An Assessment of Mobile Telephone Subscriptions in Full Member Markets of the Central American Integration System (SICA)

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Abstract of the Dissertation

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Dissertation Director:
Professor Jerome Williams

Using Global Production Network theory as the foundation, this research focuses on the growth and proliferation of mobile telephone subscriptions in full member markets of the Central American Integration System, from year 2000 to 2014. This research also looks at the mobile telephone penetration rate in these markets as well. The purpose of this research is to answer the main research question, "*What's causing mobile telephone subscription growth in Central American Integration System Markets?*", and the sub-questions "*Why are some markets above the 100% mobile telephone penetration rate?"; "Why are some markets not above the 100% mobile telephone penetration rate?"* The significant covariates of each regression model was interpreted and the information from the model summary and ANOVA table were both used for responding to the hypothesis of each market. The research results showed that population and income covariates contribute to mobile telephone subscription growth in the full member SICA markets, and each SICA market had either a population or an income covariate that showed significance in the number of mobile telephone subscriptions. A mathematical equation of each SICA market's regression model was constructed.

Preface

The work of this dissertation titled “An Assessment of Mobile Telephone Subscriptions in the Full Member Markets of the Central American Integration System” has been a two year commitment to studying mobile telephone subscriptions in the Dominican Republic and Central American markets. It has been written to fulfill the graduation requirements for the Doctor of Philosophy in Management degree at Rutgers Business School Newark and New Brunswick.

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Chapter 1: Introduction

1.1 Introduction of the Study

The number of mobile telephone subscriptions globally are on pace to outnumber the world population. Currently the number of Subscriber Identification Module (SIM) card connections used in mobile telephones outnumber the global population; SIM cards used in mobile telephones store data for mobile telephone subscribers. The number of SIM connections worldwide total more than 8.3 billion (Mobile connection, including M2M, 2017). The global population is at approximately 7.4 billion people (US and World Population Clock, 2017). The number of unique mobile telephone subscribers worldwide total more than 5 billion (Unique Mobile Subscribers, 2017). The International Telecommunications Union (ITU) and GSMA tracks the number of mobile telephone subscriptions globally. Since it is not feasible to write a dissertation about mobile telephone subscriptions on all 189 member countries of the United Nations, this dissertation research focuses on one particular region of markets.

In this dissertation study an assessment of mobile telephone subscriptions in full member markets of the Central American Integration System (SICA) is performed. The Central American Integration System has a total of eight full member markets. Seven of the eight full member markets are regionally located near each other: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama. The other full member market, Dominican Republic, is separated from the other full members by the Caribbean Sea. These eight full members are sovereign nations ruled independently, with government structure, law and order, and a legal system (Lobo et al., 2016). The Central

American Integration System is a treaty among the markets created to bring about unification, peace, freedom, democracy, and development to the Central American economies and to the Dominican Republic. This alignment of the nations can be referred to as a supranational organization. Peter (1965) referred to treaties formed by a collection of nations as "supranationational organizations". "Supranational organizations was defined by Robert Schuman in The Schuman Declaration written in 1950; Schuman defined supranational organizations as countries working collectively headed for a merging of their economic concerns; this declaration led Europe towards integration. Long before the Central American Integration System treaty these nations had to gain independence from Mexico and Spain and also attempted to become economically integrated (Perez-Brignoli, 1989; O'Keefe, 2000) but failed due to issues among each other. However, the SICA treaty has brought unification to the region. Just as Europe was led toward integration as a supranational organization, the Central American Integration System is a supranational organization that strives continue to bring economic development and unification between the eight full member markets involved in the treaty. When these markets improve its economy, it provides hope for the people and gives them something to look forward to; also each member raises the standard of living for its citizens and improves its human development index rank.

The UN ranks the well-being of the people in economies using human development indicators. The UN focuses on three concepts in regards to human development. The first concept of human development is self or the individual person, which focuses on the individual's health and the life a person leads. The second concept of human development is opportunity and it pertains to rights in a nation that gives

people the freedom to use their ability toward living the life they desire to have. The final concept of human development is choice. This is people having the choice to choose among many available opportunities afforded to them within the home country. These three concepts are what the UN considers as primary dimensions of life. There are 12 indicators that are used by the UN in order to present the fundamental dimensions of life. The indicators are health, education, income, inequality, gender, work, employment, and vulnerability, human security, trade and financial flows, mobility and communication, environment sustainability, and demography. In this dissertation study some of these 12 indicators are changed to measurable independent variables for correlation analysis and to develop a statistical model to help explain mobile telephone subscription growth among the full members of SICA.

In the literature of mobile telephone subscriptions the digital divide is often discussed. Digital divide is defined as the differential access to and use of the Internet and other media according to race, gender, income, and location (Rice and Katz, 2003). The digital divide is not the same today as it was 15 years ago, and the reasons for adopting mobile telephone service in a developing economy may not be the same reasons for adopting mobile telephone service in a developed economy. In high human development index (HHDI) and medium human development index (MHDI) nations such as Jamaica and Sub-Saharan Africa nations, mobile telephones are primarily purchased to help the mobile telephone user contact help during a time of need (James, 2015). This could also be the case for the developing countries of Central America as well and is contrary to the primary reason(s) people in developed nations purchase a mobile telephone. Figure. 1 shows the number of mobile telephone subscriptions grew rapidly among the SICA full

members from 2000 to 2013 and declined as a whole group in 2014. At the end of year 2000 the total number of subscribers for the full members was over 3.1 million; by the end of year 2013 the total number of subscribers reached over 68 million. Population can play huge a role in the total number of mobile telephone subscriptions in a country. A high number mobile telephone subscriptions in a market can signal there's a high market population but not in all cases. Conversely, a high number of mobile telephone subscriptions in a market can also happen in a low population market; this could indicate a high mobile penetration rate due to users having multiple mobile telephones; or it may just be multiple SIM cards used on one mobile telephone. For instance, among the SICA full members, Honduras has a high market population (market population above 7,835,247) yet it has a low number of mobile telephone subscriptions (number of mobile telephone subscriptions below 7,050,746). On the contrary, El Salvador has a low market population (population below 7,835,247) yet it has a high number of mobile telephone subscriptions (number of mobile telephone subscriptions above 7,050,746). Figure. 2 shows the population rank of each market.

Figure 1. Number of mobile subscriptions (2000-2014) for all full member SICA markets.

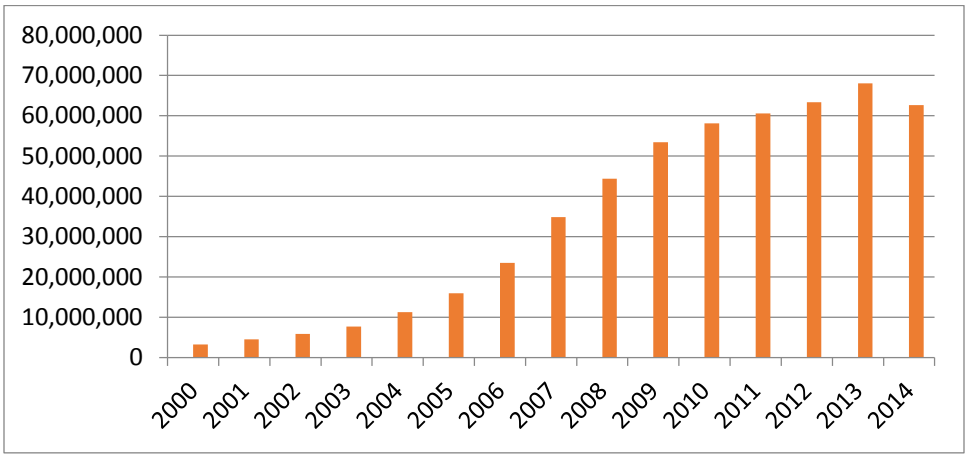
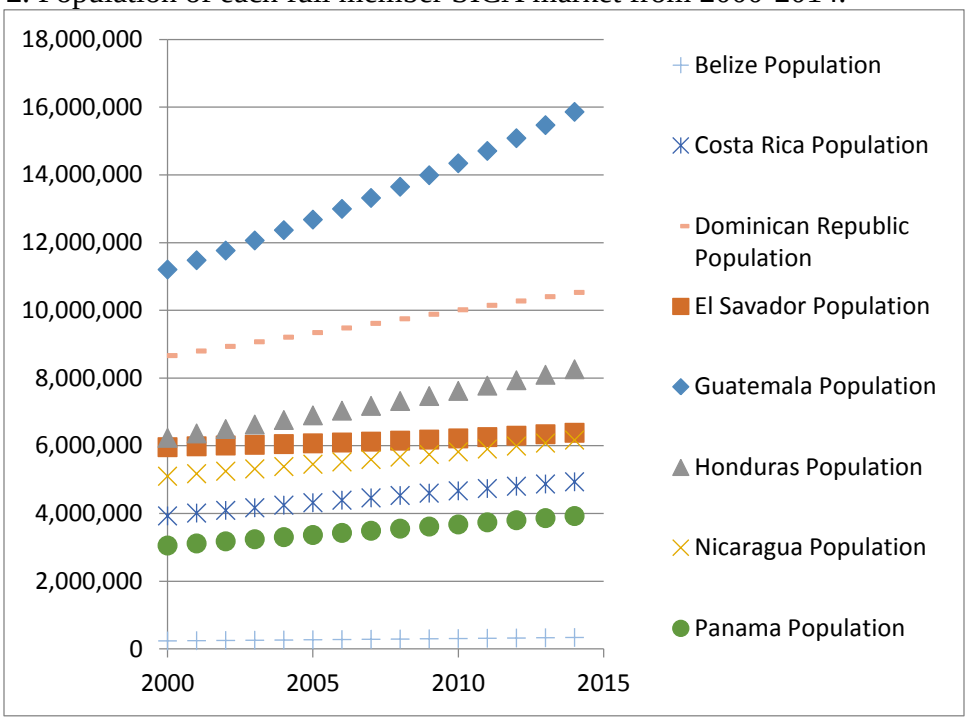


Figure 2. Population of each full member SICA market from 2000-2014.



The eight full member markets are classified according to the UN's Human Development Index Report as either High Human Development Index (HHDI) markets or Medium Human Development Index (MHDI) markets. The HHDI markets of SICA are Dominican Republic, Belize, Costa Rica, and Panama. The MHDI markets of SICA are El Salvador, Guatemala, Honduras, and Nicaragua. Mobile telephone users in HHDI markets may or may not use a mobile telephone for the same reasons as a mobile telephone user in MHDI markets; this situation is addressed in the areas of the digital divide and mobile telephone adoption. In addition to situating the markets based on its United Nations human development index rank, this study developed a statistical model for each SICA market that explains mobile telephone subscription growth in these markets using data from 2000 to 2014. Mobile telephone penetration rate (MPR) among the eight full members is explored as well as answering the research questions that

established this dissertation study. Mobile telephone penetration rate is defined as the number of mobile telephone subscriptions per 100 people in a market. This research shows that although the markets have mobile telephone service providers more telecom operators can explore the option of getting licensed to operate in the markets due to non-monopolized and untapped rural areas in the SICA markets. The literature themes that are discussed in this dissertation provide an overview of various topics covered in mobile telephone research such as the digital divide, mobile telephone adoption, mobile telephone usage, health and safety of mobile telephones, and regulation and policy of the mobile market's telecommunication industry.

1.2 Significance of the Study

Why study mobile telephone subscriptions in this region? The motivation behind this study is there has been no scholarly research performed on mobile telephone subscriptions that includes all full member markets of the Central American Integration System in one study using the Human Development Index ranking. In addition to the lack of research on these markets, the event of mobile telephone subscriptions outnumbering the global population has to occur at the individual market level and regional level prior to the event happening on a larger global level. The event of mobile telephone subscriptions outnumbering the global population means that at some point the mobile penetration rate in markets are greater 100%. Currently the total number of mobile telephone subscriptions for the markets combined in this study outnumbers the total combined population of the markets in this region. So studying and understanding

what is happening with mobile telephone subscriptions at the individual market level and in this region level leads to a better discussion of what is happening with mobile telephone subscriptions on a global level. Therefore this dissertation study is a key contributor to explaining the phenomenon of the number of mobile telephone subscriptions outnumbering the global population. Although some full member SICA markets have reach a 100% MPR, there is still much room for mobile telephone subscription growth in these markets. The basic feature mobile telephone has been widely adopted however, the smartphone is the future of mobile telephones and has not been adopted widely in the full member SICA markets. Due to Central America being located between two large talked about continents North America and South America, the full member markets often coasts below the radar. This study has the goal to inspire much research interest in the mobile telephone subscription markets of SICA. Mobile telephones are constantly being updated by manufacturers; there is no 100% accurate count of all the mobile telephone devices and there needs to be accountability for all mobile telephones in the event of emergency and for tracking purposes due to protection of the general population. Telecom operators are upgrading and creating more networks to allow better communication and usage of the device as well as to allow more mobile telephone users to communicate or use data at any given time. The mobile device emits and receives frequency signals; so mobile telephones need to be studied in order to understand the long-term effects of using the device. The mobile telephone is a permanent part of our lives and knowing more about the device is critical in the long-term.

Chapter II. Theory, Literature Review, and Contributions to the Literature

2.1 Theoretical Framework Global Production Network

In order to bring mobile telephones to people there needs to be a collective effort. The collective effort comes from a collaboration of all parties involved with bringing the mobile telephone to the market and ultimately to the end user. The mobile telephone has a supply chain and the mobile device is delivered from its source (upstream) to the end user (downstream). This includes research and development, material producers, mobile telephone manufacturers, distribution warehouses, transporters, retailers, and the subscribers that purchase the mobile telephone. In addition to firms located upstream and downstream on the supply chain, policy and regulatory framework assumes a responsibility in getting the product to the marketplace. Flowing from the development of a product at its source (upstream) and down to the consumption of that product (downstream), global production network theory highlights all facets of the supply chain. Hess and Coe, (2006) describes global production network theory as the following:

> "(a) the complex nonlinear networks of firms engaging in research and development (R&D), design, production, marketing, and consumption of products and services, and how these are structured both organizationally, and geographically at a variety of spatial scales;
> (b) the distribution of power within those networks, and changes therein;
> (c) the significance of the processes of value creation, enhancement, and capture within those networks;
> (d) the embeddedness of production networks namely, how they constitute and are reconstituted by the economic, social, and political arrangements of the places they inhabit;
> (e) the influence of a range of nonfirm institutions for example, supranational organizations, government agencies, trade unions, employer associations, nongovernmental organizations, and consumer groups that shape firm activities in the particular locations" (pp. 1207).

Hess and Coe (2008) defined GPN as a sequence of linked functions, processes and transactions through which a particular product or service is produced, dispersed for use, and ultimately consumed. GPN is a theory that bridges the gap between mobile telephone proliferation and adoption on the one hand and supply chain management on the other. The connected functions in this dissertation are government, network operator/infrastructure, mobile telephone manufacturers, and the mobile telephone user. How are the functions connected? The government is connected because it provides the policy and regulation over the telecommunications industry in the market, it grants licenses to network operators in order to build infrastructure and the government requires mobile manufacturers to label mobile devices with the proper health warnings. The mobile manufacturer is connected to the network operator via building mobile telephones that send and receive radio frequency signals to the cellular towers. The mobile telephone user immediately becomes connected to the other functions when adopting the mobile telephone.

