3G and 4G network speeds.

Box 11: Mergers in Honduras and El Salvador: consideration of efficiencies

In Honduras, in light of the differing results for the concentration indices, the Commission examined the impact of the merger in terms of unilateral effects, coordinated effects and entry barriers, and found a risk that the transaction would harm the competition dynamic. However, it concluded that the efficiencies would result in an overall positive impact for consumers. The parties presented 19 efficiency claims, of which the key points were:

- Cost savings by eliminating network duplication and sharing fixed costs in infrastructure and administrative costs were quantified at USD 31.9 million per year. It was estimated that prices could be reduced by 16% over the four years following the merger.

- Efficiency claims pointed to a boost in investment and enhanced coverage. It was argued that quality would be improved as a result of improved economies of scale, the capacity to invest USD 150 million over the five years following the merger, and through more efficient spectrum use.

The Commission finally authorised the merger subject to price reductions and investments effectively taking place.[40] In its decision, the Commission placed particular emphasis on spectrum use in the context of growing demand for capacity and limited spectrum. The Commission explicitly argued that the merger could contribute to spectrum distribution that would optimise the capacity of the networks.[41]

This assessment is in contrast to the decision of El Salvador's Superintendency of Competition. After finding that the merger would lead to a high concentration of subscribers and spectrum, and would facilitate unilateral and coordinated effects, the Superintendency rejected the efficiency claims (Table 9) – most of which were similar to those made in the Honduras merger.

Table 9

Efficiency claims in the El Salvador merger

Efficiency claim	Assessment by the Superintendency
Cost savings	*"Efficiency cannot be verified due to differences in the information submitted"*
Enhanced coverage and fewer points with no signal or poor signal	*"Efficiency is not inherent to the merger, because it can be achieved by other means, such as infrastructure deployment"*
Greater investment	*"Efficiency is not inherent to the merger, because it cannot come from the cost savings (which have not been verified)"*
Optimisation of spectrum use by combining blocks	*"Efficiency is not inherent to the merger, because the operators themselves already have the chance to implement more optimal configurations in their network"*
Solution to spectrum fragmentation, allowing users of one of the parties to access 3G networks and 4G rollout	*"After further spectrum assignment, Digicel no longer has all of its spectrum fragmented"*

Source: Based on Resolution SC-013-S/C/R-2012, of the Superintendency of Competition, El Salvador. References to the assessment by El Salvador's Superintendency of Competition are based on the arguments laid down in the resolution. Rather than actual quotes by the Superintendency, they are a simplified summary of the main grounds for not accepting the efficiency claims submitted by the parties.

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40. The Commission argued a lack of clarity as to whether these efficiencies would be passed on to consumers and expressed doubts about savings estimates. The goals of reducing prices, boosting investment and improving coverage were put forward by the Commission itself as conditions for approving the merger.
41. For example, Resolution No. 19-CDPC-2011-AÑO-VI of the Commission for the Defence and Promotion of Competition (Honduras) argued: "If we consider that the mobile market is at a stage of relative maturity in terms of number of subscribers (...), it is reasonable to think that there will be a significant amount of future pressure on the capacities of the networks (...). This greater pressure for data capacity will mean using spectrum blocks with carriers of greater bandwidth than the carriers used for voice services. (...) Because spectrum is a limited resource, it cannot be assigned indiscriminately without quickly creating a shortage. (...)". *Consideration must be made of* "the spectrum distribution mechanisms, necessarily taking into account assignment of minimum-sized continuous blocks to ensure efficient use of this resource for high speed data"

4.2 Retail and wholesale regulations designed to promote investment and leave room for competition

Most countries in the region have retail and wholesale regulations; e.g., all countries except Guatemala have retail price caps or regulations on final quality (see Table 10, based on the content explained in Annex 2). These regulations are maintained under the presumption of a lack of effective competition

commonly determined using market definitions and indices that can be incorrect (see Section 4.1). Regulations of this kind typically highlight the short-term benefits and give less consideration to dynamic efficiencies.

