

Competition and Regulation of Mobile Phones in Small Island Nations

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[https://doi.org/10.33318/jpacs.2017.37\(1\)-2](https://doi.org/10.33318/jpacs.2017.37(1)-2)

Abstract

Small island nations face a number of challenges in achieving economic development. The small size of these nations means they lack the economic density required to take advantage of economies of scale and specialization, and the distance from larger markets raises transportation costs and limits their ability to be part of global production networks. In meeting these challenges the telecommunications industry has a vital role to play. Telecommunications reform has meant the introduction of competition into parts of the industry (mobile phone, long distance, and Internet). In this paper, the growth of mobile phone use is observed and analysed. The findings are that growth of the sector has taken place at a varied rate across the various nations studied, and that lower mobile phone prices are associated with more competition and independent regulation.

Keywords: competition; mobile phones; regulation; small islands; telecommunications.

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Introduction

In recent decades, the telecommunications sector in most countries has gone through a period of reform, involving the phasing-in of competition into parts of the industry (mobile phone, long distance, and Internet). In addition, governments have imposed incentive-based regulation on monopoly elements. The impetus for this reform has come from a variety of factors, including technological change, the development of new services, and the view that vertically integrated firms do not achieve the greatest possible levels of efficiency (Berg & Hamilton, 2000; Estache, Goicoechea, & Manacorda, 2006). Private investment has also been sought by governments in order to encourage the development of the industry and to relieve the pressure on government finances to raise the necessary capital to finance investment in new telecommunications technologies (Kalba, 2008).

Increasing competition in the telecommunications sector does involve regulatory complexities and therefore substantial changes have been made in the way that firms in the industry are regulated. This has meant the creation of a range of new regulatory agencies in a number of countries (Wonka & Rittberger, 2010; Yesilkagit & Van Thiel, 2008; Knack & Keefer, 1995; Levy & Spiller, 1996; Gray, 1998, Estache & Martimort, 1999). This process has extended to relatively small countries as well as larger and wealthier ones (Stern, 2001; Gilardi & Maggetti, 2010; Abbott & Ma, 2013; 'Ofa, 2012).

In the case of small island countries, economic development involves a number of challenges. The small size of these countries means that they lack the economic density needed to take advantage of economies of scale and specialization. The remoteness of these countries can also limit the scope of participation in global production networks (World Bank/Horscroft, 2012; Gibson & Nero, 2006). One way to mitigate the disadvantage of small size and isolation is through the development of new information and communication technologies (Rouvinen, 2006; Kalba, 2008; World Bank/Horscroft, 2012). The area of new communications technology that has seen the greatest growth in use in recent years is mobile phones. In a number of cases, mobile phone user numbers have increased dramatically (see Figure 1). Related to this growth has been the role of competition in lowering phone charges and enabling user expansion. In the case of small island countries, there has been some debate over whether the introduction of competition can appreciably lower service charges, given the small size of markets and the difficulty in achieving economies of scale within

individual firms if there are multiple providers.

The purpose of this paper is to quantify the impact of competition and regulation on the pricing of mobile phone services in small island countries. The method used in this study is to first provide an overview of the expansion of the mobile phone sector in a range of small island countries. This will be followed by a statistical determination of the relationship between the prices of mobile phone services in a range of island countries and variables such as the size and income of the country, population density, the number of operators, and the existence of independent regulators and government-owned companies. The price of mobile phone services would be expected to have an influence on user adoption of mobile phones, especially in low-income countries. The paper is structured as follows. In the first section the issue of the relative merits of monopoly versus competitive provision is addressed. A background to telecommunications and regulatory reform is then presented. This is followed by sections on the reform of the sector in a range of small island economies, a description of data and methodology used, and then the results of the study. The final section provides some conclusions.

Monopoly Versus Competition

Before the 1980s, it was universally accepted that the telecommunications industry had natural monopoly characteristics.

A monopoly created and sustained by increasing returns to scale is called a natural monopoly. The defining characteristic of a natural monopoly is that it possesses increasing returns to scale over the range of output that is relevant for that industry. (Krugman & Wells, 2013, p. 377)

This tends to be the case in industries where capital costs predominate, creating economies of scale that are large in relation to the size of the market and, hence, creating high barriers to entry (Pindyck & Rubinfeld, 2009, p. 368). These high barriers also reduce the possibility of new entrants, which means the market is not “contestable” (Baumol, Panzar, & Willig, 1982).

In the case of telecommunications, the source of the economies of scale was the open-wire line system, which involved stringing wires between poles in order to send messages. This required a considerable capital investment, which created a barrier to entry. In the case of the small island countries, links to other countries was via undersea cables. Both of these involved very high fixed costs and relatively low

marginal costs of adding customers. Economies of scale were, therefore, believed to be important and the assumption was that there was generally only room for one network (Viscusi, Vernon, & Harrington, 2000, p. 465; Alexiadis & Cave, 2010, pp. 501-502; Shy, 2001, p. 7). This meant that most countries had telecommunications services delivered either by a government-owned, monopoly telephone company or by heavily regulated privately-owned monopolies. These monopolies typically operated a range of services within a single company, such as long distance and local calls and later, when developed, mobile phone services. These companies were vertically integrated, which means they operated several aspects of the value chain of an industry, with some producing services that others use to produce finished services. In the case of telecommunications, this can mean that a firm operates long-distance links, the local loop, and mobile phone services as well as supporting equipment. Vertical separation, in contrast, means allowing new entrants to provide selected services, such as mobile phones, that interconnect with the other parts of the industry (Berg, 2001; Gutierrez & Berg, 2000).