The ground rules of global production networks derive from the concept of embeddedness. There's territorial embeddedness (Coe et al., 2008); firms in the network are influenced by locational forces such as nearness of suppliers. Firms located in the same community form industrial clusters and begin thriving off the existence of one another; this concept of clustering is discussed in Mironko, (2014) where costs are reduced due to the abundance of resources already in place for firms conducting similar business operations. There's societal embeddedness where firms in the network are shaped by environmental characteristics within the community (Hess, 2004; Coe et al., 2008). Similar to agglomeration economies, where location decisions can bring about

firm benefits as a result of market externalities (David and Rosenbloom, 1990; Hess, 2004; Mironko, 2014), firms of spatial networks profited and matured from the presence Nokia Corporation. There's also network embeddedness (Coe et al., 2008) where multinationals and small to medium sized firms form partnerships or joint ventures and benefit across national borders or other strategic locations. Network embeddedness is demonstrated well via Nokia Corporation's business model. Nokia Corporation, which is a global provider of mobile broadband network infrastructure, formed strategic alliances to help its development of technologies necessary for mobile telephony (Dittrich and Duysters, 2007). Embeddedness roots go back to reciprocity and redistribution (Polyani, 1944; Hess 2004). Polyani, (1944) points to the sustenance of family that creates reciprocity; and due to the righteousness of the husband's wife and children the husband is able to bring high-quality work to his community and be given just return for the work. Redistribution takes place when an important person brings provisions back from a day out to the people of their area; they then allocate the supplies among the people and storing any leftover supplies (Polanyi, 1944). Reciprocity and redistribution includes social relations, and man's economy is engrossed in social relationships (Polanyi, 1944). Global production networks include material and tangible social relationships assets, where material assets are those assets used in the fabrication process (Coe et al., 2008).

Firms involved in R&D together must have trust throughout the business relationship due to sensitive product information on display. Trust which has been discussed in the literature (Polanyi, 1944; Granovetter, 1985; Hess, 2004) and can bring about confidence formed by the partners involved during its R&D endeavors; and in these R&D endeavors are embedded lengthy relationships that requires sustainability;

sustainability being defined in line with (Starik and Rands, 1995; Carter and Rogers, 2008). Each firm involved in the partnership during this R&D phase has a behavior that is shaped by continuous social relations (Granovetter, 1985; Hess, 2004). Firmly rooted in the dynamic market of mobile telephony are embedded social relations that's driving growth of all firms involved in the partnerships of R&D, design, manufacturing, marketing, and sales of the mobile telephone. Granovetter, (1985) explains at the firm level human interactions (social relations) can influence business processes; and the decisions made at a higher level, such as the managerial level, can guide the organization's direction in the marketplace and form new partnerships as well via embeddedness. Mobile telephone handset manufacturers and mobile telephone carriers have to be dynamic in the marketplace due to the alternating choices, desires, and needs of mobile telephone users. The choices, desires, and needs of mobile telephone user are dictated by innovation and evolution of the mobile telephone device, the services offered by third party applications, and the technological infrastructure ready to deliver a service and meet the needs of the mobile telephone user. A joint effort is necessary, and the most efficient way to deliver mobile telephone services to mobile users. For instance, cellular telephone towers contain multiple mobile telephone carrier satellites; although mobile telephone carriers could afford full ownership of the cellular telephone tower it is more economical to lease the available space needed to deliver service to the mobile users of its network. Even though mobile telephone carriers target some of the same mobile telephone customers in that marketplace, they will likely be sharing the same cellular telephone network(s). Straight Talk, a popular prepaid mobile telephone service provider in the US, uses a strategy similar to this. Straight Talk uses the networks of AT&T,

Sprint, T-Mobile, or Verizon Wireless to deliver mobile telephone service to its customers; and although the mobile telephone carriers are sharing the same network to deliver service, they are still competing for some of the same mobile telephone customers.

Mobile telephone materials flow through its network and the economy from one state to the next and will continue this flow until it reaches the next GPN (Hudson, 2008). As components and an assembled device, the mobile telephone flows from research and development to consumption; also, there's a strong push for recycling mobile telephones as well which allows them to continue to be used for parts or for resale by carriers via allowing a mobile subscriber to trade in an old mobile telephone and upgrade to a new mobile telephone. The mobile telephone has become embedded in Central American markets; the process of embeddedness has network and relationship interactions among NGOs, laborers, consumers, firms, and states (Hess and Coe, 2006; Coe et al., 2008).

2.2 Literature Review

2.2.1 GPN and Mobile Telephones.

Mobile telephones have a social arrangement the daily activities of people all across the globe. The mobile telephone is embedded in the social life of humans. We communicate with our love ones through the device. The mobile device helps us plan and track events with calendars, it allows us to respond to personal discussions via email, and allows us to interact with friends through social media. In addition to being

embedded in human social life, the mobile device is embedded in the economic activities of humans and businesses. Prior to buying a home or car people may browse a selection of homes and cars via their smartphone; they may or may not make purchase online, however, the option to make the purchase is available and many people actually do purchase these items online with their smartphone. Grocery shopping and buying clothes are performed via the smartphone; we make the selection of our goods, we make payment and submit the order for our goods, and our goods are delivered to our doorstep. The mobile device is embedded in the activities of firms. Employees are provided with the mobile device to conduct business related transactions. Employees provided with the device communicate with their clients and managers, they make sales of products, and contact other firms to perform business transactions. This research is concentrated on GPN's embeddedness of mobile telephones in society and economic activities.

2.2.2 Firms Collaborating.

Firms collaborating in research and development are research partners. Research partners are similar to strategic alliances. A research partnership is an innovation rooted relationship involving a major endeavor in research and development (Hagedoorn et al. 2000); and, prior successful research partnership endeavors can lead to agreements in other activities along the supply chain of a product such as the product design phase (Gulati, 1999), due to a firm having prior exposure of a network resource such as knowledge of a firm's product. It is very difficult for firms to remain competitive and perform all functions along the supply chain in-house. In modern times, it is better for a

firm to form an alliance of strategic partnerships, to establish a global production network, which would allow the necessary business skills, technological capabilities, knowledge capacity, and resources to flow through each supply chain management function, maximizing revenue and profit. Global production networks, joint ventures, strategic alliances, and global value chains require coordination, trust, commitment, promise, alignment, and collaboration (Gulati et al., 2012); they even require contracts. Any firm(s) involved in the global production network, strategic alliance, joint venture, or global value chain who reneges on their agreed commitment to take part in a supply chain process will cause delay in the product moving downstream on the supply chain towards the customer.

2.2.3 Mobile Telephone Brands.

Large mobile telephone handset brand names like Apple, HTC, and Samsung focus on its global marketing strategy and trust its contract manufacturer(s) to produce its mobile telephone handsets (Luthje, 2006; Chan et al., 2013). Brands have an influence on people of different cultures; Westerners and Easterners are analytical and holistic thinkers respectively (Monga and John, 2007; Monga and Williams, 2016). Monga and Williams (2016) demonstrated varied situational variables can influence consumer behavior patterns. Studying consumer behavior patterns in the marketplace has led scholars to see Westerners and Easterners purchase mobile telephone handset brands based on prestige, popularity, quality, and aesthetics (Moslehpour and Le Huyen, 2014). Therefore it's imperative for mobile telephone handset brands such as Apple, HTC,

Samsung, and the like to focus more on marketing strategies of its brand image in order to influence consumer purchasing behavior, and then outsource the manufacturing of mobile telephone handsets to contractors. Considering that the mobile telephone handset market is global, it is in the best interest of multinational firms such as Samsung and Apple to outsource or offshore the manufacturing portion of its mobile handsets to those nations that can offer cost savings (Baden-Fuller et al., 2000; Lewin and Cuoto, 2006; F.J. Contractor et al., 2010). Popular mobile telephone carriers in Central America, such as Movistar, Claro, Digicell, and Tigo, sell mobile telephone handsets (Samsung, Lenovo/Motorola, LG, Huawei, etc. are mobile telephone handset manufacturers) manufactured in other countries (China, Vietnam, Korea, India, etc. are countries where mobile telephone handsets are manufactured). In 2014 India's government launched an initiative called "Make in India" in order to attract multinational enterprises to manufacture electronic devices in its country; firms such as (HTC, Samsung, Lenovo, etc. are mobile handset manufacturers) have entered into agreements with contract manufacturers (Flextronics, Foxconn, Global Devices Network, etc. are contract manufacturers) in order to take advantage of reduced labor and logistics costs offered by India versus doing business in China (Suresh and Sharma, 2016). Foxconn is the manufacturer of the iPhone and is able cut prices on materials, production capacity, and logistics, in order to maintain its appeal to Apple (Chan et al., 2013). Sophisticated distribution channels are in place for these mobile telephone handsets to depart manufacturing facilities in China, South Korea, Vietnam, or India and arrive in a timely manner in Central America. Each part of the mobile telephone handset's journey from

Asia to Central America requires coordination, the process of interaction that integrates collective actions of the organizations involved (Okhuysen and Bechky, 2009).

Integration among the economies was supported by allowing national citizens of one Central American nation automatic citizenship in another Central American nation (O'Keefe, 2000). Although some parts of the region have more crime than others, overall the crime creates a negative view of the region. The general public can suffer consequences that result from criminal activity, violence, and gang related actions. Since these negative actions bring about negative consequences, job opportunities in the marketplace are driven away or not even brought to the nation. Prior to the SICA treaty an agreement was made to stimulate industrial growth using the Central America the Central American Common Market (CACM); the regional trade agreement was created between Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua in order to improve economic conditions within the region (O'Keefe, 2000). However, this regional trade agreement was put to an end due to disputes between the nations involved. Nicaragua and Honduras viewed the trade agreement as unequal and mainly benefitting the nations of Costa Rica and Guatemala (O'Keefe, 2000). But in order for the economic integration system to work long-term for the participating countries, all nations that partake in the Central American Integration System treaty have to set aside any prior disagreements, nations should exercise respect towards the other nations at all times, nations should abide by the laws established in the FTA, nations should abide by the rulings of the Central American Court of Justice, and the Central American Bank for Economic Integration should provide equal funding and financing of projects to the public and private sectors all full member nations of the FTA.

Ranking the eight countries according to 2015 purchasing power parity (PPP) per capita shows that Panama, Costa Rica and Dominican Republic are the top three wealthiest within the Central American Integration System:

Table 1. Ranking SICA markets based on 2015 Purchasing Power Parity per capita

Panama	$21,634.56
Costa Rica	$15,534.03
Dominican Republic	$13,347.97
Belize	$8,338.99
Guatemala	$7,704.20
El Salvador	$6,275.84
Nicaragua	$5,018.76
Honduras	$4,849.30

Source: World Bank

2.2.4 Digital Divide, Adoption and Usage.

Digital divide is the difference in access to technology between different segments of the population. Mobile telephone usage is the method or manner in which a mobile telephone adopter uses a mobile telephone. South Korea has one of the highest levels of smartphone penetration rates among all Organization for Economic Cooperation and Development (OECD) nations according to the Pew Research Center; this allows South Korea to have one of the lowest digital divides among its people when compared to other developed mobile telephone subscription markets. This is probably due to a combination of S. Korea's small land-size, population density, and its great technological infrastructure; this combination allows S. Koreans to have access to the latest technology at a higher rate of diffusion versus other OECD countries. China, a much larger country, is divided into three major regions: Eastern, Central, and Western (Hu and Wang, 2006); it also has the largest mobile telephone market on the planet (Cheng and Chen, 2016; MIIT China, 2014); China's mobile telephone rate of diffusion would more than likely be slower, and it would take longer to reduce its digital divide versus other developing and

developed nations. Loo and Ngan, (2012) used IT for development to explain the digital divide in China, where the nation is divided into rural areas, and smaller and larger cities; the authors recognized three areas of digital divide that causes concern: hardware factors, software factors, and other factors like economic and technological literacy factors. China's mobile telephone penetration rate improved substantially after the year 2000, probably due to improved technological infrastructure and an upsurge of prepaid accounts (Zhang and Prybutok, 2005). However, the question that remains is "What's driving the phenomenal growth of mobile telephone subscriptions?"

The one driver of mobile telephone subscription growth that stands out from most is the advancement of technology within the telecommunications industry. As the technology advanced from 1G (first generation of mobile communication devices used analog signal transmission), to 2G (second generation of mobile communications devices operated based on wireless technology), to 3G (third generation of wireless mobile telecommunications technology), and to 4G (fourth generation of wireless mobile telecommunications technology) the adoption and diffusion rate of the mobile telephone device has grown exponentially. In the early stages of mobile telephone diffusion the lower, middle and upper class segments of the population were not all able to afford the mobile telephone device. According to Wei (2001) technological improvements has since made the mobile device more affordable, by decreasing the manufacturing costs of the device itself and lowering the cost to provide wireless service provided by a network carrier that is necessary for its use. In Wei (2001) adoption theory is discussed in regards to the non-adopters of the mobile telephone where it was reported that for those who

don't use or own a mobile telephone are the same people who are not likely to be using other forms of technology.

Since 2001, the mobile telephone has become more of a permanent part of modern society and schools are now providing students with the opportunity to become even more comfortable and skillful using other forms of technology and mobile devices by way of creating classroom curriculums that contain courses requiring the daily use of mobile technology devices. In Australian schools Pegrum, Oakley, and Faulkner, (2013) used interviews on staff members at schools to study mobile handheld technology adoption in Australian schools. Australia's government formed an initiative called the Digital Education Revolution to motivate the merging of information and communication technologies (ICTs) in its schools' curriculum; this billion dollar initiative encourages creativity and communication amongst other effects with ICTs and smartphones. Smartphone is defined by Jeon et al., (2011) as "a mobile telephone that offers more advanced computing ability and connectivity than contemporary basic feature telephone; smartphones run complete operating system software providing a platform for application developers." Eigenmann and Vaz, (2015) defined smartphone as a mobile telephone fabricated on a mobile operating system, that has additional advanced computing capability and connectivity than a basic feature mobile telephone would be equipped with. Primary, secondary, and collegiate schools of Very High Human Developed (VHHD) countries are more inclined to have students enrolled that are skillful at using advanced capability computing devices such as smartphones and tablets for purposes of emailing, accessing social networking sites, or browsing the Internet for leisure activities,

business or job opportunities. According the Pew Research Center, eighty eight percent of South Koreans own a smartphone.

Mobile telephone adoption is a person taking on the use of a mobile telephone device in order to conduct telephony activities while on the go. Those nations with high Internet usage tend to be markets that lead in smartphone adoption. Cultural differences among nations have been observed when focusing on mobile telephone adoption patterns; using Hofstede's cultural dimensions Lee et al., (2013) studied adoption of mobile telephones in South Korea and the U.S for two cultural extremes. The article discussed how cultural differences of Type 1 (Individualism, Low Uncertainty Avoidance, and Short-term Orientation) and Type 2 (Collectivism, High Uncertainty Avoidance, and Long-term Orientation) affect mobile telephone adoption, where Type 1 culture is a civilization that gives high regards to the individual view, and Type 2 culture is a civilization that gives high regards to the social view or collective belief of society. Like Hofstede's cultural dimension model, the Bass model can also be used to study the adoption rate of mobile telephones for a particular country. Islam and Meade (2012) used a nonlinear mixed model to estimate a generalized Bass model on the diffusion of 3G mobile telephones in 35 countries; in addition to ideas of cross-country differences being conveyed, the authors found the impact of intense competition on the prospects of adoption and market growth as well.