Table 10

Comparative analysis of retail and wholesale regulations

	Retail regulation					Wholesale regulation
	Price cap regulation	Quality regulation	Prohibitions on price discrimination			Interconnection price directly established
			Price discrimination in general	Cross-subsidisation	Tied services	
Panama	No	Yes	Yes	Yes	No	No
Costa Rica	No	Yes	No	Yes	No	No
El Salvador	Yes (voice)	No	No	No	No	Yes
Guatemala	No	No	No	No	No	No
Honduras	Yes (voice)	Yes	Yes	Yes	Yes	No
Nicaragua	Yes (voice)	No	Yes	Yes	No	No

Based on the comparative analysis in Annex 2 (tied to the Spanish version of this report).

PUBLIC POLICY RECOMMENDATIONS FOR RETAIL AND WHOLESALE REGULATIONS

1. Retail price regulation reduces incentives to invest and can make providing services unsustainable in the long term

At various times, countries in the region have had regulations on final market prices. El Salvador, Honduras and Nicaragua still have price caps. Over time, Costa Rica, Panama and Guatemala have declared effective competition in the retail market. The characteristics of the regulations are explained in Annex 2 (tied to the Spanish version of this report).

Price setting continues in some markets under the premise that above-cost prices are not consistent with

competitive markets. However, competitive markets can experience periods when prices are above or below average costs.[42] This is particularly so in the case of markets with economies of scale and high fixed costs (such as telecoms), where fixed cost recovery requires operators to obtain a margin over variable costs.

Price capping in El Salvador, Honduras and Nicaragua can be problematic because such regulations reduce the return on future investment, which can discourage investment. Operators that have already invested and are unable to recover their investments may decide to exit the market in the long term (e.g., where pricing methodologies do not allow for an appropriate recoupment). These mechanisms also apply to wholesale price regulation; e.g., in relation to interconnection regulation (see Annex 2).

42. In perfectly competitive markets, prices are the same as costs only in the long term (i.e., when all costs are variable, so that marginal costs include fixed costs).

2. Retail price cap regulations can create 'benchmarks' in price competition

In markets with few firms, price cap regulation can create *benchmarks* in price competition. Firms affected by price caps try to set their final prices as close as possible to the upper limit to maximise profitability, but this can eliminate competition in lower price ranges. This occurs when price caps are higher than prices would be without regulation.

3. Regulations on minimum quality levels can have counterproductive effects

Regulators in some markets have established minimum quality criteria for the provision of services, under the presumption of a lack of effective competition. Panama, Costa Rica and Honduras have regulations of this kind, and El Salvador is conducting a consultation process to establish quality criteria (see Annex 2 tied to the Spanish version of this report). Of all the countries analysed, Costa Rica has the most restrictive regulations, which oblige operators to provide unlimited data service at a minimum speed of 256 kbps.

Establishing restrictive quality parameters and requiring unlimited services can be counterproductive because costs are increased so much that quality parameters cannot be maintained over time. This occurs when available capacity is limited and/or the price cannot reflect the increase in costs (i.e., prices set below average costs). The example of Costa Rica shows how establishing regulations on quality can impact the results of average 4G speeds (see Box 12).

4. Price discrimination barriers reduce consumption of services

Price discrimination, or the flexibility to set different margins for different services and market segments, allows operators to increase the amount of mobile services consumed and produced in the market. By creating a range of services, operators can meet the needs and willingness to pay of different consumer segments. A typical example of price discrimination in advanced markets is pricing that makes distinctions according to the amount of data, voice and SMS (second-degree price discrimination).

In Honduras, Nicaragua and Panama, the introduction of regulations limiting the ability of operators to offer differentiated services has reduced consumption and production of mobile services (see Annex 2 tied to the Spanish version of this report). These restrictions take the form of general principles that prohibit price discrimination, cross subsidisation and tied services.

Box 12: Impact of Costa Rica's minimum speed parameter

Costa Rica ranks lowest in terms of 4G speeds in Latin America (Figure 20), even though its income per capita is the highest in Central America and close to the average across Latin America.