The development of microwave radio technology and the use of satellite technology changed this. First of all, the use of satellite transmissions over long distances meant that multiple providers could operate, even to some of the most isolated parts of the world. Secondly it meant that wireless telephony in the form of mobile phone services were developed. These made use of a cellular radio system with relatively inexpensive receiver-transmitter stations to pick up signals from mobile phones to replace expensive-to-duplicate wires. This technological change greatly reduced the fixed-cost component of the cost function and resulted in smaller efficient firm size (Viscusi, Vernon, & Harrington, 2000, p. 466; Estache, Goicoechea, & Manacorda, 2006).

Even after these developments, there was still debate over whether small economies could maintain multiple, competing firms in mobile phone service provision, given the small—and often less dense—populations involved. The establishment of competing mobile phone networks did involve some capital expenditure (even though it was far less than that required for the establishment of a wires network). Effectively, by introducing competition, these economies of scale (if they still existed) were traded off in favour of competition, which it was hoped would encourage higher levels of productive efficiency (if not scale efficiency) and lower prices. If competition leads to lower prices, then it is implied that the economies of scale achieved from monopoly provision might still exist, but would be less important than the potential efficiency achieved from competition (Li & Xu, 2004; Kalba, 2012). In the case

of mobile phones, the existence of multiple providers in a number of small, island countries suggests that the economies either do not exist or, if they do, are not so substantial that they preclude new entries.

In addition, the nature of competitive strategies on the part of the mobile phone companies (incumbents and new entrants) should be borne in mind. It is possible, for instance, that a market leader could omit the opportunity to eliminate a competitor because it fears the retaliation a government might bring against it in the form of increased market regulation. The nature of competition is also impacted by the various strategies companies can take, such as bundling, product diversification, advertising, etc., which can help new entrants.

Global Telecommunications Reforms

As technology has improved, the general trend has been toward the opening up of these monopolies to competition in order to encourage efficiency gains, and to promote the introduction and adoption of new products (mobile phones, long-distance services, and Internet provision). Consumer demand for these products has also been high and has required substantial additions of new investment. As national governments have not necessarily had the resources available to invest in the creation of these services, they have often encouraged private companies to invest in the construction of new facilities.

To facilitate this process, a number of reforms have taken place, including the corporatization of government-owned telecommunication agencies and, in some cases, privatization. Corporatization has involved the separation of regulatory and commercial functions into separate government authorities and firms, which has meant the creation of new regulatory agencies (Shirley, 1999; World Bank, 1995). These changes have meant that the opening up of telecommunications markets has spread from developed countries to a number of smaller, developing countries.

This process of reform of infrastructure has been taking place now for a number of years and, in terms of the general impact of privatization, corporatization, and competition, a great deal of theoretical and empirical research has been undertaken. Summaries of this theoretical literature have been attempted by Vickers and Yarrow (1995); World Bank (1995), Shleifer (1996, 1998); and Megginson and Netter (2001). Although it is accepted that privatization, by depoliticising managerial decisions and creating greater incentives to innovate, can lead to the achievement of reduced costs;

it is the introduction of competition that is thought to be the most important driver of efficiency improvements (Nickell, 1996; Li, 1997; Ros, 1999; Wallsten, 2002; Berg, 2001). That said, competition and privatization often go together. Governments are less likely to protect incumbent utility companies from competition if they have no ownership stake; therefore, a privatized industry is one that is often also opened up to competition. In addition, competition raises the risks to the government of owning companies and therefore the introduction of competition often leads to increased pressures to privatize state-owned assets (Abbott & Cohen, 2014).

In the case of the telecommunications sector, a number of studies of the impact of privatization and competition have been undertaken. In particular, the increase in competitive pressures has been shown to have contributed to growth of the sector by raising productivity, lowering costs, and reducing the price of services (Li & Xu, 2004). Since the 1980s, the telecommunications sector has been a relatively fast-growing sector in most countries and this has been aided by competitive pressures (Li & Xu, 2002). There is also evidence that growth of the telecommunications sector creates positive externalities for the economy as a whole (Roller & Waverman, 2001). Further research on the reform of the telecommunications sector has been done by Li and Xu (2004), Levy and Spiller (1996), Kikeri, Nellis, and Shirley (1992); Boyland and Nicollet (2000), Gual and Trillas (2006), and Estache, Goicoechea, and Manacorda (2006).

In the case of lower-income countries, the rapid growth of the telecommunications sector, especially the adoption of mobile phone technology, has attracted a great deal of attention. A number of researchers, therefore, have studied the performance, regulation, and structure of the sector in developing countries. These include the work of Petrazzani (1995), Petrazzini and Clark (1996), Wallsten (2000, 2001), Gutierrez (2003), Ros (1999, 2003); Roth (1987), Fink, Mattoo, and Rathindran (2003), Montoya and Trillas (2007), Mohammed and Strobel (2011), Makhaya and Roberts (2003), Samarajiva (2000), Sridhar and Sridhar (2004), Berg and Hamilton (2000), and Maiorano and Stern (2007). Although this body of work is relevant to a study of the situation in small island economies, given the often low income levels in these nations, the work on developing countries has tended to concentrate mainly on markets of a fairly substantial size. This makes those markets fundamentally different from those of the small island countries, where the issues of scale economies are more acute. Reform of the telecommunications sector came relatively late to the small island countries; as did growth of the mobile phone sector. The developing Latin American countries, for instance, saw the introduction of widespread mobile phone

use (numbers of people subscribing) in the early 1990s and much of the regulatory reform in those countries took place at that time (Gutierrez & Berg, 2000).