There are many usages of the mobile telephone, and one of the first widely embraced features of the mobile telephone was short messaging service (SMS). Studying cultures in developing and emerging economies, (Sey and Ortoleva, 2014) used postcolonial cultural theory (Appadurai, 1996) to discuss SMS usage leading to play. In

the past the lower class population were less likely to own a mobile telephone than the upper or middle class. The recognition of this mobile telephony adoption difference sparked much research interests in the area of digital divide between segments of the population. Rice and Katz (2003) using a national survey studied Internet and mobile telephone usage to research and analyze three different kinds of digital divides. In regards to the digital divide of mobile telephony the authors showed income, marital status, and work status played a role in one being a mobile telephone user or nonuser; the study also revealed mobile telephones can be used to save lives as well as organize demonstrations by groups. Using a dynamic panel data modeling type of framework (Akematsu, Shinohara, and Tsuji, 2012) conducted an empirical analysis of the factors promoting 3G mobile telephone use among Japanese users. In 3G and 4G mobile telephone diffusion Japan and South Korea have been leaders among other OECD markets. From an entrepreneurship perspective, Ling et al. (2015) discussed the main use of mobile telephones by tricksaw operators, who transport people and products, in Myanmar.

The ability to use the Internet with ease on smartphones can encourage mobile telephone adoption in the younger generation. Leapfrogging theory, where a novel Internet user accesses the Internet using a mobile telephone instead of the traditional method of accessing the Internet via a computers, and used by (Puspitasari and Ishii, 2015), demonstrated that in Indonesia younger and more educated people tend to connect to the Internet via smartphones than any other method; accessing the Internet via the smartphone can be a substitute for the strategy having a combination of fixed line telephony and broadband Internet services in the home, due to Internet users desiring to

browse the World Wide Web while on the go. There are many reasons why people are more inclined to adopt the mobile telephone device while abandoning the fixed telephone line and broadband services in the process. This process of adopting the mobile telephone and substituting fixed line telephony for mobile telephony shows an advancement of society as well as an advancement of technology to keep pace with the demands and lifestyle of the people who use mobile telephone users.

2.2.5 Fixed-Line Substitution for Mobile Telephony.

Mobile telephony adoption and usage has been the reason for declining use of fixed-line telephony. Grzybowski and Verboven (2016) discovered high fixed-line telephone to mobile telephone substitution, and fixed line telephony would be used more often if it weren't for the success and popularity of the mobile telephone. The smartphone and even the basic feature mobile telephone are two extraordinary devices that have found a significant role in society that's difficult to eradicate. Broadband Internet services has become remarkably faster and more reliable, however broadband Internet services accompanied with the fixed line telephone just isn't enough to thwart the adoption and rapid diffusion of the mobile telephone device.

Switching costs are the shortcomings that a consumer accepts from substituting goods or services (Chen and Hitt, 2002; Maicas et al., 2009); although customers can incur switching costs for fixed to mobile substitution, customers are willing to pay this fee in order to abandon fixed telephony service and make the switch. The switching costs can be monetary or non-monetary in value, and the monetary or non-monetary costs can

be high or low. Non-monetary switching costs can be likened to opportunity costs, and the high or low costs can depend on the range of cognitive and or social connection the user has with the service that is being substituted. Not only can customers incur costs when they switch between mobile telephone service providers but they may also face monetary and non-monetary switching costs going from fixed telephone service to mobile telephone service (Hoernig, Bourreau, and Cambini, 2015), where Hoernig et al., (2015) looked at fixed to mobile telephone substitution from the view of the waterbed effect and determined that termination rates influences mobile subscription substitution and landline discontinuation. Termination rates are the financial fees payed as a result of switching to new service (e.g., fixed to mobile substitution or mobile to mobile subscription substitution), the disadvantages gained from switching to new type of service, or the advantages lost due to switching from the old service to a new type of service. The financial fees, disadvantages and advantages that are likely to be gained or lost as a result of the switch have an effect on the decision of customers that desire to switch from fixed-line service to mobile telephone service. For instance, unlike the mobile telephone, fixed-line service doesn't offer customers an option to make telephone calls while on the go. This ability to make telephone calls on the go could have a greater effect on the customer and be considered a high termination rate the customer will likely face when switching from mobile telephony to fixed-line service. In addition to calling and receiving calls on the go, the basic feature mobile telephone and smartphone offer the ability to browse the Internet, send and receive email, password protection verification, pay bills, navigate directions, and capture moments of life through camera or video recording options. Mobile and fixed-line telephony was studied using survey research

and the waterbed effect, and prior to year 2000 the mobile telephone and fixed-line telephone were complementary items (Vogelsang, 2010); however, since the year 2000, mobile telephones have become substitutes for fixed-lines. An increase in access to mobile technology due to improved mobile telephony infrastructure and development has allowed the substitution process to proliferate at a very fast pace.

2.2.6 Mobile Telephony Infrastructure.

Scholars have written on the various themes within the topic of telecommunications infrastructure required to bring mobile telephone service from its source to the end user. Expanding telecommunications infrastructure within a Medium Human Development Index nation may improve that nation's economic output. Donou-Adonsou et al., (2016) performed a study on telecommunications infrastructure in Sub-Saharan Africa using an instrumental variable generalized method of moments on a panel of 47 nations; the study showed an increase in economic output when developing telecommunications infrastructure for the nations of Botswana, Ghana, Republic of the Congo, and South Africa. These Sub-Saharan nations can be likened to some Central American nations: El Salvador, Guatemala, Honduras, and Nicaragua; the Sub-Saharan and Central American nations are ranked similarly as Medium Human Development Index (MHDI) according to the 2015 Human Development Report. In order to increase economic development in Jordan its government launched an initiative that focused on computerization and e-Government. e-Government is defined as the joining of the government with its inhabitants, companies, and other shareholders via personal

computers, laptops, smartphones, and the Internet (Al Nagi and Hamdan, 2009). The goal of the initiative was to create transparency of government bureaucracies and organizations in order to bring about clarity with the people of Jordan. This initiative in particularly focused on e-Government transactions that were Government-to-Government (G2G) transactions, Government-to-Business (G2B) transactions, and Government-to-Citizen (G2C) transactions according to Al Nagi and Hamdan (2009).

Countries that have good e-Governance (i.e. United States, Canada, Japan, and France) tend to be nations with good telecommunications infrastructure and are more likely to receive foreign direct investment from private or foreign investors. Therefore, oftentimes the incumbents in a particular telecommunications sector will wait for the government or an investor to make that initial investment when developing infrastructure in the telecommunications industry. The initial investment in telecommunications infrastructure will usually benefit other telecommunication firms within the industry; and regulation has an impact on the incumbent's incentives for investing in next generation access infrastructure (Tselekounis and Varoutas, 2013). If the industry is highly regulated this forces the incumbent to not invest in NGA networks because the incumbent fears they have to charge the entrant(s) a cost-based price for access to the network instead of being able to charge a premium price to the entrant. Therefore the entrant is free-loading because they didn't make the significant investment nor do they have to pay a high rate for access. Tselekounis and Varoutas, (2013) presents a model that shows how much regulatory uncertainty affects the incumbent's incentive to invest in infrastructure; if the incumbent can bring high quality service to the marketplace it can foreclose the entrant from the market because customers will choose the more reliable

service. In addition to telecommunication network infrastructure being improved, the infrastructure and manufacturing of mobile telephones improved as well.

Mobile telephones began as a device only made for sending and receiving telephone calls while on the go; in the 1990s text messaging services was added to the mobile telephone. These two basic features were expensive services that accompanied the convenience and luxury of owning a mobile telephone. In the US mobile telephone carriers charged per minute talk and text messaging fees that, when coupled with a lack of wireless network infrastructure made owning a mobile telephone very pricey. However, talk and text messaging prices reduced when network infrastructure was enhanced from 1G to 4G LTE, and mobile telephone handsets became capable of performing many more functions in addition to allowing the user to talk and text. Enhancing mobile network infrastructure and mobile telephone handsets permitted superior connectivity to the Internet via the mobile telephone. The increased capabilities of the mobile telephone that a user has such as online shopping, video streaming, online banking, high quality video recording, downloading and installing applications, navigating guide, social networking, mobile gaming, and mobile hotspot ability increased the likelihood one would substitute the use of a fixed-line telephone for the mobile telephone (Rennholf and Routon, 2016).

The best qualities of the basic feature mobile telephone in the late 1990s and early 2000 were its talk and text messaging capabilities. With the transformation of the basic feature mobile telephone into the smartphone, features such as talk and text messaging has almost become unlimited standard services offered with postpaid and prepaid mobile telephone accounts in VHHD markets; often in those HHD, MHD, and LHD markets

mobile telephone carriers charge by minutes used to talk and or text for postpaid or prepaid mobile telephone accounts. However, in VHHD markets mobile telephone customers began taking advantage of the opportunity to use unlimited data; then in 2011 it was reported in the NY Times newspaper wireless carriers AT&T and Verizon were throttling the data usage of its mobile telephone customers. Throttling is the practice of slowing the Internet download speed of the mobile telephone user. Since more people are accessing the Internet via the smartphone wireless carriers in VHHD markets are primarily paying attention to the amount of data that is used by the mobile telephone account holder.

Data and content downloaded from the Internet is measured in gigabytes; therefore anytime one accesses and downloads information from the Internet, it is considered data usage. The download speed of the content from the Internet is based on the wireless carrier's network (i.e., 3G, 4G, 4G LTE, or 5G). Wireless carriers charge per gigabyte data used on the mobile device for most postpaid mobile accounts; they have also begun to adopt this practice for prepaid mobile accounts as well. In the US, prepaid mobile accounts are sometimes provided a service that allows an amount of data usage for one month and are usually provided with unlimited talk and text messaging use. However, in the developing countries of Central America, this is not the case. This practice of wireless carriers allowing mobile telephone customers unlimited talk and text messaging is not widespread as it is in the US. For example, in Belize, DigiCell mobile telephone customers can purchase unlimited talk and text for a specified price from 9 p.m. to 7 a.m. for an extra cost in addition to their current service.

Investment in mobile telephone handset infrastructure was necessary for the high adoption and penetration rate in countries today. As a result of the continuous improvements in the design of the basic feature mobile telephone handset, the industry innovated a smartphone that has added more reason to substitute the mobile telephone for the traditional landline telephone; this is due to the smartphone containing more features and allowing the user to perform more actions while on the go. Today's smartphones have the capability of being a mobile Wifi hotspot for a laptop computer or other electronic device. In the smartphone's "Settings" menu, initiating the mobile Wifi hotspot service is just a matter of ticking a box or swiping the Wifi prompt from "Off" to "On"; the other minor step involves creating a password for security purposes. However, in a few easy steps a smartphone owner or user can connect one or multiple devices to the Internet. This type of smartphone capability creates more reason to abandon fixed broadband service, which is delivered via digital subscriber line (DSL), cable modem, fiber optic technology, satellite, or wireless. If one creates the mobile Wifi hotspot in the home via a smartphone, broadband Internet service is not needed in the home. Broadband Internet service providers offer mobile broadband Internet service via Universal Serial Bus (USB) or a wireless card that connects to the electronic device in order to challenge the smartphone's built-in capability of creating a mobile Wifi hotspot for other electronic devices while on the go. Although mobile broadband Internet service can be created using a USB or wireless card, it does not come close to delivering the greatest amount of freedom to the user that emanates from the smartphone. This is usually the situation in developed and Very High Human Development (VHHD) countries such as the Germany, South Korea, and the United States. However, in High Human Development (HHD)

countries broadband Internet and fixed-line telephony are the dominant services provided to the inhabitants and businesses of the country. All over Central America fixed broadband Internet service is offered. There are projects that expand broadband Internet service and fixed-line telephony to public facilities and homes in areas throughout Costa Rica that currently lack these services. The projects are introduced by the National Telecommunications Fund (FONATEL), which has the mission to promote universal access as well as deliver telephony and Internet throughout the entire country.

2.2.7 Telephony Policy and Regulation.

One entity cannot be solely responsible for regulatory problems that have an effect on broadband Internet services, fixed-line telephony or mobile telephony; policy, regulation, government initiatives, global standardizing organizations, and marketplace competition in the telecommunications industry can influence the growth of broadband Internet adoption and mobile telephony growth. Two-sided market is defined as a meeting place where two sets of agents come together and interact through a medium (Genakos and Valletti, 2015). When observing the events that take place between two agents in mobile telephony competition, using waterbed effect, it is argued that regulators need to account for both sides of the market competition (Genakos and Valetti, 2012). A mobile telephone payment system in Asia was studied, and the authors argue that regulation affects the telecommunications industry structure. According to (Miao and Jayakar, 2015) there's a distinct difference between China's mobile payment platform and Japan and South Korea's mobile payment platform. Miao and Jayakar, (2015)

observed mobile payment systems in China, Japan, and South Korea comparing business models of the three markets; using this view, they argue that regulation affects the industry structure differently for each of the three markets. Oftentimes regulation is not aligned with current technological communications and certain areas of ICT are affected as a result; (Bauer, 2014) uses the theory of platform markets and systems approach to assess their potential contribution to the development of a forward-looking framework for ICT governance. Policy reform has been proven as a method to lower the digital divide. However, there needs to be a balance of regulation on the industry. Using the information and communication technology (ICT) distributional position in 154 countries, Howard and Mazaheri, (2009) observed the effects of four policy reform plans on a market's share of Internet bandwidth, Internet hosts, Internet users, personal computers, and mobile telephones; the policy reforms are to privatize the national telecommunications provider, break-up the telecommunications' provider's domestic monopoly over the consumer services market, grant a regulating agency autonomy from direct political supervision, achieve more than partition the regulator from the head of state in regards to legally disclosing relationships and to successfully depoliticize the agency. The authors also showed that regulatory autonomy alleviates the digital divide, and that too much regulatory abandonment augments the digital divide.

Many governments are focusing on developing initiatives that alleviate the divide between those who have access to the Internet and those who do not have access to the Internet. According to the ITU mobile telephony subscriptions worldwide have outnumbered fixed-line telephony for over ten years; and some governments believe that by improving next generation access (NGA), fixed-line broadband service can reduce the

occurrence of switching from a fixed-line to a mobile service. According to Beltran (2014) one of the motives customers in the VHHD markets of Australia and New Zealand began making the switch from fixed-line broadband service and going to mobile telephony service was to obtain better Internet service; and the author discusses how Australia and New Zealand can improve the quality of fixed-line broadband services while making it accessible to more people. This article pertains to the path used by the governments of Australia and New Zealand to improve its next generation access networks as well as the policy and market concerns that affect these improvements. Using the market failure approach (Beltran, 2014) demonstrated using public funds to improve NGA signaled a lack of trust in market competition to bring about improvement(s) in next generation access infrastructure.