Figure 20

4G network speeds in Central and South America, Q4 2016

Download speed (Mbps)   Upload speed (Mbps)
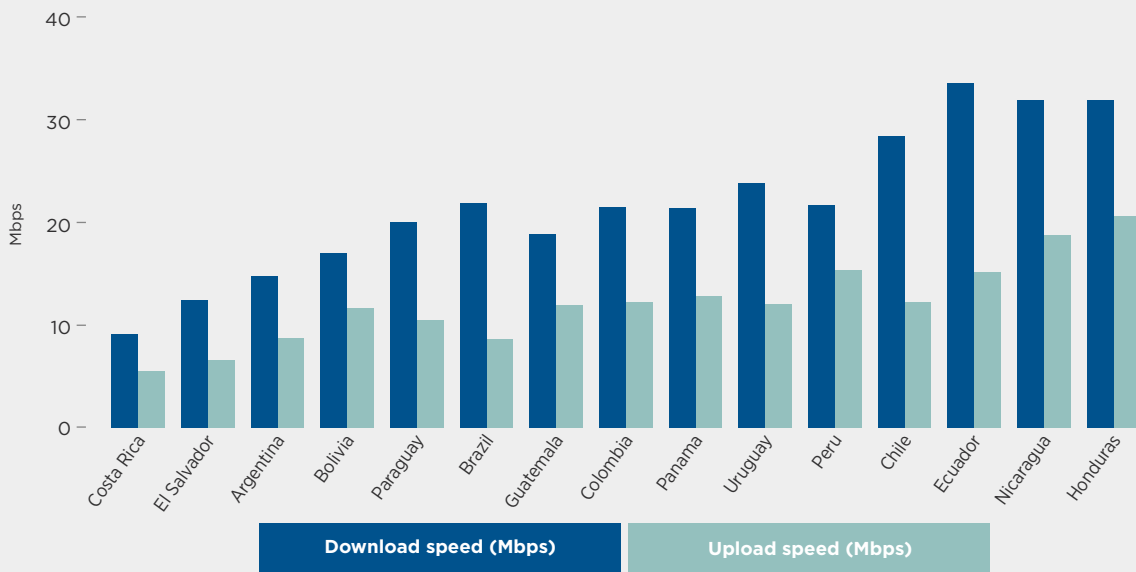
Source: Speedtest Intelligence

Following market liberalisation in 2011, regulator SUTEL made it compulsory for postpaid tariffs to offer unlimited mobile data. This put pressure on network capacity. Due to mass postpaid use of networks, SUTEL established principles on fair-use policies, allowing operators to reduce the speed once users had consumed their allocated capacity.

In 2014 and 2015, SUTEL held public consultations to remove the principle of flat rate for postpaid mobile data. These attempts were stopped by the Constitutional Court after an application for judicial review was filed to seek the suspension of the tariff-setting process.

In September 2017, SUTEL ceased setting prices and announced that there was effective competition in the mobile services retail market, leaving operators free to set their prices.

However, in October 2017, further appeals for judicial review were lodged with the Constitutional Court with regard to fair-use policies. The Constitutional Court repealed the decision that introduced the grounds for the fair-use policies and ordered SUTEL to establish a minimum functional speed. SUTEL set the functional speed of the internet access service at 256 kbps, which remains in force today.