As new telecommunications operators have entered various markets, and as national telecommunications operators have been corporatized or privatized, the role of the state has changed from being a main provider of telecommunications services to that of being a rule-maker and regulator (Majone, 1994, 1996, 2001; Balla, 2011). This has meant that in telecommunications markets new regulatory agencies have been established to license new entrants (technical regulation) and to regulate the prices of interconnection agreements between competing companies (economic regulation). These technical and economic regulatory functions have either been bundled together into a sector-based regulator (generally along with responsibilities over broadcasting) or, alternatively, the economic functions have been placed into regulatory agencies that combine the economic functions of a range of sectors (e.g., telecommunications plus electricity and water).

Sector regulators typically have regulatory authority over telecommunications, radio communications, and broadcasting transmissions. The main responsibilities include frequency and station-license allocations to broadcasters as well as the licensing of telephone (fixed-line and mobile-phone) operators. They also often have economic responsibilities in the form of the regulation of interconnection pricing agreements between operators. Sector regulators of this sort are common because combining communications and broadcasting together allows for some common use of scarce knowledge and abilities.

These new regulatory agencies have been granted varying degrees of independence (Organisation for Economic Cooperation and Development, 1999; Maggetti, 2010; Samarajiva, Mahan, & Barendse, 2002). Independence, in this context, generally means that the regulatory agencies have been created by acts of parliament, function at arm's length from government, and have power over such things as: inspection, referral, advice to third parties, licensing, accreditation, and enforcement (Stern, 1997). In most cases they are funded by industry levies or licensing fees. Not all countries have undertaken this type of reform to this degree. In a number of cases, the regulation of telecommunications is still undertaken by ministerial-led departments and in some the telecommunications industry is still dominated by government-owned agencies.

The Telecommunications Sector in Small Island Economies

In the case of small island countries, new entry to telecommunications markets has occurred, even though delayed. Originally, it was believed that economies of scale could only be achieved by single, vertically integrated monopolies, and for this reason most countries had single, government-owned operators. As competition entered the largest markets, it was still believed by some that small countries, such as the island economies, still benefited from monopoly provision. Gradually, new entrants entered these markets as well, despite the difficulties of scale that had to be overcome.

Telecommunications reform and growth is potentially very important to these countries, especially given the isolation and small-scale economies that they experience, which greatly increases the costs of doing business (Winters & Martins, 2004; Gibson & Nero, 2006; World Bank/Horscroft, 2012; Sutherland, 2011; 'Ofa, 2012). There is evidence that the introduction of such things as mobile phones can improve the way in which businesses conduct their operations in small island economies (see, for instance, Pacific Institute of Public Policy, 2009).

In this study, a range of small island countries from a number of regions around the world was observed. These countries are listed in Table 1, and it can be seen that they do range quite a bit in population size and average income (see also Table A1 in the Appendix). The lower-income countries tend to be those in the South Pacific, while those in the Caribbean tend to exhibit a fairly wide range of income levels.

In terms of the development of mobile phones in these countries, development occurred most swiftly in the 2000s decade. This occurred after a period of telecommunications reform elsewhere, one of the most important being the privatization of the British company, Cable and Wireless. This company had been nationalized originally in 1947, after the Labour Party's victory in the 1945 British general elections. While the company remained in being as a government-owned company (continuing to own assets and operating telecommunication services outside of Britain), all assets within that country were integrated with those of the Post Office, which operated the domestic telecommunications monopoly. Cable and Wireless was important to many of the small island economies because it was the main company that linked them with the outside world. In a number of the smaller Caribbean countries, it also operated the domestic telecommunications system. In many of the other countries, the domestic telephone service was carried out by the local post office, as it had been, at first, in Britain, and outside links were operated by Cable and Wireless. In a

number of cases in the Caribbean, the American company AT&T was an important carrier. In 1979, the Conservative Party government led by Margaret Thatcher began privatizing nationalized industries and in November 1981 the government sold the first half of its share in Cable and Wireless. The company was later reformed and its subsidiary in the Caribbean in 2008 adopted the LIME name. LIME operates as the incumbent telecommunications service provider in many of the islands where it resides, and in many cases was the original developer of mobile phone services (Table 1).

The other main mobile phone network provider in the Caribbean and South Pacific is the company Digicel. In 2001 the Jamaican Government decided to open its phone market up to competition and the company, owned by Irish entrepreneur Denis O'Brien, was established to operate in that market. Today (2018), it operates in 31 markets across the Caribbean, Central America, and Pacific regions. The company is incorporated in Bermuda and based in Jamaica and has about 13 million wireless users. As of 2018, Digicel's markets comprise: Anguilla, Antigua and Barbuda, Aruba, Barbados, Bermuda, Belize, Bonaire, the British Virgin Islands, the Cayman Islands, Curaçao, Dominica, El Salvador, Fiji, French Guiana, Grenada, Guadeloupe, Guyana, Haiti, Jamaica, Martinique, Nauru, Panama, Papua–New Guinea, Samoa, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Tonga, Trinidad and Tobago, Turks and Caicos, and Vanuatu. A part of the growth and spread of Digicel was encouraged by the takeover of the American company Cingular in 2005. Cingular, a joint venture between SBC Communications and BellSouth Corp., sold its operations and licences in the Caribbean and Bermuda to Digicel. Cingular took over the Caribbean business when it took over AT&T Wireless. Cingular sold former AT&T Wireless properties to Digicel, including licences, network assets, and subscribers in Barbados, Bermuda, the Cayman Islands, Antigua and Barbuda, Anguilla, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, St. Vincent, and the Grenadines.