The broadband infrastructure initiatives by the governments of Australia and New Zealand are similar to the government initiative of the HHD market, Costa Rica. The initiatives of the Australian, New Zealand, and Costa Rican markets are similar in regards to the governments of all three markets having the mission to expand broadband services throughout the entire country as well as to give its inhabitants better quality Internet service than previously experienced. In the case of the two VHHD markets, Australia and New Zealand, they have Gross National Incomes (GNI) per capita, Purchasing Power Parity (PPP) of $44,570 and $35,580 respectively according to The World Bank for 2015; the world average GNI per capita, PPP is $15,529.50. Therefore Australia and New Zealand have relatively high incomes per capita than most nations. This high income coupled with low unemployment rates of 5.80 and 4.90 for year 2015 in Australia and New Zealand respectively suggests these well developed economies have inhabitants who

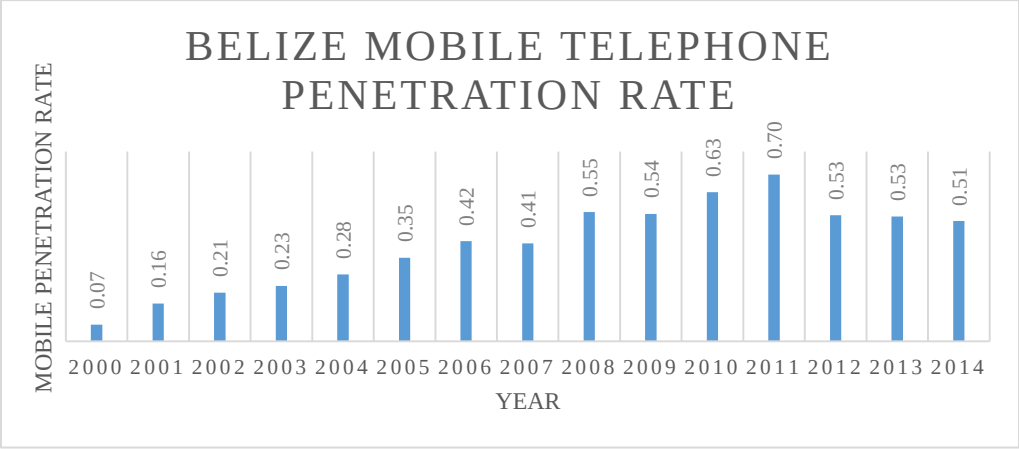
are likely to own a smartphone, but they also desire to access the Internet within the home without using a smartphone. For 2015 year, the HHD market of Costa Rica has a GNI of $14,910 and an unemployment rate of 9.7. According to the World Bank twenty-three percent of inhabitants in Costa Rica, do not reside in an urban setting. The Superintendencia de Telecommunicaciones (Superintendent of Telecommunications) in Costa Rica intends to bring broadband Internet to those regions with the greatest socio-economic disadvantage; twenty-four of these regions have inhabitants who are indigenous people of Costa Rica according to the Superintendence of Telecommunications. Within the indigenous communities are schools that need Internet access. Some people believe that the private sector will not invest in telecommunications in these indigenous regions of Costa Rica due to issues with land ownership rights. This coupled with a higher level of unemployment makes it more likely for the government to implement its initiative and propagate broadband Internet services to the rural population at a reasonable cost throughout Costa Rica.

2.2.8 Telecommunications Regulation and Policy for SICA Markets.

Belize's telecommunications market is regulated under the authority of Belize Telemedia Limited (BTL), and BTL creates and enforces all policy for Belize's telecommunications industry. Since Belize has a small mobile telephone subscription market there are two dominant telecom operators, Digicell and Speednet. These two firms are granted license to be telecom operators in Belize by BTL. Regulation and policy dictates the access to mobile technology on the user side as well as influences investment

in infrastructure on the supplier side of the product offering. Therefore policy and regulation amongst other factors can influence the mobile telephone penetration rate in a market. Belize has the lowest mobile telephone penetration rate among all SICA markets. Figure below shows Belize's mobile telephone penetration rate since 2000.

Figure 3. Belize mobile telephone penetration rate

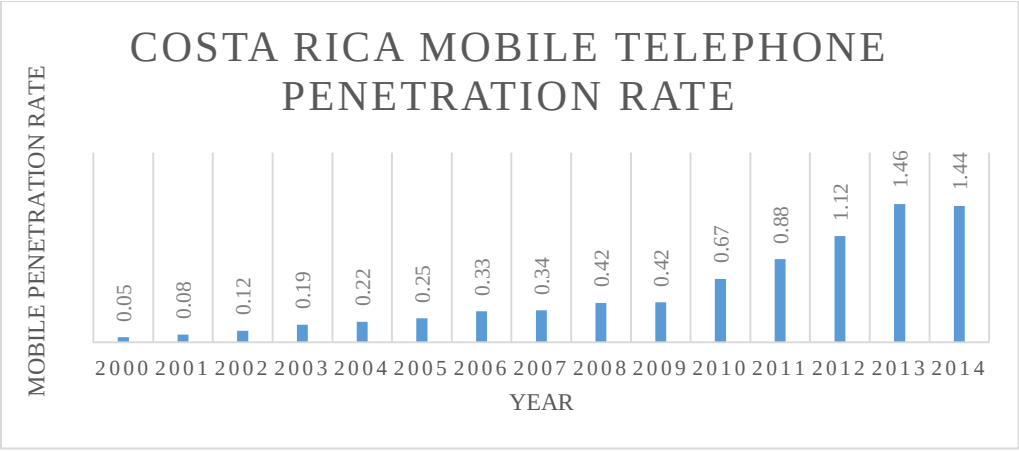


Belize, an HHD economy, ranks eighth in population and has the smallest mobile telephone subscription market in SICA. In addition to being the smallest mobile telephone subscription market, Belize has the lowest mobile telephone subscription rate of 48.907 (per 100 inhabitants) and this subscription is the lowest in SICA. The country saw its highest mobile telephone penetration rate in 2011 at 70 percent; however since 2011 its mobile telephone subscription rate has declined. Fixed-line telephony in Belize has also been on a decline and is approximately six fixed telephone subscriptions (per 100 inhabitants). According to Grzybowski and Verboven (2016) as fixed-line telephony decreases, mobile telephony increases; but this is not the situation with Belize. The mobile telephone subscription market in Belize is dictated by Digicell. Digicell operates under the authority of Belize Telemedia Limited (BTL). Since Belizeans' have a fixed

broadband subscription (per 100 inhabitants) rate of 2.877 and an Internet user (per 100 inhabitants) rate of 41.59, this shows that Belizeans are likely to be accessing the Internet via a smartphone or at a public facility's desktop such as a library. Fixed broadband Internet subscriptions rate (per 100 inhabitants) in Belize is 2.88; this is a rate that is similar to Guatemala's fixed broadband Internet subscriptions rate of 2.83.

Costa Rica's telecommunications industry has its policy and regulation created and issued by the Superintendencia de Telecommunicaciones (SUTEL). SUTEL uses the National Telecommunications Fund (FONATEL) to develop projects that expand broadband Internet service and fixed-line telephony to public facilities and homes in areas throughout Costa Rica that currently lack these services. The telecom operators licensed to bring telephony services to Costa Rica are Claro (owned by América Móvil), ICE Cellular, and Movistar (owned by Telefónica). Costa Rica's mobile telephone penetration is influenced by SUTEL's policy and licensed telecom operators; its mobile telephone penetration rate from 2000 to 2014 is shown below in the figure.

Figure 4. Costa Rica mobile telephone penetration rate

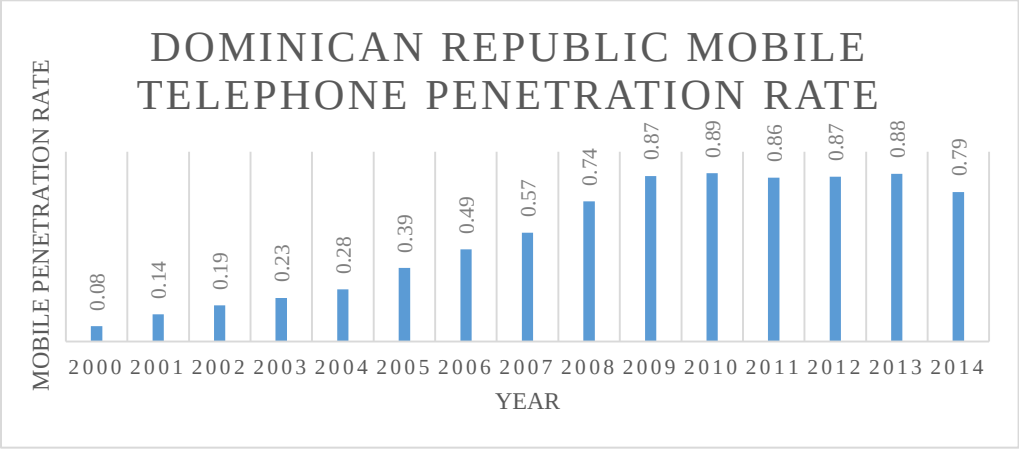


Costa Rica and El Salvador both had the second highest mobile telephone penetration in 2014 among all SICA markets; in 2015 its mobile telephone penetration

rate increased to 1.51 and again is second to Panama's market. Costa Rica's market is a low population market with a high number of mobile telephone subscriptions. Costa Rica has the highest Internet usage among all SICA markets. The broadband Internet usage rate in Costa Rica is current at 60%, and the world average is roughly 43%; this includes accessing the Internet via computer and mobile telephones (Individuals using the Internet % of population, 2016).

Dominican Republic has the Instituto Dominicano de las Telecommunicaciones (INDOTEL) that regulates and enforces policy for its telecommunications industry. INDOTEL also supports the expansion of telecommunications infrastructure to areas that are economically and socially disadvantaged in Dominican Republic using the Telecommunication Development Fund (FDT). The telecom operators in Dominican Republic are Claro (owned by América Móvil), Orange (owned by France Telecom), Tricom, and Viva (owned by Trilogy Internation Partners). Dominican Republic's mobile telephone penetration is influenced by INDOTEL's policy and the licensed telecom operators; its mobile telephone penetration rate from 2000 to 2014 is shown below in the figure.

Figure 5. Dominican Republic mobile telephone penetration rate

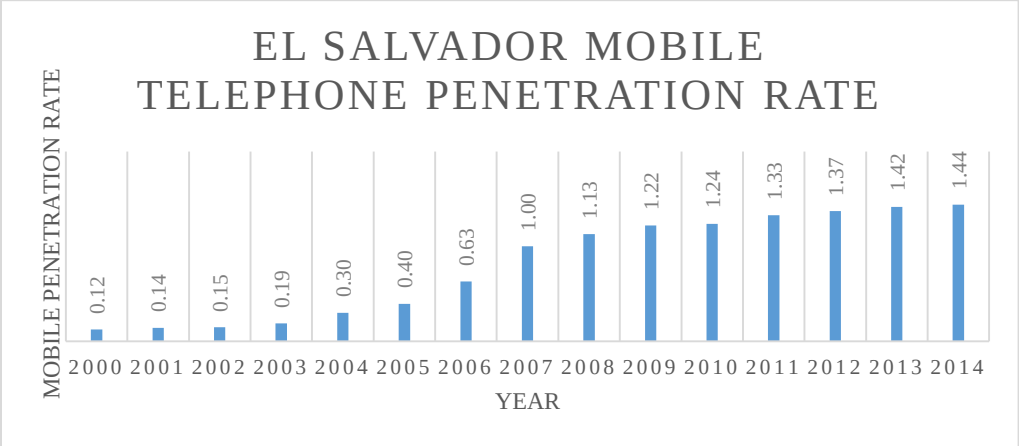


Dominican Republic is a HHD market and ranked seventh in mobile telephone subscriptions (per 100 inhabitants) among the eight SICA markets in 2015; and although the market is the second most populous in the Central American Integration System, the country's number of mobile telephone subscriptions (per 100 inhabitants) does not reflect its population when compared to the population of other SICA markets with a high population. When using GDP to measure the size of a nation's economy, Dominican Republic ranks first in the Central American Integration System, and also it has the second largest population among all eight markets. However, with the exception of Belize, all other SICA markets have a mobile telephone penetration rate greater than Dominican Republic. According to the World Bank, in 2015 Dominican Republic had a double-digit unemployment rate of 15 percent, and its unemployment rate is higher than any other market in the Central American Integration System. This low unemployment rate could be a contributor to the low mobile telephone rate. Another market in the Central American Integration System with a low mobile telephone penetration rate and double-digit unemployment is Belize.

El Salvador has a regulatory body leading its telecommunication industry, the General Superintendence of Electricity and Telecommunications (SIGET). In addition to SIGET, El Salvador has the Legislative Assembly, the Telecommunications Law, the National Telecommunications Administration (ANTEL), and the Wireless Telecommunications Service (INTEL) that is responsible for policy creation, the terms and application of a telecommunications law, wired and wireless telephone service in El Salvador. The telecom operators licensed to deliver mobile telephone service to El Salvador are Claro (owned by América Móvil), Digicel, Movistar (owned by Telefónica),

RED (owned by Intelfon) and Tigo (owned by Millicom). El Salvador's mobile telephone penetration is influenced by SIGET's, ANTEL's, and INTEL's policy in addition to the licensed telecom operators; its mobile telephone penetration rate from 2000 to 2014 is shown below in the figure.

Figure 6. El Salvador mobile telephone penetration rate

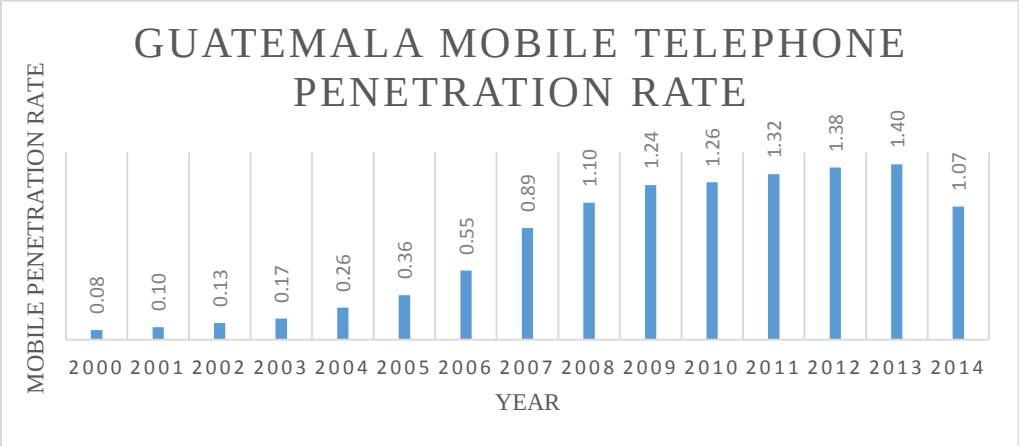


El Salvadors' rate of Internet users via computer or mobile telephone is at 27 per 100 inhabitants; this ranks the market near the bottom and only above Honduras and Nicaragua in regards to Internet usage for its population. This low Internet usage suggests that most El Salvadorians may be using a basic feature mobile telephone or they are not using the Smartphone's data, which allows the mobile telephone user to access the Internet. Like Costa Rica, El Salvador's market is a low population but high mobile telephone subscription market. El Salvador is a market that has been in the process of strengthening its government agencies and policy that allows more investment in science, technology, and innovation. Although El Salvador's wireless and Internet market is not fully developed its mobile penetration rate is well above 100 percent. This high MPR could be due to its mobile telephone subscription market competition. With four telecom

providers in the low population market, customers have an advantage and can switch mobile telecom providers when their needs are not being serviced.

Guatemala's telecommunications industry is regulated under the authority of the Superintendency of Telecommunications (SIT). The General Telecommunications Law established SIT and gives the Superintendent of Telecommunications the power to create and implement policy as well as complete control over Guatemala's telecommunications' industry. The telecom operators providing mobile telephony services in Guatemala are Claro (owned by América Móvil), Movistar (owned by Telefónica), RED (owned by Intelfon), and Tigo (owned by Millicom). The General Telecommunications Law establish The Superintendency of Telecommunications (SIT) regulates the telecommunications industry in Guatemala; SIT has granted licenses to the four telecommunications networks (Tigo, Claro, RED, and Telefónica) that provides mobile telephone service in Guatemala. Guatemala's mobile telephone penetration is influenced by SIT's policy and the licensed telecom operators; its mobile telephone penetration rate from 2000 to 2014 is shown below in the figure.