4.3 Spectrum regulations designed to promote efficient use

PUBLIC POLICY RECOMMENDATIONS FOR SPECTRUM REGULATIONS

1. Spectrum must be assigned quickly, appropriately and in sufficient amounts for sustainable coverage deployment and capacity
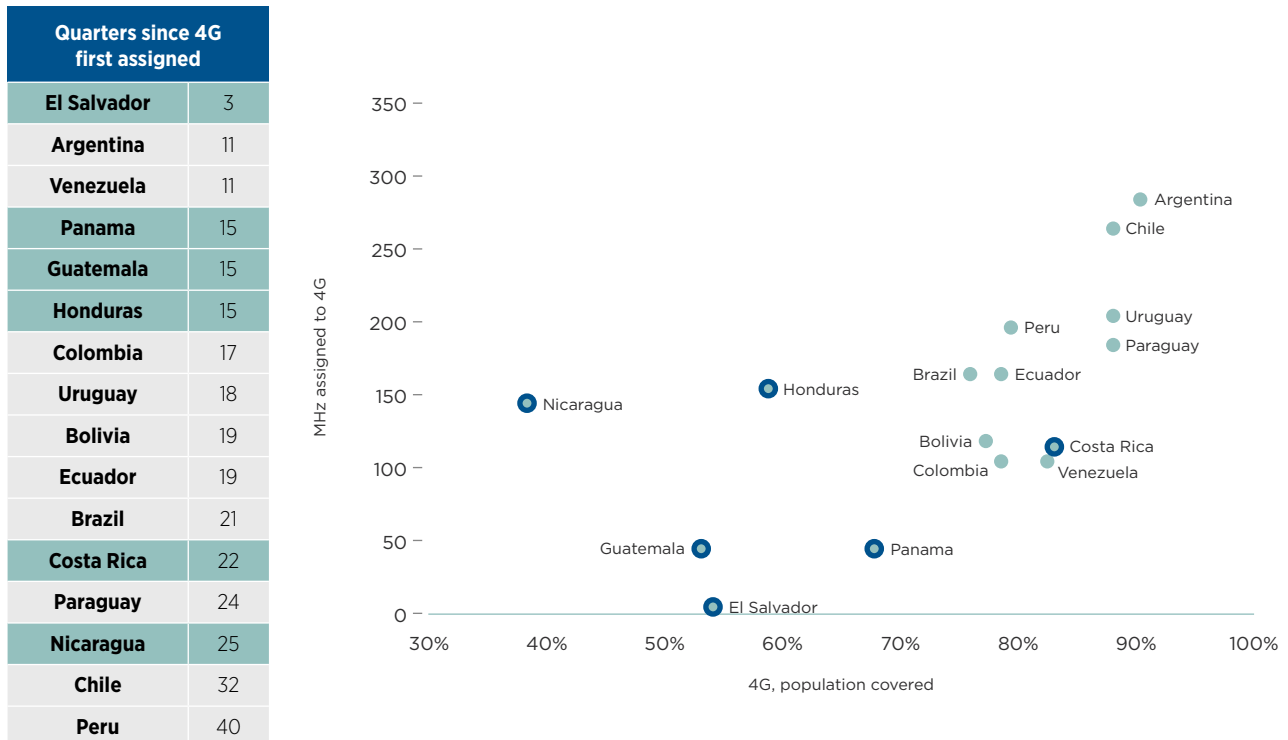
Assigning spectrum in sufficient amounts is important as it allows a sustainable increase in network coverage capacity. With a fixed amount of spectrum, capacity and coverage can be enhanced by deploying more cells and sites. However, returns on these investments decrease as more cells and sites are built, because the additional capacity and coverage gained is lower (which raises the costs per bit transmitted). This is due to the structure of costs in purchasing, building and maintaining sites and cells. Making spectrum

available quickly and appropriately is important – not only because services cannot be provided without spectrum, but also because late assignment tends to occur in conditions of greater scarcity. This can eventually increase assignment prices.

Assignment of 4G spectrum shows a positive correlation to coverage levels in Latin America (see Figure 21). Central American countries have tended to assign lower amounts of spectrum for 4G services, leading to a delay in 4G rollout. El Salvador, Panama, Guatemala and Honduras assigned 4G spectrum much later than other countries in the region. Nicaragua, meanwhile, is an outlier partly due to the regulatory environment; despite having more than 150 MHz assigned, it has a comparatively low coverage level.[43]

Figure 21

4G coverage and amount of spectrum assigned by country, 2017

Quarters since 4G first assigned	
El Salvador	3
Argentina	11
Venezuela	11
Panama	15
Guatemala	15
Honduras	15
Colombia	17
Uruguay	18
Bolivia	19
Ecuador	19
Brazil	21
Costa Rica	22
Paraguay	24
Nicaragua	25
Chile	32
Peru	40

Source: GSMA Intelligence

43. The low coverage in Nicaragua is partly due to a regulatory change in the channelling of the assigned frequencies, which delayed coverage deployment until 2015.