Reform in the South Pacific came a little later. The first island country to have competition in mobile phones was Tonga, where a new company was established in 2003 (it later was sold to Digicel). The Government of Samoa established a regulator in 2006 and began a process of privatization of its main telephone company. Digicel began operating in Samoa in 2006 and later expanded its operations to Papua–New Guinea (2007), Vanuatu (2008), Tonga (2008), Fiji (2008), Nauru (2009), and the Solomon Islands and Tahiti (Sutherland, 2012; 'Ofa, 2011). Finally, there are a few island countries that, to date, have retained the old model of dominance by a single

telecommunications authority and no new regulated entry. These island countries include the Cook Islands, Kiribati, and the Marshall Islands.

Table 2 includes a list of a range of small island nations along with the names of the regulatory agencies responsible for their telecommunications industry. As a number of small island countries have created independent regulators and have encouraged the introduction of new mobile phone operators into these markets, it is now possible to determine the degree to which this development has benefited consumers.

In the case of the development of regulatory agencies in small island nations, sectoral (as opposed to multi-sectoral) agencies are the most common. This is so because in most cases the technological and investment imperatives in the development of the telecommunications sector have been most compelling (in contrast to electricity and water supply). A number of island governments, therefore, have established sector-specific regulators in communications in order to facilitate its development. Island nations such as Cyprus, Malta, Mauritius, the Isle of Man, Samoa, the British Virgin Islands, and the Turks and Caicos Islands all have regulators of this sort. In addition, a range of other countries also have communications regulators alongside those operating in other utility areas (the Cayman Islands, Iceland, and Trinidad and Tobago). Those countries with multi-sector regulators that include the economic regulation of telecommunications include Anguilla, the Bahamas, Barbados, Guam, Jamaica, and the Virgin Islands.

Despite the proliferation of new regulatory agencies in small island countries, some nations have retained regulation under direct ministerial control. These countries include Antigua and Barbuda, Tonga and Palau (see Table 1). In each of these cases, competition in mobile phone markets has occurred without the creation of an independent regulator, with ministerial departments carrying out the technical regulation.

Table 1: Telecommunications data, small island nations, 2017

Country	Competition introduced	Companies	Regulator
Anguilla	2005	Lime; Digicel	Public Utilities Commission
Antigua & Barbuda	2000	Lime; Digicel; APUA	Ministry of Information, Broadcasting, Telecommunications, Science & Technology
Bahamas	N/A	BTC	Utility Regulation and Competition Authority
Barbados	2004	LIME: Digicel; Sunbeach	Fair Trading Commission
Bermuda	2003	Cellone (ATN); Digicel	Telecommunications Commission
British Virgin Is.	2008	Lime; Digicel, CCT	Telecommunications Regulatory Commission
Cayman Islands	2004	Lime; Digicel	Information & Communications Technology Authority
Cook Islands	N/A	Telecom Cook Islands	None (single government telecommunications agency operates)
Cyprus	N/A	CYTA-Vodafone	Office of the Commissioner for Electronic Communications & Postal Regulation
Dominica	2003	LIME; Digicel; Orange	Eastern Caribbean Telecommunications Authority
Fiji	2008	Fiji Telecom; Vodafone Fiji; Digicel Fiji	Telecommunications Authority of Fiji
Grenada	2003	LIME; Digicel	Eastern Caribbean Telecommunications Authority
Guam	1992	GTA; NTT Docomo Pacific	Guam Public Utilities Commission
Iceland		Siminn; Vodafone Iceland; Nova	Post and Telecommunications Administration in Iceland
Isle of Man	2007	Manx Telecom; Sure mobile	Communications Commission
Jamaica	2001	LIME; Digicel; Oceanic Digital (Claro)	Office of Utilities Regulation
Kiribati	N/A	TSKL Kiribati	None (single government telecommunications agency operates)
Malta	2003	Go; Vodafone	Malta Communications Authority
Marshall Islands	Na	NTA Marshall Islands	None (single government telecommunications agency operates)
Mauritius	2005	(Cellplus) Mauritius telecom; MTML	Information and Communications Technology Authority
Micronesia	N/A	FSMTC Micronesia	None (single government telecommunications agency operates)
Nauru	N/A	Digicel Nauru	Department of Telecommunications
Palau	2006	PNCC Palau; PMC Palau	Ministry of Public Infrastructure, Industries & Commerce
Samoa	2006	Bluesky Samoa; Digicel	Office of the Regulator
Solomon Islands	N/A	Solomon Telekom Bemobile	Telecommunications Commission of the Solomon Islands
St Kitts and Nevis	2003	LIME; Digicel	Eastern Caribbean Telecommunications Authority

St Lucia	2003	LIME; Digicel	Eastern Caribbean Telecommunications Authority
St Vincents	2003	LIME; Digicel	Eastern Caribbean Telecommunications Authority
Tonga	2003	TCC Tonga; Digicel Tonga	Ministry
Trinidad & Tobago	2006	Bmobile TSTT; Digicel	Telecommunications Authority Trinidad and Tobago
Turks & Caicos Is.	2006	LIME; Digicel; Islandcom (ATN)	Telecommunications Commission
Virgin Is. (USA)		Sprint PCS; AT&T Mobility; Choice Wireless	Virgin Islands Public Services Commission
Vanuatu	2011	Telecom Vanuatu; Digicel	Telecommunications & Radio communications regulator