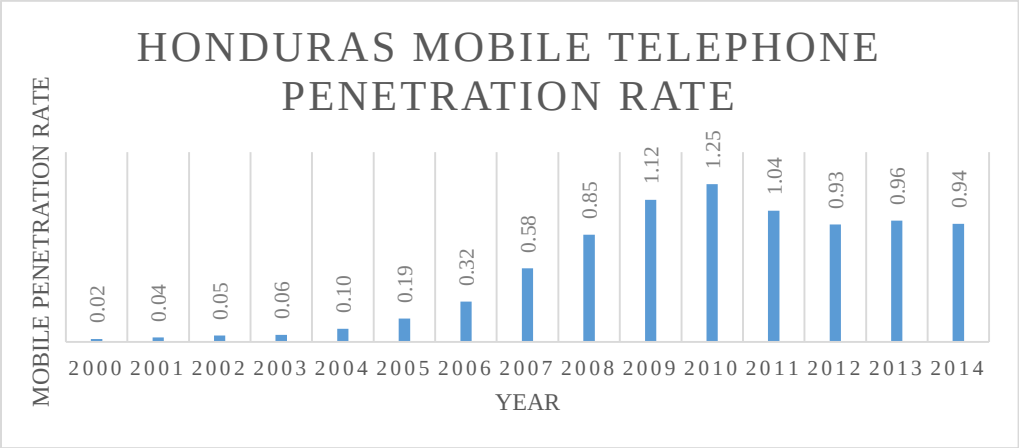
Figure 7. Guatemala mobile telephone penetration rate



Guatemala's rate of Internet users in 2015, (per 100 inhabitants) is 27.1, and well below the world average rate of Internet users (per 100 inhabitants), which is 43.998. Since only 2.83 Guatemalans per 100 inhabitants are accessing the Internet via broadband services, this suggests that either the smartphone or a public facility's desktop is the primary means of accessing the Internet. In 2014 Guatemala's mobile telephone subscription market consisted of 95% prepaid accounts (Guatemala: Cell phone market figures, 2014).

Honduras has CONATEL (La Comisión Nacional de Telecommunicaciones or The National Telecommunications Commission) that creates and implements its telecommunications policy and has also been given regulatory authority over its telecommunication industry; additionally CONATEL is responsible for reducing the digital divide and developing Information and Communication Technologies (ICT) infrastructure in Honduras. The state owned telecom operator is called the Honduran Telecommunications Company (HONDUTEL). HONDUTEL promotes competition in Honduras' broadband Internet, fixed-line and mobile telephony marketplace; other telecom operators in Honduras are Claro (owned by Américan Móvil), Digicel, and Tigo (owned by Millicom). Honduras' mobile telephone penetration is influenced by CONATEL's policy and the licensed telecom operators; its mobile telephone penetration rate from 2000 to 2014 is shown below in the figure.

Figure 8. Honduras mobile telephone penetration rate

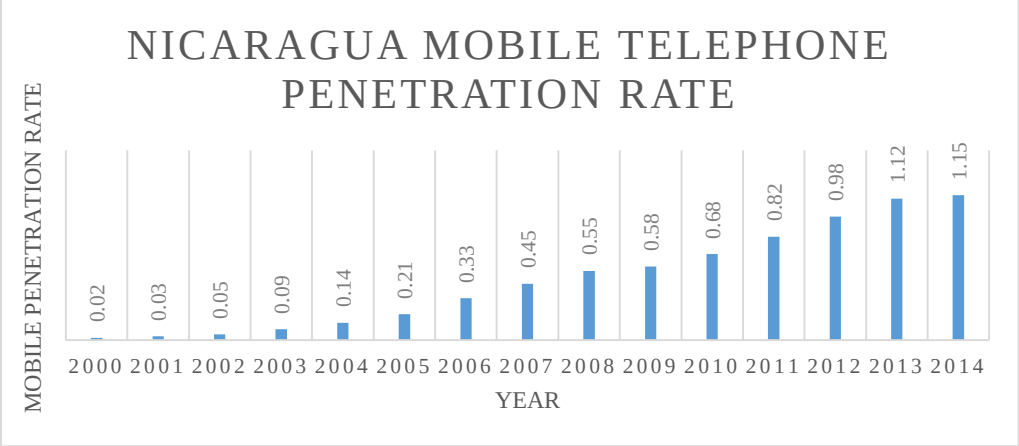


Honduras, an MHD market, has slightly increased its indicators that the HDI report uses to rank all nations; even with this slight improvement, Honduras has fallen from a MDI rank 121 in 2011 to MDI rank 132 in 2015. Among all eight SICA markets Honduras and Nicaragua have the most room for improvement for ICT policy, regulation, telecommunications infrastructure, and Internet usage among its inhabitants. In 2010, when compared to all other Central American markets Honduras had the second highest mobile telephone penetration rate, after only Panama; but for the last five years the number of mobile telephone subscriptions in Honduras has declined from its peak in 2010. The number of inhabitants using the Internet in Honduras continues to rise, and Internet usage in the country currently exceeds twenty-eight percent of the population. The majority of mobile telephone subscription accounts in Honduras are prepaid; over ninety percent of these mobile telephone subscription accounts are prepaid and fewer than ten percent are postpaid mobile telephone subscription accounts. According to the World Bank, Honduras ranks sixth among all SICA markets in mobile telephone

subscriptions (per 100 inhabitants); Dominican Republic and Belize follow after Honduras in mobile telephone subscription rank respectively in Central America.

In Nicaragua, TELCOR (Instituto Nicaraguense de Telecommunicaciones y Correos) is responsible for regulating the telecommunications sector, building network infrastructure, granting licenses, and expanding ICT service to businesses, public facilities, and its inhabitants. One of the main agendas for TELCOR is to increase Internet and mobile telephone service in the rural areas of Nicaragua that lack these services the most. The telecom operators in Nicaragua are Claro (owned by Américan Móvil), CooTel (owned by Xinwei), and Movistar (owned by Telefónica). Nicaragua's mobile telephone penetration is influenced by TELCOR's policy and the licensed telecom operators; its mobile telephone penetration rate from 2000 to 2014 is shown below in the figure.

Figure 9. Nicaragua mobile telephone penetration rate



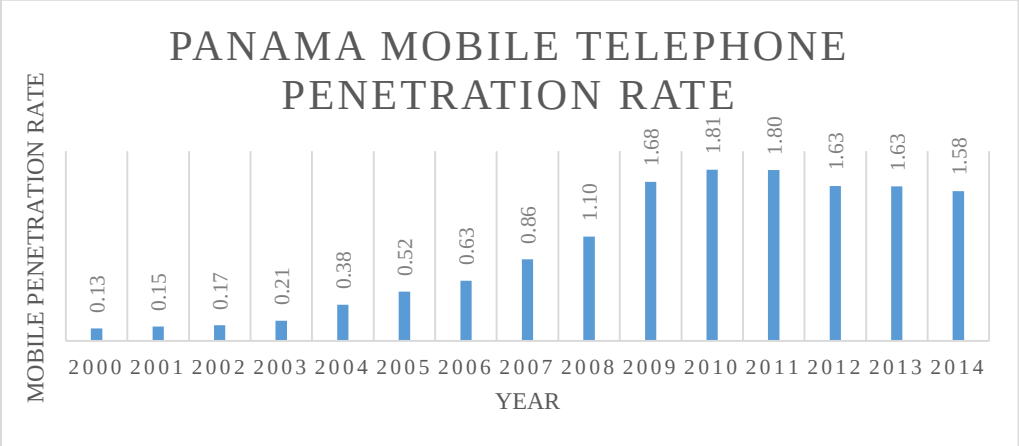
Nicaragua, a Medium Human Development market, has a GNI per capita, PPP of $5,060 for year 2015; this GNI per capita, PPP is significantly lower than the world's average GNI per capita, PPP of $15,929 and roughly $5000 lower than the average GNI of all Central American markets. In regards to the United Nations ranking of the nations

in the Human Development Index, Nicaragua has moved up ahead of several developing nations since 2012. According to the ITU, Nicaragua's 2015 mobile telephone penetration rate (per 100 inhabitants) was at 116 percent; however less than 20 percent of the population are Internet users. The ITU does not state whether less than 20 percent of the Nicaraguan population were accessing the Internet via desktop or mobile telephone. This means almost 80 percent of Nicaraguans are not accessing the Internet; and although the mobile telephone penetration rate in Nicaragua is above 100 percent, it is also means Nicaraguans are mostly using the basic feature mobile telephone. Basic feature mobile telephones are called no data plan required phones and do not allow the mobile user Internet access (www.wirefly.com). When a smartphone is the mobile device of choice for the mobile user, then the user is more prone to access the Internet via the smartphone (Madden et. al. 2013). In addition to Internet access being low on smartphones in Nicaragua, fixed-line broadband Internet service subscriptions (approximately 2 per 100 inhabitants) are low as well.

Panama, has several institutions ASEP and AIG (i.e., Autoridad Nacional de los Servicios Públicos – Public Services National Authority and Autoridad Nacional para la Innovacíon Gubernamental – Governmental Innovation National Authority) functioning to implement ICT policy and regulation according to The World Bank. ASEP and AIG coupled with private telecommunications companies in Panama come together to reduce the digital divide between its inhabitants residing in rural and urban settings. The telecom operators licensed to bring telephony services to Panama are Claro (owned by América Móvil), Digicel Panama, Movil (owned by C&WP), Movistar (owned by Telefónica). Panama, a HHD economy, ranks higher in Information and Communications

Technologies (ICT) when compared to its other Central American regional neighbors; in addition to this, Panama has the highest mobile telephone penetration rate among all SICA markets. Panama's mobile telephone penetration is influenced by ASEP and AIG's policy and the licensed telecom operators; its mobile telephone penetration rate from 2000 to 2014 is shown below in the figure.

Figure 10. Panama mobile telephone penetration rate



The mobile telephone market in Panama is competitive, and the residents have four wireless carriers (i.e., Movil, Movistar, Claro, and Digicel) to choose from for its small population. Competition is great for the customers and helps keep prices at a firm level in Panama's mobile telephone marketplace (Ford and Håkansson, 2013; Trout, 2015). According to Padilla-Perez and Gaudin, (2014) the HHD markets of Costa Rica and Panama showed the highest political and financial commitment to science, technology, and innovation (STI) institutions and policies versus the other Central American economies. Costa Rica and Panama are both emerging markets with relatively similar economic conditions such as having roughly the same GDP $54,136,830,000 and $52,132,290,000 respectively; the markets both have shaped robust institutions that are

tailored for governmental modifications and policies that cover a diverse group of telecommunications areas while the other Central American markets are either in the process of strengthening its STI institutions (i.e., El Salvador and Guatemala) or creating funding in order to finance STI institution activities (i.e., Honduras and Nicaragua).

2.2.9 Mobile Telephone Health and Safety.

Mobile telephones have been linked to health issues that could cause tumors to form in humans as well as affect their reproductive cells. Hardell et al., (2007) completed a study on mobile telephones and tumors in the brain using published studies in the literature and confirmed that there is an increased risk of the mobile telephone user developing the tumors, acoustic neuroma and glioma. Recently the United States National Toxicology Program (NTP) completed a study on the health hazards of mobile telephones, specifically focusing on the dangers of radio frequency (RF) waves being sent and received in mobile telephones using male rats. Sperm quality parameters such as motility, viability, sperm count, and morphology decreases as exposure to mobile telephones increases (Agarwal et al., 2008); this study observed the sperm quality of 361 men at a male infertility clinic. Using meta-analysis that included *in vitro* and *in vivo* studies, a reduction in sperm quality parameters such as motility and viability due to mobile telephones were confirmed hones were linked to this reduction in sperm quality (Adams et al., 2014); support of sperm death as a result of mobile telephone exposure was also talked about and made known in Yan et al., (2007). The frequency signals that mobile telephones expose humans to and transmit are based on wavelengths from the

electromagnetic spectrum. Mobile telephones use waves in the electromagnetic spectrum to transmit signals for communication. The waves on the electromagnetic spectrum consists of gamma rays, x-rays, ultraviolet waves, visible light waves, infrared waves, microwaves, and radio waves, from the shortest wavelength to the longest wavelength. Mobile telephony technology use radio waves lengths with frequencies ranging from 800 MHz to 1900 MHz. Finite difference time domain (FDTD) numerical electromagnetic method (Ghandi, Gianluca, and Furse, 1996) was used to estimate the electromagnetic absorption in the head and neck of humans for mobile telephones in the range of 835 Mhz and 1900 Mhz.

2.3 Hypotheses.

A prior study on mobile telephone adoption in Sub-Saharan African nations (Buys, Dasgupta, Thomas, and Wheeler, 2009; Aker and Mbiti, 2010) led to the development of hypotheses for this research. The prior study show that population and income are significant factors for mobile telephone adoption in the Sub-Saharan African markets. Several of the Sub-Saharan African markets in the study are Medium Human Development Index (MHDI) markets; several markets in this dissertation study are MHDI markets. It was interesting to know if these same factors, population and income, were significant factors for mobile adoption in the markets of this dissertation study. In doing so, the following educated guesses were formed:

E1. Population is a significant covariate for explaining the number of mobile telephone subscriptions in the full member markets of the Central American Integration System.

E2. Income is a significant covariate for explaining the number of mobile telephone subscriptions in the full member markets of the Central American Integration System.

The educated guesses were generalizations of the hypotheses formed in the study to answer the main research question and sub-questions. The main research question is "*What's causing mobile telephone subscription growth in the full member markets of the Central American Integration System?*" The research sub-questions were derived from the observation of some markets having a mobile penetration rate greater than 100% and less than 100%. So it was interesting to know why these markets varied in MPR. Therefore the following research sub-questions were formed; "*Why are some markets above the 100% mobile telephone penetration rate?", and "Why are some markets not above the 100% mobile telephone penetration rate?"* In formulating the hypotheses to answer these questions, 14 independent variables were chosen to explain the number of mobile telephone subscriptions in the full member markets of the Central American Integration System. The 14 independent variables were population and income variables, since the educated guesses were based on population and income factors. Since there are eight markets being studied in this research, the testing of the hypotheses were divided as four markets tested the hypotheses based on a population variable and four markets tested the hypotheses based an income variable. The SICA markets selected to be tested based on the regression model findings for a population variable were Belize, Dominican

Republic, Costa Rica, and Panama. Based on the findings, the following hypotheses were expected when testing the population covariates for each market.

The covariate being used to represent Belize's student population is Urban Population. Belize has the lowest number of student enrollment in primary education in the Central American Integration System. The following hypothesis is created for testing the covariate Urban Population:

H1: The covariate Urban Population is significant for predicting mobile telephone subscriptions in Belize.

The particular population covariate being tested for the Dominican Republic market is Rural Population. Dominican Republic has the second largest urban population in the Central American Integration System. The following hypothesis is tested for the covariate:

H2: The covariate Rural Population is significant for predicting mobile telephone subscriptions in Dominican Republic.

The population covariate tested for the Costa Rican mobile telephone subscription market is Enrollment in Primary Education. The covariate has the following hypothesis:

H3: The covariate Enrollment in Primary Education, is significant in predicting mobile telephone subscriptions for Costa Rica.

The population covariate tested for the Panamanian mobile telephone subscription market is Urban Population. Panama has the seventh largest mobile telephone subscription market in the Central American Integration System. The covariate has the following hypothesis:

H4: The covariate Urban Population is significant for predicting mobile telephone subscriptions in Panama.