- Central America as a region is lagging behind in total spectrum assignment for mobile services, and spectrum for 4G in particular. Panama, Guatemala and El Salvador are the markets with the lowest spectrum assignments in Latin America and are well below average. Additionally, in Guatemala and El Salvador, the typical frequency bands for deploying 4G services in Latin America (700 MHz, AWS and 2.5 GHz) have not been made available to the industry yet.

- According to studies by the International Telecommunication Union (ITU)[44], the estimated spectrum requirement for mobile services for 2020 is in the range of 1300 MHz to 1720 MHz. This is much higher than the current 273 MHz average in the countries analysed in Central America[45] and the 335 MHz average across Latin America (see Table 11).

Table 11

Spectrum assignment by technology in use

	Total MHz assigned	MHz for 4G	MHz for 2G/3G	4G bands	Proportion of MHz assigned to 4G	Proportion of MHz in relation to ITU estimate[46]
Latin America	338	163	176		48%	26%
Central America	270	100	170		37%	21%
Nicaragua	330	160	170	700; AWS; 1900	48%	25%
Honduras	320	170	150	700; AWS/AWS Ext; 2.5	53%	25%
Costa Rica	380	130	250	1800; 2.5	34%	29%
Panama	220	60	160	700	27%	17%
Guatemala	186	60	126	850; 1900	32%	14%
El Salvador	219	20	199	1900	9%	17%

Source: GSMA Intelligence

2. Spectrum optimisation can be achieved only with larger blocks and in high and low bands

Because spectrum is a limited resource, authorities should aim to maximise its performance. Due to the physical propagation properties of spectrum, operators require assignment in sufficiently large blocks and in diversified holdings (i.e., high and low frequencies) to achieve greater capacity at lower cost (i.e., *technical efficiency*). This is because costs and network capacity depend on the amount of bandwidth a network offers.

- **Spectrum block size.** Spectrum used in large blocks achieves greater efficiency (e.g., in LTE, blocks of 2x20 MHz paired and 40 MHz unpaired spectrum), allowing greater capacity to be generated with the same combined spectrum assignment (Roetter 2011). A study on the performance of spectrum blocks from 2x5 MHz to 2x20 MHz found that markets in Latin America that limit spectrum aggregation or constrain expansion with larger blocks can double or even quadruple the cost of providing mobile broadband (Leighton 2009).

- **Diversified frequency holdings.** Operators provide services in different topographical and demographic contexts (urban and rural, high- or low-density areas). To maximise network capacity, a combination of low (<1 GHz) and high frequencies (>1 GHz) is necessary. Low frequencies have a propagation range suitable for deployment areas with fewer base stations in denser areas, whereas high frequencies with short ranges and large capacities are more effective in denser areas requiring cells in very close proximity to handle heavier traffic in terms of Mbps/km^2.

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44. Report ITU-R M.2290.
45. Percentage of spectrum licenced to mobile operators for International Mobile Telecommunications (IMT) (from ITU-R M.2290).
46. Total MHz for estimated amount of spectrum required according to the ITU, in relation to the 1300 MHz lower limit.

5. Conclusions

Mobile markets are subject to cycles of technology change that have become increasingly shorter, requiring greater investment intensity. Innovation brings new services, improves the quality of existing services and significantly reduces prices in the medium to long term. This increases consumer welfare, especially with the rapidly growing demand for data.

Over the last 15 years, Central America has systematically lagged behind South America in technology migrations. The delay first occurred in 3G and has spilled over to 4G deployment, becoming even more pronounced. To remedy this, authorities must create an environment that promotes intense competition in investment and innovation. Market structures must give operators the ability and incentive to invest and innovate. This requires operators to have sufficient scale, financial strength and expected returns on investment, as well as efficiency in the use of spectrum.

Investment and innovation in mobile communications in Central America follows an inverted U relationship with the number of operators

The results of this study show that there are significant mechanisms by which markets with higher concentration indices can strengthen the ability and incentive for operators to invest. This can then lead to markets where players compete more intensely in investment and innovation. The analysis finds that the markets in Central and South America with a lower number of players record a better performance in investment and innovation indicators.