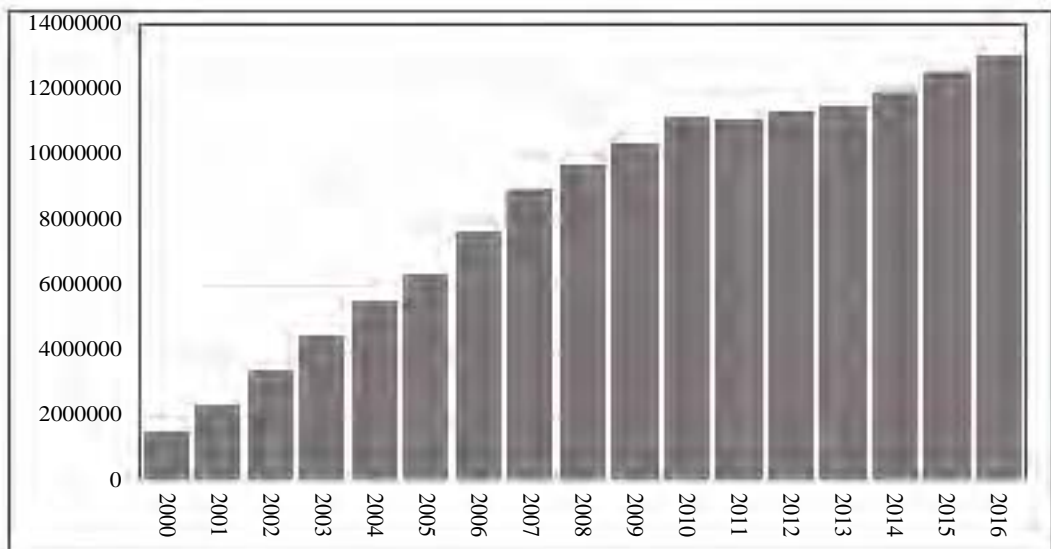
Sources: (Abbott & Ma, 2013; Cellone Bermuda, <http://www.cellone.bm/> (retrieved November 1, 2013); Cellplus Mauritius, <http://www.mauritiustelecom.com/> (retrieved November 3, 2013); CYTA Vodafone, <https://www.cyta.com.cy/> (retrieved November 3, 2013); ICT Pulse, 2012; GTA Pulse, <http://www.gta.net/> (retrieved November 1, 2013); Manx Telecom, <http://www.manxtelecom.com/> (retrieved November 1, 2013); Network Strategies, 2013, Pacific Island mobile tariffs update, <http://www.strategies.nzl.com/wpapers/2013013.htm> (retrieved November 1, 2013); Siminn Iceland, <http://www.siminn.is/english/> (retrieved November 2, 2013). N/A-no competition, single service provider.)

Growth and Competition

As was previously mentioned, the introduction of mobile phones came later in the small island economies than in most other countries. Most of the growth of mobile phones was not to take place in the sampled nations (listed in Table 1) until the 2000s. In many other countries, substantial growth in use had taken place in the 1990s. Figure 1 shows the number of mobile phone users in the same nations shown in Table 1 between the years 2000 and 2016. From the data in Figure 1, it can be seen that at the beginning of the 2000s mobile phone use was not widespread in the island nations. By 2016, use had grown substantially, although it is noticeable that numbers have plateaued in recent years. Mobile phone use varies across the nations, and in Table 1 it can be seen that it is more than one phone per person in some nations in the Caribbean. Even in the islands of the Pacific, mobile phone use is quite widespread and a phone per every two people is common (see Table A1 in the Appendix). It is also noticeable that mobile phone use is almost universally more popular than traditional land-line use; in some cases the number of mobile phones subscribers being many times that of the number of land lines. In some cases, such as in lower-income countries like the Solomon Islands, telephone-line technology was never developed to a great degree and the use of less costly mobile phone technology is very widespread.

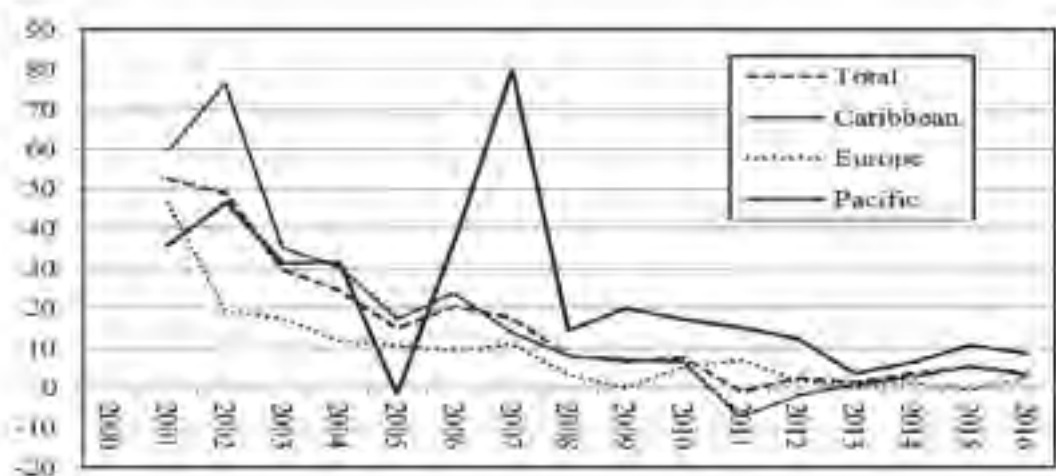
Despite the widespread use of mobile phone technology across all of these countries, real income levels are important influencers of the level of penetration of mobile phones in a society.. The highest income countries have the highest levels of mobile phone use, and there is some evidence that the highest income countries received mobile phone services first. Figure 2 breaks down the data from Figure 1 into regional growth rates (Pacific, Caribbean, Europe). The growth of mobile phone use is high in all regions, but tends to have been higher, earlier, in the small European island countries (Iceland, Isle of Man, Malta, Cyprus) before those of the Caribbean and the Pacific.

Figure 1: Number of Mobile/Cellular Phone Subscribers in Small Island Nations; 2000 to 2016



Source: (International Telecommunications Union.)

Figure 2: Growth of the number of mobile/cellular phone subscribers in small island nations; 2000 to 2016



Source: International Telecommunications Union.