The SICA markets being tested established on findings for an income based variable were Honduras, El Salvador, Guatemala, and Nicaragua. Based on the findings, the following hypotheses are expected when testing the income covariates.

The actual income covariate being tested for the Honduras mobile telephone market is Exports of Goods and Services, and it has the following hypothesis:

H5: The covariate Exports of Goods and Services is significant in explaining the number of mobile telephone subscriptions in Honduras.

The actual income covariate being tested for the El Salvadoran mobile telephone subscription market is Gross National Income Growth (Annual %), and it has the following hypothesis:

H6: The covariate Gross National Income Growth (Annual %) is significant for predicting mobile telephone subscriptions in El Salvador.

The actual income covariate being tested for the Guatemalan mobile telephone subscription market is Adjusted Net National Income Per Capita (Current US$), and it has the following hypothesis:

H7: The covariate Adjusted Net National Income Per Capita (US$) is significant for predicting mobile telephone subscriptions in Guatemala.

The actual income covariate being tested for the Nicaraguan mobile telephone subscription market is Exports of Goods and Services, and it has the following hypothesis:

H8: The covariate Exports of Goods and Services is significant in predicting mobile telephone subscriptions in Nicaragua.

Chapter III. Research Design, Data, and Methods

3.1 Research Design

The research design is quantitative, correlative, and explanatory. All data in the study was collected from the International Telecommunications Union (ITU) website for the dependent variable, the World Bank for the independent variables, and the United Nations Human Development Report 2015. Eight mobile telephone subscription markets of the Central American Integration System (SICA) were studied to identify factors contributing to mobile telephone subscription growth from 2000 through 2014. The SICA markets studied were Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama. The study performed was quantitative research that determined the relationships between the X and Y variables in these markets. Quantitative research study was carried out instead of a qualitative research due to the type of data used in this study, zero interviews were conducted, content analysis was not necessary, and the primary analytical goal was to find the variables that could be contributing to the growth of mobile telephone subscriptions in SICA markets.

3.2 Data

3.2.1 Classification of the Markets.

The United Nations (UN) measures human development of its member nations. Human development is the enhancement of choice in a human's life (What is human development, 2016). The UN uses the Human Development Index to rank nations on its ability to offer to its inhabitants a long and healthy life, knowledge and a decent standard of living. These three concepts are what the UN considers as fundamental dimensions of life. The ranking of member countries based on its offering of these fundamental dimensions of life are Low Human Development Index (LHDI), Medium Human Development Index (MHDI), High Human Development Index (HHDI), and Very High Human Development Index (VHHDI). For grouping purposes the population of all countries was summed together then divided by the number of SICA full members, eight. This procedure gives 7,050,746 as a baseline for high market population for the region and if a market's population is below this 7,050,746 then the market is considered low market population for the region. This procedure was also performed for 2014 mobile telephone subscriptions for the eight markets. The baseline for high number of mobile telephone subscriptions is 7,835,247 and if a market's number of mobile telephone subscriptions is below this amount then the market is considered to have a low number of mobile telephone subscriptions.

There are 12 indicators that are used by the UN in order to present the fundamental dimensions of life. The indicators are health, education, income/composition of resources, inequality, gender, work, employment, and vulnerability, human security, trade and financial flows, mobility and communication,

environment sustainability, and demography. In this dissertation study these 12 indicators are converted to measurable independent variables for correlation analysis and used to develop a statistical model to help explain mobile telephone subscription growth among the full members of the Central American Integration System. The Central American markets are classified as the following shown in Table 2.

Table 2. Classification of SICA Markets

HHDI Markets	**MHDI Markets**
Belize	El Salvador
Costa Rica	Guatemala
Dominican Republic	Honduras
Panama	Nicaragua

(Source: 2015 UN Human Development Index Report)

3.2.2 Dependent Variable.

The dependent variable for all eight markets was Mobile Telephone Subscriptions. The Mobile Telephone Subscriptions data for each of the eight markets was downloaded from the International Telecommunications Union's website and database. At the start of the mobile telephone subscription boom in 2000 for the Central American Integration System full member markets, Guatemala's market had the highest number of mobile telephone subscriptions; and Guatemala's mobile telephone subscription market was followed by the markets of the El Salvador and the Dominican

Republic, respectively. From 2001 through 2003 the Dominican Republic had the highest number of mobile telephone subscriptions among the SICA markets. However, since the number of mobile telephone subscriptions adopted in a market has become correlated with the total population in a market and Guatemala has the largest population among all full member SICA markets, Guatemala eventually became the market with the highest number of mobile telephone subscriptions between all full members in the Central American Integration System.

Using a market's number of mobile telephone subscriptions and its population, the mobile telephone penetration rate was calculated for each market.

Equation 1. Mobile Penetration Rate

$$MPR = \frac{\text{Total Number of Mobile Telephone Subscriptions}}{\text{Total Population}}$$

Mobile Penetration Rate is MPR and is used to determine how many mobile telephones subscriptions there are per person in a country. Total Number of Mobile Telephone Subscriptions is the number of mobile telephone subscriptions for each market from 2000 through 2014 reported by the International Telecommunications Union is listed below Table 3. Total Population is the total number of people in the market.

Table 3. SICA markets number of MTS from 2000-2014

Year	Belize	Costa Rica	Dominican Rep.	El Salvador	Guatemala	Honduras	Nicaragua	Panama
2000	16,812	211,614	705,431	743,628	856,831	155,271	90,294	410,401
2001	39,155	326,944	1,270,082	857,782	1,146,441	237,629	164,509	475,141
2002	51,729	502,478	1,700,609	888,818	1,577,085	326,508	237,248	525,845
2003	60,403	778,299	2,091,914	1,149,790	2,034,776	379,362	466,706	692,406
2004	75,000	923,084	2,534,063	1,832,579	3,168,256	707,201	738,624	1,259,948
2005	96,000	1,101,305	3,623,289	2,411,753	4,510,067	1,281,462	1,119,379	1,748,740
2006	118,000	1,443,717	4,605,659	3,851,611	7,178,745	2,240,756	1,830,220	2,174,451
2007	118,314	1,508,219	5,512,859	6,137,381	11,897,563	4,184,834	2,502,281	3,010,635
2008	160,032	1,886,570	7,210,483	6,950,703	14,948,640	6,210,711	3,108,002	3,915,246
2009	161,783	1,950,318	8,629,815	7,566,245	17,307,459	8,390,755	3,344,563	6,066,683
2010	194,201	3,128,372	8,892,783	7,700,336	18,067,970	9,505,071	3,962,247	6,646,348
2011	222407	4,153,067	8,770,780	8,316,150	19,479,105	8,062,229	4,823,534	6,735,429
2012	172423	5,378,082	8,934,196	8,649,000	20,787,080	7,370,034	5,851,723	6,213,564
2013	174615	7,111,981	9,200,410	8,991,899	21,716,357	7,767,235	6,808,930	6,297,604
2014	172300	7,101,893	8,303,536	9,194,242	16,911,811	7,725,092	7,067,860	6,205,238

Source: International Telecommunications Union

3.2.3 Independent Variables.

The 14 independent variables used in the study were Adjusted Net National Income per Capita (Current US$), Adolescent Fertility Rate (Births per 1,000 Women Ages 15-19), Armed Forces Personnel, Total, Enrollment in Primary Education, Both Sexes (Number), Exports of Goods and Services (Current US$), Foreign Direct Investment, Net Inflows (% of GDP), Foreign Direct Investment, Net Outflows (% of GDP), GDP (Current US$), GNI Growth (Annual %), Gross National Expenditure (% of GDP), Health Expenditure per Capita (Current US$), Labor Force total, Rural Population, and Urban Population. The secondary data for years 2000 through 2014 for the 14 independent variables were collected from the World Bank's website. These 14 independent variables were derived from indicators used by the UN that represent key

dimensions of life. The indicators used were health, education, income, employment, trade and financial flows, and demography.

The independent variables were tested among one another and among the dependent variable using correlation analysis. This first step of correlation analysis in the development of the model was done to verify if the covariates have a linear relationship with the response variable. Those covariates that had a very weak linear or non-linear relationship versus the response variable were not discarded from the study. A weak or non-linear correlation doesn't automatically show that there is not a connecting relationship between X and Y. Studies cite prior research that showed there is no association concerning time expended on studying for a test and concrete performance on the test being studied for (Glass and Hopkins, 1996; Black, 1999); however, instinctive rationality creates a different scenario such as if one does not study for an exam they will not perform as best as possible on that exam. Therefore the independent variables that show a weak or non-linear relationship with the response variable could ultimately wind up being influential in this study.

The next part of the correlation analysis identified the positive or negative direction of the line and whether the relationship was weak/medium/strong using the R^2 value. R-squared is the value of the line of best fit for variables Y and X plotted against each other, and it ranges from 0 to 1. However, having an R^2 of 1 is unlikely to be true of a sample due to uncertainties in all models. If there's a sufficient number of observations in a sample and the observations are located close to the line of best fit then the model will generally have a higher R^2 value. Conversely, the more distant the observations are away from the line of best fit then the lower the R^2 value will be in the model. This R^2

value is also affected by the degrees of freedom in the model. There is an inverse relationship between R^2 and the degrees of freedom. As the number of degrees of freedom decrease, R^2 will move near 1. In this research, the values for weak a R^2 are identified as 0.1 up to 0.4; medium R^2 is greater than 0.4 up to 0.7; and a strong R^2 is greater than 0.7 up to 1. In addition to evaluating R^2 of the correlation plot, the line of best fit for the data points was determined. The four trend line options using MS Excel were Exponential, Linear, Logarithmic, Polynomial, and Power.

3.3 Method

3.3.1 Regression Model.

The regression analysis was run using Microsoft Excel. Microsoft Excel was chosen as the data analysis tool due to its availability through the university's desktop computer and the university's MS Excel software version being compatible with my personally owned MS Excel software version located on my personal computer. This user friendliness of the MS Excel software allowed the research to continue to be conducted while away from the university setting.

Using multiple regression analysis, the relationship between these independent variables and the dependent variable was studied. The indicators representing key dimensions of life were converted to measurable independent variables that were used for the regression analysis. The procedure used to reduce the model to only significant variables was a modified version of backward elimination that involved elimination of

variables via statistical insignificance, logical reasoning, and insufficient data. The regression analysis for each market began with all 14 variables included in the model. The variables were eliminated from the model one at a time; and after an independent variable was eliminated from the model due to insignificance, correlation does not imply causation, or insufficient data the model was compared before and after the variable elimination. Eliminating the independent variables due to statistical insignificance was done using the p-value method with alpha level 0.05. Rather than using automated software that quickly performs the regression analysis, a step by step method of eliminating independent variables was used; this method allowed insight and familiarity with the data. Through this regression analysis process the model was reduced to eight covariates. The covariates that were removed via regression analysis were Gross National Expenditure, Foreign Direct Investment Net Inflows, Foreign Direct Investment Net Outflows, Health Expenditure per Capita, Adolescent Fertility Rate and Armed Forces Personnel Total. The remaining covariates that were used in the regression models for each market's mobile telephone subscription model were Adjusted Net National Income per Capita (Current US$), Enrollment in Primary Education, Both Sexes (Number), Exports of Goods and Services (Current US$), Gross Domestic Product (Current US$), Gross National Income Growth (Annual %), Labor Force Total, Rural Population, and Urban Population. Since the data was spread out for these covariates, all variables in the model was normalized. After normalizing the data for the final regression model, the regression model was run for a final time in order to produce practical values.

3.4 Summary

The research design helped with an efficient and structured style to answering the main research question and sub-questions. The mobile telephone subscription markets used in the study were classified according to their human development rank that is given by the UN. The data for the response variable and covariates were selected from the International Telecommunications Union and World Bank websites, respectively. Using MS Excel, correlation analysis as well as multiple regression analysis were performed to explore the data and help determine the best fitting curve for the data points and regression model for explaining mobile telephone subscriptions in each market. In addition to correlation analysis and multiple regression analysis, mobile penetration rate was determined for each market. Hypotheses were formed, and p-value testing results responded to these hypotheses. The results of the regression model show that the population and income covariates are contributors of mobile telephone subscription growth in the Central American Integration System's eight full member markets.

Chapter IV. Results and Summary

4.1 Results

Correlation analysis was used to verify relationships with one covariate versus another covariate, to examine the relationship between the response variable Mobile Telephone Subscriptions (MTS) versus the 14 covariates, and used to visualize the data through plots (See Appendix C). The following 14 independent variables were used in the study; Adjusted Net National Income per Capita (Current US$), Adolescent Fertility Rate (Births per 1,000 Women Ages 15-19), Armed Forces Personnel, Total, Enrollment in Primary Education, Both Sexes (Number), Exports of Goods and Services (Current US$), Foreign Direct Investment, Net Inflows (% of GDP), Foreign Direct Investment, Net Outflows (% of GDP), GDP (Current US$), GNI Growth (Annual %), Gross National Expenditure (% of GDP), Health Expenditure per Capita (Current US$), Labor Force Total, Rural Population, and Urban Population. R squared was used to determine the strength of correlation as weak, medium, or strong and to show the trend, the line of best fit was formed in the scatterplot. In many illustrations the line of best fit for the data points demonstrated a curve shape, showing that the data is uncertain and not exactly linear (See Appendix B). The independent variables found in the regression model to be significant for explaining the number of mobile telephone subscriptions are displayed; in addition to this, each market's model has a mathematical equation and is described with parameters and covariates; the model summary, and ANOVA tables are also given for each mobile market's regression model. When describing the model summary and

ANOVA table the focus is on the covariate, the covariate's coefficient, the p-value and Significance F; and using these each hypothesis was answered.

4.2 Correlation Analysis for Belize's MTS Market

Adjusted Net National Income per Capita was the first independent variable to be plotted against the response variable, Belize Mobile Telephone Subscriptions (MTS), in the correlation analysis (See Appendix C). The plot of the response variable versus the covariate produced a medium positive relationship with an $R^2 = 0.74$. The best fitting curve of the data points displayed a polynomial shape (See Appendix B). The covariate Adjusted Net National Income was missing a value for the year 2014. To get the independent variable's value for year 2014, the mean was calculated for years 2012 and 2013 and this value was used in its place. The Adjusted Net National Income calculated mean value for year 2014 is (3,361) and the value for years 2012 and 2013 are $3,314 and $3408 respectively. The independent variable Adjusted Net National Income has a strong relationship with the response variable, and it was significant variable in predicting mobile telephone subscriptions for Belize. The plot of Belize Mobile Telephone Subscriptions versus Adjusted Net National Income Per Capita (US$) demonstrates the curve of a polynomial scatterplot (See Appendix B). The response variable versus the covariate, Adolescent Fertility Rate (Births per 1,000 Women Ages 15-19) displayed a strong negative relationship with an $R^2 = 0.90$. The best fitting curve for the data points was an exponential curve (See Appendix B). Despite the strong negative relationship with the response variable, Adolescent Fertility Rate was

insignificant in predicting mobile telephone subscriptions in Belize and also removed from the regression model.