First, the study has examined the relationship between competition and investment. Specifically, it has looked

at the relationship between a competition intensity index (measured through operator profitability) and operator investment, based on a simulation of capex models for 26 operators in 13 countries across Central and South America (with data from 2001 to 2016).

- In Central America, the relationship between the competition intensity index and investment follows an inverted U. At low levels of competition intensity, adding operators increases operator investment. However, beyond certain levels, adding greater competitive pressure results in lower capex levels.

- We found that operator capex is maximised with operator EBITDA levels of 32-38%. This means that operators with profitability levels below this range would make larger investments if they were in market structures where they have greater profitability.

Secondly, analysis of the impact of the number of players on 4G network performance shows similar results. The results are produced from models of 4G network download speeds for 52 operators in 16 countries in Central and South America from 2013 to 2016, estimated with Speedtest Intelligence data.

- The level of market concentration measured by the HHI has a positive impact on 4G download speeds. For example, a 1000 point increase in the HHI leads to an increase in download speeds of approximately 2.7 Mbps.

- Operators in markets with two or three players experience increases in 4G download speeds over operators in the other markets. The increases are 8.4 Mbps in two player markets and 2 Mbps in structures with two or three players (in the most conservative estimates). This corresponds to an increase of 40% in two-player markets and 10% in markets with two or three players over the average 4G performance in Central America.

- Operators in markets with four or more players experience a 2 Mbps reduction in their speeds over operators in the other markets (in the most conservative estimates). This is a 10% reduction over the average download speed in Central America.

The findings underscore the need for public policy that supports ability and incentive to invest

The findings of the study indicate that public policy should support a series of critical factors that provide incentive and ability to invest. These include operator scale, profitability, available margins and optimisation of spectrum use. The study identified three key areas of action:

1. Merger review must be consistent with an environment in which there is ability and incentive to compete heavily in investment

All competition laws in Central America have approaches to market definition, competition analysis and entry barriers that may be incorrect, resulting in an underestimation of the competitive situation. In relation to considering efficiencies, all the laws make similar provisions but the two most recent cases of merger assessment differ in the degree to which efficiencies are accepted.

These recommendations apply to all the markets, although specific barriers were identified in Panama, where regulations have prohibited mergers between operators for many years, and El Salvador, where merger reviews have disregarded the role of efficiencies.

Q **Competition policy**

1. Market definition must include a forward-looking approach to the competitive pressures in the digital ecosystem

2. Market analyses must avoid using biased indicators of market power and competition

3. Entry barriers must be assessed by taking into account the innovation inherent to the ecosystem

4. Efficiencies should be assessed using flexible criteria, in light of empirical evidence

2. Retail and wholesale regulations must promote profitable environments and leave room for competition

Most countries have regulations on prices or quality. These regulations focus strongly on short-term benefits and do not place enough importance on ensuring an environment in which operators have sufficient profitability and return on investment.

- Three of the six markets have retail price caps (Honduras, El Salvador and Nicaragua), direct regulations on final quality (Costa Rica, Panama and Honduras), and constraints on price discrimination (Costa Rica, Panama and Nicaragua).

- These regulations remain in force because authorities presume there is a lack of competition, based on indicators that do not necessarily capture the competition intensity in the market.

Retail and wholesale regulation

1. Retail price regulation reduces investment levels and can make providing services unsustainable in the long term

2. Retail price cap regulations can create 'benchmarks' in price competition

3. Regulations on minimum levels of quality can have counterproductive effects

4. Price discrimination barriers reduce consumption of services

3. Spectrum regulations must be consistent with efficient spectrum use

On average, the countries in Central America have only 100 MHz assigned for 4G services, compared to an average of 163 MHz in Latin America. Overall, Central America has assigned only 21% of the spectrum that the International Telecommunication Union has estimated is required for efficient and effective provision of mobile services. Guatemala, Panama and El Salvador are particularly lagging behind in this regard.

Spectrum regulation

1. Spectrum must be allocated quickly, appropriately and in sufficient amounts for sustainable coverage rollout and capacity

2. Spectrum optimisation can be achieved only with larger blocks of spectrum and in low and high frequency bands

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