Data and Methodology

The main objective of this study is to quantify the impact of competition and regulatory reform on the pricing of mobile phones in small island countries. Some other economic factors that also may have had an influence on pricing are also included, such as the level of per capita income, population size and density, and the existence of an incumbent government-run telecommunications company.

The data on pricing comes from estimations made by ICT Pulse (the Caribbean countries), by Network Strategies (the Pacific nations), and by the authors of the paper directly from individual companies' websites (the European countries). In compiling a price for mobile services, the method used by the Organisation for Economic Cooperation and Development (2006) for the monthly spend on mobile services for a low-volume user (US\$ at purchasing power parity rates) has been used, over the years 2010 to 2012. In the small island countries, the majority of mobile phone users can be classified as low-volume users and so this spend figure is a good proxy for mobile phone charges overall. The countries covered in the study are those that were listed in Table 1, and the data used is provided in the Appendix in Table A2. The island nations in the study have a range of population sizes and densities and income levels, just as they have a range of mobile phone adoption levels.

The basic methodological approach used is to run a simple least squares regression

using the monthly spend by low-volume users³ (price or charges) as the dependent variable and the number of mobile phone operators as the main independent variable.⁴ Other relevant independent variables have also been included (real per capita income, population). The equation was also estimated with dummy variables to indicate other characteristics, such as the existence of an incumbent government-owned operator and an independent regulator. Descriptive statistics of the data used are shown in Table 2.

Theoretically, it would be expected that lower prices would be associated with greater levels of competition as competing firms would put pressure on each other to operate at higher levels of efficiency, lower costs, and lower prices. It is assumed that the new entrants that bring competition do not suffer too much from a lack of scale economies, because, if that were important, entry would greatly favour the incumbent.

Table 2: Descriptive Statistics 2010 to 2012

<i>Mobile phone low-volume users spend (PPP \$US)</i>	
MEAN	19.4
STDEV	10.6
MAXIMUM	54
MINIMUM	5
<i>Number of mobile phone operators</i>	
MEAN	2.0
STDEV	0.7
MAXIMUM	3
MINIMUM	1
<i>Per capita income PPP \$US</i>	
MEAN	19,768
STDEV	17,566
MAXIMUM	86,500
MINIMUM	2,327
<i>Population</i>	
MEAN	356,277
STDEV	558,833
MAXIMUM	2,889,187
MINIMUM	9,200
<i>Population density</i>	
MEAN	263.5
STDEV	306.5
MAXIMUM	1,311
MINIMUM	3
<i>Independent regulator</i>	
Yes	69.7%
<i>Incumbent government-owned company</i>	
Yes	33.3%

Sources: Central Intelligence Agency, 2013; World Bank, 2018. ICT Pulse, 2012. Network Strategies. Cellone Bermuda, <http://www.cellone.bm/> (retrieved November 1, 2013); Cellplus Mauritius, <http://www.mauritiustelecom.com/> (retrieved November 3, 2013); CYTA Vodafone, <https://www.cyta.com.cy/> (retrieved November 3, 2013); GTA Pulse, <http://www.gta.net/> (retrieved November 1, 2013); Manx Telecom, <http://www.manxtelecom.com/> (retrieved November 1, 2013); Siminn Iceland, <http://www.siminn.is/english/> (retrieved November 2, 2013).

³ A low volume user is defined as one who makes 30 calls and sends 100 text messages per month (Network Strategies, 2013).

⁴ The software used for the analysis was Mplus version 7.1 (Muthén & Muthén, 1998–2013).

Equation 1 was developed by taking the monthly spend on mobile phones of low-income users for each of the years from 2010 to 2012 as the dependent variable (P) and as a proxy for mobile phone prices, with the following as independent variables:

- The number of mobile phone companies operating in the country (N)
- The population level in the country (D)
- The level of per capita real income in \$US Purchasing Power Parity (Y)
- R – A dummy variable where 1 is where an independent regulator exists
- G – A dummy variable where 1 is where the country has an incumbent government-owned company
- L – The population density of the country (people per square kilometres of land)

This is shown in Equation 1.

$$P = \alpha + \beta_1 N + \beta_2 D + \beta_3 Y + \beta_4 G + \beta_5 R + \beta_6 L \quad \text{Equation 1}$$

Results

Initially, each independent variable was regressed with the dependent variable separately (Table 3a). When this was done the results are as follows:

- The relationship between mobile phone prices and the number of mobile phone operators is significant (significance level: 0.000). The sign here is a negative one, which is what we might expect. With a greater number of operators, the prices of services are lower. With fewer operators the prices tend to be higher.
- The relationship of mobile phone prices with the regulatory dummy is significant. In this case there is a negative relationship. This is as expected, as a regulatory agency is associated with more competition in markets and lower prices. It is possible that the creation of independent regulators is associated with a more pronounced movement towards competition and lower prices in mobile phone markets.

- In the case of per capita income, the relationship with mobile phone prices is a coefficient of 0.000, with non-significant p value of 0.065. Income therefore has no impact on prices.
- The relationship between population size and prices is significant (significance level: 0.000). The relationship figure is a negative one. This is not what would normally be intuitively expected (i.e., larger populations enjoying economies of scale and lower costs), and it is not clear from the study why this might be occurring. Such a relationship may exist via the production costs (such as high-income countries having typically a higher relative wage—and thus costs—and, accordingly, the price being higher), but further research would need to be undertaken to confirm this.
- The relationship of the mobile phone prices with the incumbent government-owned dummy is also significant, and a positive sign (significance level: 0.002). This implies that an incumbent government-owned entity is associated with higher prices.
- There is no statistically significant relationship between population density and prices. This does not mean that there is no relationship between them, just that it is not being captured statistically in this study.
- The R^2 in most cases is relatively small, except for the existence of an independent regular, which correlates with lower prices to a fair degree. This means that there must be other explanations that are important along with the variables used.