The correlation plot of the response variable versus Armed Forces Personnel, Total revealed a strong correlation and an $R^2 = 0.86$ (See Appendix C). In addition to the strong relationship; the best fitting curve of the data points was a polynomial curve (See Appendix B). Armed Forces Personnel was insignificant in predicting mobile telephone subscriptions for Belize and also removed from the regression model. The response variable plotted alongside the covariate Enrollment in Primary Education, Both Sexes produced a strong positive correlational relationship and an $R^2 = 0.86$; the best fitting curve of the data points was an exponential curve; in addition the covariate was insignificant in the Belizean model for predicting mobile telephone subscriptions (See Appendix B and Appendix C). The response variable plotted together with the covariate Exports of Goods and Services created a strong correlation and an R^2 value of 0.86; the best fitting curve for the data points had a polynomial shape (See Appendix B). Furthermore the covariate was insignificant in predicting mobile telephone subscriptions in Belize. The correlation plot of the response variable versus the covariate Foreign Direct Investment, Net Inflows showed a weak correlational relationship with an R^2 of 0.21; the shape of the best fitting curve for the data points was an exponential curve (See Appendix B and Appendix C). The covariate was not significant in predicting mobile telephone subscriptions. The correlation plot of the response variable versus the covariate Foreign Direct Investment, Net Outflows displayed a medium correlation relationship with an $R^2 = 0.41$; the best fitting curve for the data points was a polynomial curve (See Appendix B and Appendix C). The covariate was also insignificant in

predicting Belize's number of mobile telephone subscriptions and also removed from the model.

The correlation plot of the response variable versus the independent variable Gross Domestic Product exhibited a strong correlational relationship with an $R^2 = 0.90$; the shape of the best fitting curve for the data points was a polynomial curve (See Appendix B and Appendix C). The covariate was insignificant in predicting mobile telephone subscriptions in Belize. The correlation plot of the response variable against the covariate Gross National Expenditure formed an R^2 of 0.80 (See Appendix C). The best fitting curve for the data points was an exponential curve (See Appendix B). Furthermore, the independent variable was not significant in predicting Belize's number of mobile telephone subscriptions and removed from the model. The correlation plot of the response variable against the covariate Gross National Income Growth displayed a medium correlational relationship and an $R^2 = 0.41$; the best fitting curve of the data points was an exponential curve (See Appendix B and Appendix C). Gross National Income Growth was insignificant in predicting mobile telephone subscriptions in Belize.

The correlation plot of the response variable against the covariate Health Expenditure Per Capita displayed a strong correlational relationship with an $R^2 = 0.93$; the best fitting curve of the data points was a polynomial curve (See Appendix B and Appendix C). In addition to this correlation relationship with the response variable, Health Expenditure Per Capita was insignificant in predicting Belize's mobile telephone subscriptions and also removed from the model. The correlation plot of the response variable against the covariate Labor Force, Total showed a strong correlational relationship with an $R^2 = 0.94$; the shape of the best fitting curve for the data points was a

polynomial curve (See Appendix B and Appendix C). The covariate Labor Force, Total was insignificant in predicting mobile telephone subscriptions in Belize. The correlation plot of the response variable against the covariate Rural Population displayed a strong correlational relationship with $R^2 = 0.92$; the shape of the best fitting curve for the data points was a polynomial curve (See Appendix B and Appendix C). Furthermore Rural Population was insignificant in predicting mobile telephone subscriptions in Belize. The correlation plot of the response variable against the covariate Urban Population demonstrated a strong correlational relationship with an $R^2 = 0.92$; the shape of the best fitting curve for the data points was a polynomial curve (See Appendix B and Appendix C). The covariate was also significant in predicting Belize's number of mobile telephone subscriptions.

4.2.1 Multiple Regression Model for Belize MTS Market.

Belizean mobile telephone subscription regression model produced two significant variables. The two significant covariates in the model were Adjusted Net National Income per Capita (US$), and Urban Population. Interpreting the covariate, Adjusted Net National Income per Capita in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Adjusted Net National Income per Capita by one unit then the number of Belizean mobile telephone subscriptions decreases by 0.71. The probability of the regression output coefficient for Adjusted Net National Income per Capita happening by chance was 0.53%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Urban Population in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Urban Population by one unit then the number of mobile telephone subscriptions in Belize increases by 1.60. The probability of the regression output coefficient for Urban Population happening by chance was 6.39E-06, and this is significantly less than the 5% allowed at the 95% confidence level. Moreover, from the ANOVA table, the F statistic test revealed that probability of the multiple regression output happening by chance was 8.48E-08; and a little more than 7% of the data went unexplained in the regression model. This is told by the Adjusted R^2 value of 0.922. Also the two degrees of freedom is divided by the regression model's total sum of squares value of 13.07201 to produce a mean square of 6.536005. This left a residual of 12 degrees of freedom divided by a total sum of squares value 0.927; this produced a mean square value of 0.077332. Since the data is spread out and there is a large difference in values for the covariates, the Total Sum of Squares was a very large value. To account for this large value, the data was normalized using the standard deviation technique (See Appendix D). This involved finding the standard deviation value of all X and Y variables, then divide each individual data point by its standard deviation value. After finding the normalized value for the X and Y variables, the regression analysis was performed again using these new values. The following hypothesis is considered for the Belizean market:

H1: The covariate Urban Population is significant for predicting mobile telephone subscriptions in Belize.

Answering H1 was done using probability via the p-value and Significance F of the model's output. The p-value showed it was 6.39E-06 probability happening by chance and the Significance F showed the probability of the multiple regression output happening by chance was 8.48E-08. The probabilities demonstrate a very strong likelihood of significance for the covariate and accuracy of the regression model. The data was analyzed using the following mathematical equation:

Equation 2. Belize Mobile Telephone Subscriptions Model:

$$\text{Belize MTS} = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + E$$

Table 4. Belize Model Parameters

β_0	Intercept
β_1	Model output coefficient of X_1
β_2	Model output coefficient of X_2

Table 5. Belize Model Variables

X_1	$Covariate_1$, Adjusted Net National Income Per Capita
X_2	$Covariate_2$, Urban Population
E	Residual error; the difference between the observed value of the dependent variable (Y) and predicted value ($\bar{Y}$)

Table 6. Belize Model Summary

		Coefficients	Std. Err.	t Stat	P-value
Intercept		-7.66201	0.9251	-8.281	2.63E-6
Adj. Net Nat. Inc. per Capita	**	-0.71542	0.2110	-3.390	0.0053
Urban Population	***	1.602451	0.2110	7.5933	6.39E-6

* p<.05; ** p<.01; *** p<.001

Table 7. Belize ANOVA Table Summary

	df	SS	MS	F	Sig. F
Regression	2	13.0720	6.5360	84.518	2.63E-6
Residual	12	0.9279	0.0773		
Total	14	14			

4.3 Correlation Analysis for Costa Rica's MTS Market.

Costa Rica's independent variable enrollment in primary education, both sexes (number) is missing data for the 2003; the data for this year was added via taking the sum of years 2000, 2001, and 2002. After taking the sum of years 2000, 2001, and 2002, the average of these three years were used as year 2003. The response variable Costa Rica Mobile Telephone Subscriptions plotted versus the covariate Adjusted Net National Income per Capita (Current US$) revealed a strong positive correlational scatterplot with an $R^2 = 0.87$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Adjusted Net National Income Per Capita was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Costa Rica. The response variable Costa Rica Mobile Telephone Subscriptions plotted versus the covariate Enrollment in Primary Education, Both Sexes revealed a strong negative correlational scatterplot with an $R^2 = 0.98$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Enrollment in Primary Education was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Costa Rica.

The response variable Costa Rica Mobile Telephone Subscriptions plotted versus the covariate Export of Goods and Services Sexes revealed a strong negative correlational scatterplot with an $R^2 = 0.97$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Exports of Goods and Services was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Costa Rica. The response variable Costa Rica Mobile Telephone Subscriptions plotted versus the covariate Gross Domestic Product (Current US$) revealed a strong negative correlational scatterplot with an $R^2 = 0.98$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Gross Domestic Product was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Costa Rica. The response variable Costa Rica Mobile Telephone Subscriptions plotted versus the covariate Gross National Income Growth (Annual %) revealed a weak negative correlational scatterplot with an $R^2 = 0.19$ (See Appendix C). The best fitting curve of the data points was an exponential curve (See Appendix B). The independent variable Gross National Income Growth was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Costa Rica.

The response variable Costa Rica Mobile Telephone Subscriptions plotted versus the covariate Labor Force, Total revealed a strong positive correlational scatterplot with an $R^2 = 0.97$ (See Appendix C). The best fitting curve of the data points was an exponential curve (See Appendix B). The independent variable Labor Force, Total was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Costa Rica. The response variable Costa Rica Mobile

Telephone Subscriptions plotted versus the covariate Rural Population revealed a strong negative correlational scatterplot with an $R^2 = 0.97$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Rural Population was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Costa Rica. The response variable Costa Rica Mobile Telephone Subscriptions plotted versus the covariate Urban Population revealed a strong positive correlational scatterplot with an $R^2 = 0.98$ (See Appendix C). The best fitting curve of the data points was a power curve (See Appendix B). The independent variable Urban Population was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Costa Rica.

4.3.1 Multiple Regression Model for Costa Rica's MTS Market

Costa Rica's mobile telephone subscription model displayed one significant variable; the significant variables was Enrollment in Primary Education, Both Sexes in the optimized regression model. It shows that if you keep all other variables the same at current levels in the regression model and only increase Enrollment in Primary Education by one unit then the number of mobile telephone subscriptions in Costa Rica decreases by 0.98. The probability of the regression output coefficient for Enrollment in Primary Education happening by chance was 1.25 E-11, and this is significantly less than the 5% allowed at the 95% confidence level.

Furthermore, in regards to H5 on the population variable Enrollment in Primary Education, the following hypothesis is considered for the Costa Rican market:

H3: The covariate Enrollment in Primary Education, Both Sexes is significant in explaining the number of mobile telephone subscriptions in Costa Rica.

Answering H3 was done using probability via the p-value and Significance F of the model's output. The p-value showed it was 1.25E-11 probability of the regression output happening by chance and the Significance F test revealed that probability of the regression output happening by chance was 1.25E-11. The probabilities demonstrate a very strong likelihood of significance for the covariate and accuracy of the regression model. The data was analyzed using the following mathematical equation:

Equation 3. Costa Rica Mobile Telephone Subscriptions Model:

Costa Rica MTS = $\beta_0 + \beta_1 * X_1 + E$

Table 8. Costa Rica Model Parameters

β_0	Intercept
β_1	Model output coefficient of X_1

Table 9. Costa Rica Model Variables

X_1	Covariate$_1$, Gross Domestic Product
E	Residual error; the difference between the observed value of the dependent variable (Y) and predicted value ($\bar{Y}$)

Table 10. Costa Rica Model Summary

	Coefficients	Std. Error	t Stat	P-value
Intercept	11.974	2.349	5.096	0.000346
Enrollment in Primary Ed. ***	-0.9866	0.045	-21.83	1.25E-11

*** p<.001

Table 11. Costa Rica ANOVA Summary

	df	*SS*	*MS*	*F*	*Sig. F*
Regression	1	13.62835	13.628	476.7172	1.252E-11
Residual	13	0.371643	0.0285		
Total	14	14			

4.4 Correlation Analysis for Dominican Republic's MTS Market

When performing correlation analysis, the variables that demonstrated a strong relationship with the response variable, mobile telephone subscriptions, are GDP (current US$), Adjusted Net National Income per Capita (current US$), Adolescent Fertility Rate (Births per 1,000 Women Ages 15-19), Exports of Goods and Services (current US$), Health Expenditure per Capita (current US$), Labor Force, Total, and Urban Population. MTS had the strongest linear relationship with the independent variable Labor Force. The variables that were eliminated from the regression model were Gross National Income Growth (Annual %), Foreign Direct Investment, Net Outflows (% of GDP), Foreign Direct Investment, Net Inflows (% of GDP), Armed Forces Personnel, Total, and Gross National Expenditure (% of GDP) due to correlation and collinearity issues.

The response variable Dominican Republic Mobile Telephone Subscriptions plotted versus the covariate Adjusted Net National Income per Capita (Current US$) revealed a strong correlational scatterplot with an $R^2 = 0.91$. The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Adjusted Net National Income Per Capita was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Dominican Republic.

The response variable Dominican Republic Mobile Telephone Subscriptions plotted versus the covariate Enrollment in Primary Education, Both Sexes revealed a correlational scatterplot with an $R^2 = 0.50$. The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Enrollment in Primary Education was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Dominican Republic.

The response variable Dominican Republic Mobile Telephone Subscriptions plotted versus the covariate Exports of Goods and Services revealed a correlational scatterplot with an $R^2 = 0.83$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Exports of Goods and Services was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Dominican Republic. The response variable Dominican Republic Mobile Telephone Subscriptions plotted versus the covariate Gross Domestic Product revealed a correlational scatterplot with an $R^2 = 0.92$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Gross Domestic Product was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Dominican Republic. The response variable Dominican Republic Mobile Telephone Subscriptions plotted versus the covariate Gross National Income Growth revealed a weak correlational scatterplot with an $R^2 = 0.11$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Gross National Income Growth was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Dominican Republic.

The response variable Dominican Republic Mobile Telephone Subscriptions plotted versus the covariate Labor Force, Total revealed a strong positive correlational scatterplot with an $R^2 = 0.93$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Gross National Income Growth was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Dominican Republic. The response variable Dominican Republic Mobile Telephone Subscriptions plotted versus the covariate Rural Population revealed a strong negative correlational scatterplot with an $R^2 = 0.96$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Rural Population was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Dominican Republic. The response variable Dominican Republic Mobile Telephone Subscriptions plotted versus the covariate Urban Population revealed a strong positive correlational scatterplot with an $R^2 = 0.94$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Urban Population was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Dominican Republic.

4.4.1 Multiple Regression Model for Dominican Republic's MTS Market

Dominican Republic mobile telephone subscription model displayed four significant variables; the significant variables are Adjusted Net National Income per Capita (Current US$), Exports of Goods and Services (Current US$), Gross Domestic

Product (Current US$), and Rural Population. The covariate, Enrollment in Primary Education was not significant at the 95% confidence level.

Interpreting the covariate, Adjusted Net National Income per Capita in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Adjusted Net National Income per Capita by one unit then the number of mobile telephone subscriptions in Dominican Republic increases by 2.89. The probability of the regression output coefficient for Adjusted Net National Income per Capita happening by chance was 2.022E-05, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Gross Domestic Product (Current US$) in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Gross Domestic Product by one unit then the number of mobile telephone subscriptions in Dominican Republic decreases by 3.65. The probability of the regression output coefficient for Gross Domestic Product happening by chance was 8.695E-05, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Labor Force, Total in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Labor Force, Total by one unit then the number of mobile telephone subscriptions in Dominican Republic increases by 0.939. The probability of the regression output coefficient for Labor Force, Total happening by chance was 0.12%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Rural Population in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Rural Population one unit then the number of mobile telephone subscriptions in Dominican Republic decreases by 0.88. The probability of the regression output coefficient for Rural Population happening by chance was 2.81%, and this is significantly less than the 5% allowed at the 95% confidence level. Furthermore, in regards to H2 on the population variable Rural Population, the following hypothesis is considered for the Dominican Republic market:

H2: The covariate Rural Population is significant for predicting mobile telephone subscriptions in Dominican Republic.

Answering H2 was done using probability via the p-value and Significance F of the model's output. The p-value showed it was a 2.81% probability of the regression output happening by chance and the Significance F test revealed that probability of the regression output happening by chance was 1.06E-09. The probabilities are less than 5% allowed at the 95% confidence level and demonstrate a likelihood of significance for the covariate in the regression model. The data was analyzed using the following mathematical equation:

Equation 4. Dominican Republic Mobile Telephone Subscriptions Model

$$\text{Dominican Republic MTS} = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + E$$

Table 12. Dominican Republic Model Parameters

β_0	Intercept
β_1	Model output coefficient of X_1;
β_2	Model output coefficient of X_2;
β_3	Model output coefficient of X_3;
β_4	Model output coefficient of X_4.