In addition to running the regressions separately, it is possible to run them in a single equation, and in doing so capture the effects of each of the independent variables on each other (Table 3b).

The model results of the estimated equation are in Table 3b. The results for Equation 1, shown in Table 3b, show that:

- The relationship of the variation of mobile phone prices with the number of companies is significant at the border line. The sign is a negative one, which is what we would expect. That means that a greater number of mobile phone companies (and more competition) is associated with lower prices. The tendency is for the introduction of more competition to put downward pressure on prices.

- The relationship of the variation of the price level with the dummy variable for incumbent government operation is not significant (figure of 0.515).
- The relationship of the variation of the price level with the dummy variable with an independent regulator is also significant (figure is 0.000). The figure 0.000 tells us the relationship is meaningful at the 99 % confidence level. The sign is a negative one. The existence of an independent regulator is associated with lower prices. This is not unexpected. An independent regulator is often associated with more competition and therefore lower prices.
- The R^2 is 0.423. This indicates that 42 per cent of the variations of the price of mobile phone services are explained by the factors that are included in the equation. It also means that just over half of the variation in mobile phone charges are explained by other factors. These factors might include such things as the individual characteristics of the various countries, as well as such things as the character of the companies that operate within them. It is also possible that, as the number of operators is often quite small (two or three), in some circumstances they may operate to collude on price setting and reduce the impact that competition can have on prices.

Despite the caveats made in the last bullet point, what is found overall is that the existence of an independent regulator and a number of mobile phone operators is associated with lower mobile phone charges. Higher- (or lower-) income countries are not associated with higher (or lower) charges. This means that it is possible for a country to achieve lower mobile phone charges regardless of its level of per capita income as long as the regulatory and competitive conditions promote this. Not all of the variation in mobile phone charges is explained by the variables in the equations. It is possible that a range of other factors are also important, especially individual country characteristics, and it is possible that a more sophisticated study with a broader range of information might help to understand these possible factors.

Table 3a: Regression Results with Individual Independent Variables

Note: D and Y being rescaled as $D=D/1000$; $Y=Y/1000$.

Variable	α	β	Sig level	R^2
D	21.285	-0.005	0.000	0.080
Y	21.421	0.000	0.065	0.029
N	32.311	-6.534	0.000	0.170
G	16.636	8.212	0.002	0.134
R	28.733	-13.429	0.000	0.341
L	19.710	-0.001	0.549	0.001

Table 3b: Multiple Regression Results

Intercept=32.081, R-square=0.423

Note: D and Y being rescaled to D=D/1000; Y=Y/1000.

Variable	β	Sig level
D	-0.004	0.001
Y	0.014	0.727
N	-2.770	0.053
G	1.606	0.515
R	-11.018	0.000
L	0.003	0.080

Conclusion

In recent years there have been considerable developments in the structure of telecommunications markets in a range of countries around the world. In the case of the small island countries, the main developments in terms of regulatory governance and industry structure have been in the provision of mobile phones.

In the case of the telecommunications industry, many of these small island countries have corporatized or privatized national telecommunications companies and opened up markets to new entrants. In doing so, in some cases, they have established sector regulators to license new entrants and regulated some interconnection arrangements. On the whole, this reform has been successful, as in many cases relatively small markets now operate with a number of competing companies. Mobile phone usage in particular has grown substantially in these countries aided by the investment of new operators. The findings of this study were that lower prices are associated with more competition and independent regulation. The variables used do not explain all of the variation in mobile phone charges, and it is possible that individual country characteristics are important. Future research might be able to achieve a more comprehensive understanding of what influences prices in these nations, and in particular it would be useful to research what strategies were used both by new entrants and by incumbents.

The findings are consistent with many previous studies on the telecommunications industries for larger, more developed countries, arguing that efficient regulation and competition provides the best climate for growth and efficiency in the industry. In the case of the small island nations, the development of mobile phone use took place after that of many other countries, but grew quite swiftly once the regulatory climate was reformed and competition allowed. It is noticeable that even quite small

island markets, with modest average income levels, are able to maintain competition between two mobile phone providers.

The result indicate that there is little reason to maintain monopoly provision of mobile phone operators, even in small isolated countries, and that competition in the industry can bring advantages. Further research into the role and importance of incumbent government-owned entities in competitive markets would be useful in determining the degree to which they have an impact on pricing. Further research into the impact of the nature of competition and pricing strategies would also be important in the case of those countries that have very small populations.

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Appendices

Table A1: Telecommunications data, Small Island Nations, 2017 *N/A-data not available*

Country	Population	Per capita income	Telephone lines	Mobile subscribers	Telephone lines	Mobile subscribers
	No.	US\$ PPP	No.	No.	No. per 100 people	No. per 100 people
Anguilla	17,087	12,200	6,000	26,000	35.1	152.2
Antigua & Barbuda	94,731	26,500	22,504	180,000	23.8	190.0
Bahamas	379,988	25,100	121,088	360,200	31.9	94.8
Barbados	292,336	17,500	139,715	332,208	47.8	113.6
Bermuda	70,864	85,700	29,200	59,500	41.2	84.0
British Virgin Is.	35,015	42,300	12,000	42,000	34.3	119.9
Cayman Islands	58,441	43,800	34,116	95,656	58.4	163.7
Cook Islands	9,790	12,300	7,800	11,000	79.7	112.4
Cyprus	1,221,549	36,600	320,573	1,133,780	26.2	92.8
Dominica	73,897	12,000	13,328	78,444	18.0	106.2
Fiji	920,938	9,900	74,182	1,044,685	8.1	113.4
Grenada	111,724	14,700	26,776	118,973	24.0	106.5
Guam	167,358	30,500	68,000	181,000	40.6	108.2
Iceland	339,747	52,100	164,566	401,613	48.4	118.2
Isle of Man	88,816	84,600	N/A	N/A	N/A	N/A
Jamaica	2,990,566	9,200	310,213	3,267,344	10.4	109.3
Kiribati	108,145	1,900	9,000	52,000	8.3	48.1
Malta	416,338	42,500	234,368	532,136	56.3	127.8
Marshall Islands	74,539	3,400	2,301	16,000	3.1	21.5
Mauritius	1,356,368	21,600	319,500	1,814,000	23.6	133.7
Micronesia	104,196	3,400	6,883	23,412	6.6	22.5
Nauru	9,642	12,200	1,900	9,900	19.7	102.7
Palau	21,431	16,700	7,204	24,000	33.6	112.0
Samoa	200,108	5,700	9,679	151,857	14.8	75.9
Solomon Islands	64,758	2,100	7,405	416,573	11.4	64.3
St Kitts & Nevis	52,741	26,800	17,443	76,583	33.1	145.2
St Lucia	164,994	13,500	35,545	176,648	21.5	107.1
St Vincents	102,089	11,699	20,550	112,649	20.4	110.3
Tonga	106,479	5,600	11,000	80,000	10.3	75.1
Trinidad & Tobago	1,218,245	31,200	272,187	2,165,847	22.3	177.8
Turks & Caicos Is.	52,570	29,100	3,700	N/A	7.0	N/A
Virgin Is. (USA)	107,268	36,100	76,000	N/A	70.9	N/A
Vanuatu	282,814	2,500	4,555	218,603	1.6	77.5

Sources: (Central Intelligence Agency, 2013; International Telecommunications Union, 2018; World Bank, 2018.)

Table A2: Data Used in Regression

Country	Year	Monthly spend P	Per capita income Y	Population D	Number of mobile phone companies N	Dummy for government ownership G	Dummy for regulator population density R	Population density L
		PPP \$US	PPP \$US	no	no	1=Govt.	1=Reg.	People per km ²
Anguilla	2010	16	11,693	14,950	2	0	1	164
Anguilla	2011	15	12,200	15,000	2	0	1	165
Anguilla	2012	14	12,500	15,423	2	0	1	170
Antigua & Barbuda	2010	17	19,606	87,233	3	0	0	198
Antigua & Barbuda	2011	17	19,257	88,152	3	0	0	200
Antigua & Barbuda	2012	15	19,964	89,092	3	0	0	202
Bahamas	2010	17	30,155	360,498	1	1	1	36
Bahamas	2011	17	30,809	366,331	1	1	1	37
Bahamas	2012	17	31,629	371,960	1	1	1	37
Barbados	2010	17	18,805	280,396	2	0	1	652
Barbados	2011	17	23,700	281,804	2	0	1	655
Barbados	2012	16	25,372	283,221	2	0	1	659
Bermuda	2010	24	84,381	64,237	2	0	1	1302
Bermuda	2011	23	86,000	66,000	2	0	1	1291
Bermuda	2012	23	86,500	69,497	2	0	1	1296
B. Virgin Islands	2010	19	42,300	27,000	3	0	1	180
B. Virgin Islands	2011	18	43,000	28,000	3	0	1	185
B. Virgin Islands	2012	17	43,366	31,148	3	0	1	206
Cayman Islands	2010	22	43,800	55,509	2	0	1	231
Cayman Islands	2011	22	43,800	56,601	2	0	1	236
Cayman Islands	2012	22	43,360	57,570	2	0	1	240
Dominica	2010	7	12,238	71,167	3	0	1	95
Dominica	2011	7	12,583	71,401	3	0	1	95
Dominica	2012	7	12,643	71,684	3	0	1	96
Grenada	2010	12	10,421	104,677	2	0	1	308
Grenada	2011	12	10,706	105,074	2	0	1	309
Grenada	2012	12	10,827	105,483	2	0	1	310
Jamaica	2010	6	9,000	2,701,200	3	0	1	248
Jamaica	2011	5	9,029	2,706,500	3	0	1	249
Jamaica	2012	5	9,300	2,889,187	3	0	1	250
St Kitts & Nevis	2010	13	17,551	52,352	2	0	1	201
St Kitts & Nevis	2011	13	18,015	52,971	2	0	1	204
St Kitts & Nevis	2012	13	18,034	53,584	2	0	1	206
St Lucia	2010	14	11,058	177,397	2	0	1	291
St Lucia	2011	14	11,330	179,271	2	0	1	294
St Lucia	2012	13	11,148	180,870	2	0	1	297
St Vincents & Grenadines	2010	14	10,427	109,316	2	0	1	280
St Vincents & Grenadines	2011	14	10,574	109,357	2	0	1	280

Sources: (Central Intelligence Agency, 2013; International Telecommunications Union, 2018; World Bank, 2018; Abbott & Ma, 2013; Cellone Bermuda, <http://www.cellone.bm/> (retrieved November 1, 2013); Cellplus Mauritius, <http://www.mauritiustelecom.com/> (retrieved November 3, 2013); CYTA Vodafone, <https://www.cyta.com.cy/> (retrieved November 3, 2013); ICT Pulse, 2012; GTA Pulse, <http://www.gta.net/> (retrieved November 1, 2013); Manx Telecom, <http://www.manxtelecom.com/> (retrieved November 1, 2013); Network Strategies, 2013, <http://www.strategies.nzl.com/wpapers/2013013.htm> (retrieved November 1, 2013); Siminn Iceland, <http://www.siminn.is/english/> (retrieved November 2, 2013)