Table 13. Dominican Republic Model Variables

X_1	Covariate$_1$, Gross Domestic Product;
X_2	Covariate$_2$, Adjusted Net National Income Per Capita;
X_3	Covariate$_3$, Urban Population;
X_4	Covariate$_4$, Exports of Goods and Services;
E	Residual error; the difference between the observed value of the dependent variable (Y) and predicted value ($\bar{Y}$).

Table 14. Dominican Republic Model Summary

		Coefficients	Std. Err.	t Stat	P-value
Intercept		-7.9232	0.9936	-7.9735	1.21E-05
Gross Domestic Product	*	-2.0829	0.6788	-3.0685	0.01187
Adj. Net National Inc. per Cap.	**	1.896	0.4761	3.9821	0.002592
Urban population	***	1.5169	0.1569	9.6658	2.17E-06
Exports of goods and services	*	-0.3436	0.1153	-2.9790	0.01383

* p<.05; ** p<.01; *** p<.001

Table 15. Dominican Republic ANOVA Summary

	df	SS	MS	F	Sig. F
Regression	4	13.93105	3.482761	505.0984	1.73E-11
Residual	10	0.068952	0.006895		
Total	14	14			

4.5 Correlation Analysis for El Salvador's MTS Market

The covariate Exports of Goods and Services was eliminated from El Salvador's mobile telephone subscription model due to insufficient data. The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Adjusted Net National Income per Capita (Current US$) revealed a strong correlational relationship scatterplot with an $R^2 = 0.97$ (See Appendix C). The best fitting curve of the data points

was a power curve (See Appendix B). The independent variable Adjusted Net National Income Per Capita was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in El Salvador.

The response variable El Salvador Mobile Telephone Subscriptions versus the covariate Adolescent Fertility Rate (Births Per 1,000 Women Ages 15-19) produced a strong negative correlational scatterplot with an $R^2 = 0.95$ (See Appendix C). The best fitting curve for the data points was a polynomial curve (See Appendix B). The independent variable Adolescent Fertility Rate was insignificant and removed during the development of the regression model for predicting mobile telephone subscriptions in El Salvador. The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Armed Forces Personnel, Total revealed a positive correlational scatterplot with an $R^2 = 0.51$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Armed Forces Personnel, Total was insignificant and removed from during the development of the regression model for predicting mobile telephone subscriptions in El Salvador. The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Enrollment in Primary Education revealed a weak correlational and scatterplot with an $R^2 = 0.43$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Enrollment in Primary Education was significant for predicting mobile telephone subscriptions in El Salvador.

The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Foreign Direct Investment, Net Inflows (% of GDP) revealed a weak correlational and scatterplot with an $R^2 = 0.10$ (See Appendix C). The best fitting curve

of the data points was a power curve (See Appendix B). The independent variable FDI, Net Inflows was insignificant and removed from during the development of the regression model for predicting mobile telephone subscriptions in El Salvador. The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Foreign Direct Investment, Net Outflows (% of GDP) revealed a weak correlational scatterplot with an $R^2 = 0.15$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable FDI, Net Outflows was insignificant and removed from during the development of the regression model for predicting mobile telephone subscriptions in El Salvador. The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Gross Domestic Product (Current US$) revealed a strong correlational scatterplot with an $R^2 = 0.96$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Gross Domestic Product was not significant for predicting mobile telephone subscriptions in El Salvador. The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Gross National Expenditure (% of GDP) revealed a weak positive correlational scatterplot with an $R^2 = 0.34$ (See Appendix C). The best fitting curve of the data points was a power curve (See Appendix B). The independent variable Gross National Expenditure was insignificant and removed from the model predicting mobile telephone subscriptions in El Salvador.

The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Gross National Income Growth (% of GDP) revealed a weak negative correlational scatterplot with an $R^2 = 0.11$ (See Appendix C). The best fitting curve of

the data points was a polynomial curve (See Appendix B). The independent variable Gross National Income Growth was significant for predicting mobile telephone subscriptions in El Salvador. The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Labor Force, Total revealed a strong positive correlational scatterplot with an $R^2 = 0.96$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Labor Force, Total was insignificant for predicting mobile telephone subscriptions in El Salvador. The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Rural Population revealed a strong positive correlational scatterplot with an $R^2 = 0.95$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Rural Population was significant for predicting mobile telephone subscriptions in El Salvador. The response variable El Salvador Mobile Telephone Subscriptions plotted versus the covariate Urban Population revealed a strong positive correlational scatterplot with an $R^2 = 0.93$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Urban Population was significant for predicting mobile telephone subscriptions in El Salvador.

4.5.1 Multiple Regression Model for El Salvador's MTS Market.

El Salvador mobile telephone subscription model displayed five significant variables; Adjusted Net National Income per Capita, Enrollment in Primary Education, Gross National Income Growth, Rural Population, and Urban Population. Interpreting

the covariate, Adjusted Net National Income per Capita in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Adjusted Net National Income per Capita by one unit then the number of mobile telephone subscriptions in El Salvador increases by 0.70. The probability of the regression output coefficient for Adjusted Net National Income per Capita happening by chance was 0.10%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Enrollment in Primary Education in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Enrollment in Primary Education by one unit then the number of mobile telephone subscriptions in El Salvador increases by 0.37. The probability of the regression output coefficient for Enrollment in Primary Education happening by chance was 0.19%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Gross National Income Growth in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Gross National Income Growth by one unit then the number of mobile telephone subscriptions in El Salvador decreases by 0.10. The probability of the regression output coefficient for Gross National Income Growth happening by chance was 0.10%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Rural Population in the optimized regression model shows that if you keep all other variables the same at current levels in the regression

model and only increase Rural Population by one unit then the number of mobile telephone subscriptions in El Salvador decreases by 5.03. The probability of the regression output coefficient for Rural Population happening by chance was 0.067%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Urban Population in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Urban Population by one unit then the number of mobile telephone subscriptions in El Salvador decreases by 4.52. The probability of the regression output coefficient for Urban Population happening by chance was 0.05%, and this is significantly less than the 5% allowed at the 95% confidence level. Furthermore, in regards to H6 on the income variable Gross National Income Growth, the following hypothesis is considered for the El Salvador market:

H6: The covariate Gross National Income Growth (Annual %) is significant for predicting mobile telephone subscriptions in El Salvador.

Answering H6 was done using probability via the p-value and Significance F of the model's output. The p-value showed it was a 0.10% probability of the regression output happening by chance and the Significance F test revealed that probability of the regression output happening by chance was 1.26E-10. The probabilities are less than 5% allowed at the 95% confidence level and demonstrate a likelihood of significance for the covariate in the regression model. The data was analyzed using the following mathematical equation:

Equation 5. El Salvador Mobile Telephone Subscriptions Model

El Salvador MTS = $\beta_0 + \beta_1*X_1 + \beta_2*X_2 + \beta_3*X_3 + \beta_4*X_4 + \beta_5*X_5 + E$

Table 16. El Salvador Model Parameters

β_0	Intercept
β_1	Model output coefficient of X_1;
β_2	Model output coefficient of X_2;
β_3	Model output coefficient of X_3;
β_4	Model output coefficient of X_4.
β_5	Model output coefficient of X_5.

Table 17. El Salvador Model Variables

X_1	$Covariate_1$, Gross National Income Growth;
X_2	$Covariate_2$, Adjusted Net National Income Per Capita;
X_3	$Covariate_3$, Enrollment in Primary Education;
X_4	$Covariate_4$, Rural Population;
X_5	$Covariate_5$, Urban Population
E	Residual error; the difference between the observed value of the dependent variable (Y) and predicted value ($\bar{Y}$).

Table 18. El Salvador Model Summary

		Coefficient	Std. Err.	t Stat	P-value
Intercept		184.806	36.435	5.072	0.00067
Gross National Income	**	-0.105	0.0223	-4.717	0.00109
Adj. Net National Inc. per Capita	***	0.702	0.1470	4.779	0.00100
Exports of goods and services	**	0.376	0.086	4.331	0.00190
Rural Population	***	-5.032	0.992	5.071	0.00067
Urban population	***	-4.525	0.856	-5.283	0.00050

* p<.05; ** p<.01; *** p<.001

Table 19. El Salvador ANOVA Summary

	df	SS	MS	F	Sig. F
Regression	5	13.94731	2.789463	476.5133	1.26722E-10
Residual	9	0.052685	0.005854		
Total	14	14			

4.6 Correlation Analysis for Guatemala's MTS Market

The response variable Guatemala Mobile Telephone Subscriptions plotted versus the covariate Adjusted Net National Income per Capita revealed a strong positive correlational scatterplot with an $R^2 = 0.93$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Adjusted Net National Income per Capita was significant for predicting mobile telephone subscriptions in Guatemala.

The response variable Guatemala Mobile Telephone Subscriptions plotted versus the covariate Enrollment in Primary Education revealed a strong positive correlational scatterplot with an $R^2 = 0.91$ (See Appendix C). The best fitting curve of the data points was a power curve (See Appendix B). The independent variable Enrollment in Primary Education was significant for predicting mobile telephone subscriptions in Guatemala. The response variable Guatemala Mobile Telephone Subscriptions plotted versus the covariate Exports of Goods and Services revealed a strong positive correlational scatterplot with an $R^2 = 0.91$ (See Appendix C). The best fitting curve of the data points was a power curve (See Appendix B). The independent variable Exports of Goods and Services was insignificant for predicting mobile telephone subscriptions in Guatemala. The response variable Guatemala Mobile Telephone Subscriptions plotted versus the covariate Gross Domestic Product revealed a strong positive correlational scatterplot with an $R^2 = 0.94$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Gross Domestic Product was insignificant for predicting mobile telephone subscriptions in Guatemala.

The response variable Guatemala Mobile Telephone Subscriptions plotted versus the covariate Gross National Income Growth revealed a weak correlational scatterplot with an $R^2 = 0.05$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Gross National Income Growth was insignificant for predicting mobile telephone subscriptions in Guatemala. The response variable Guatemala Mobile Telephone Subscriptions plotted versus the covariate Labor Force, Total revealed a strong positive correlational scatterplot with an $R^2 = 0.92$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Labor Force, Total as insignificant for predicting mobile telephone subscriptions in Guatemala. The response variable Guatemala Mobile Telephone Subscriptions plotted versus the covariate Rural Population revealed a strong positive correlational scatterplot with an $R^2 = 0.92$ (See Appendix C). The best fitting curve of the data points was a power curve (See Appendix B). The independent variable Rural Population as insignificant for predicting mobile telephone subscriptions in Guatemala. The response variable Guatemala Mobile Telephone Subscriptions plotted versus the covariate Urban Population revealed a strong positive correlational scatterplot with an $R^2 = 0.91$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Urban Population as insignificant for predicting mobile telephone subscriptions in Guatemala.

4.6.1 Multiple Regression Model for Guatemala's MTS Market

Guatemala's mobile telephone subscription model displayed two significant variables; the significant variables are Adjusted Net National Income per Capita (Current US$) and Enrollment in Primary Education, Both Sexes. Interpreting the covariate, Adjusted Net National Income per Capita in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Adjusted Net National Income per Capita by one unit then the number of mobile telephone subscriptions in Guatemala increases by 0.649. The probability of the regression output coefficient for Adjusted Net National Income per Capita happening by chance was 5.89E-05, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Enrollment in Primary Education, Both Sexes in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Enrollment in Primary Education, Both Sexes by one unit then the number of mobile telephone subscriptions in Guatemala decreases by 0.37. The probability of the regression output coefficient for Enrollment in Primary Education, Both Sexes happening by chance was 0.43%, and this is significantly less than the 5% allowed at the 95% confidence level. Furthermore, in regards to H7 on the income variable Adjusted Net National Income, the following hypothesis is considered for the Guatemala market:

H7: The covariate Adjusted Net National Income Per Capita (US$) is significant for predicting mobile telephone subscriptions in Guatemala.

Answering H7 was done using probability via the p-value and Significance F of the model's output. The p-value showed it was a 5.89E-05 probability of the regression output happening by chance and the Significance F test revealed that probability of the regression output happening by chance was 3.06E-08. The probabilities are less than 5% allowed at the 95% confidence level and demonstrate a likelihood of significance for the covariate in the regression model. The data was analyzed using the following mathematical equation:

Equation 6. Guatemala Mobile Telephone Subscriptions Model

Guatemala MTS = $\beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + E$

Table 20. Guatemala Model Parameters

β_0	Intercept
β_1	Model output coefficient of X_1;
β_2	Model output coefficient of X_2;

Table 21. Guatemala Model Variables

X_1	$Covariate_2$, Adjusted Net National Income Per Capita;
X_2	$Covariate_3$, Enrollment in Primary Education;
E	Residual error; the difference between the observed value of the dependent variable (Y) and predicted value ($\bar{Y}$).

Table 22. Guatemala Model Summary

	Coefficient	Std. Err.	t Stat	P-value
Intercept	-4.7290	0.79305	-5.9630	6.58E-05
Adj. Net Nat. Inc. per Cap. ***	0.64994	0.10770	6.0345	5.89E-05
Enrollment in Prim. Ed. **	0.37727	0.10770	3.5028	0.004350

** p<.01; *** p<.001

Table 23. Guatemala ANOVA Summary

	df	SS	MS	F	Sig. F
Regression	2	13.21684	6.60842	101.2582	3.064E-08
Residual	12	0.783156	0.06526		
Total	14	14			

4.7 Correlation Analysis for Honduras' MTS Market

Two covariates were eliminated from the Honduras Mobile Telephone Subscription model due to insufficient data; the variables eliminated were Armed Forces Personnel, Total and Enrollment in Primary Education, Both Sexes. The response variable Honduras Mobile Telephone Subscriptions versus the covariate Adjusted Net National Income Per Capita (Current US$) revealed a strong correlational relationship scatterplot with an $R^2 = 0.93$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable Adjusted Net National Income Per Capita was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Honduras.

The response variable Honduras Mobile Telephone Subscriptions versus the covariate Adolescent Fertility Rate (Births Per 1,000 Women Ages 15-19) produced a strong negative correlational relationship scatterplot with an $R^2 = 0.90$ (See Appendix C). The best fitting curve for the data points was an exponential curve (See Appendix B). The independent variable Adolescent Fertility Rate was insignificant and removed from the regression model for predicting mobile telephone subscriptions in Honduras. The response variable Honduras Mobile Telephone Subscriptions versus the covariate Exports

of Goods and Services (Current US$) revealed a strong positive correlational relationship scatterplot with an $R^2 = 0.83$ (See Appendix C). The best fitting curve of the data points was a power curve (See Appendix B). Exports of Goods and Services was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Honduras. The response variable Honduras Mobile Telephone Subscriptions versus the covariate Foreign Direct Investment, Net Inflows (% of GDP) revealed a weak correlational relationship and scatterplot with an $R^2 = 0.07$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable FDI, Net Inflows was insignificant and removed from the development of the regression model for predicting mobile telephone subscriptions in Honduras. The response variable Honduras Mobile Telephone Subscriptions versus the covariate Foreign Direct Investment, Net Outflows (% of GDP) produced a weak correlational relationship scatterplot with an $R^2 = 0.32$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable FDI, Net Outflows was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Honduras.

The response variable Honduras Mobile Telephone Subscriptions versus the covariate Gross Domestic Product (GDP) (Current US$) revealed a strong correlational relationship scatterplot with an $R^2 = 0.92$ (See Appendix C). The best fitting curve of the data points was a polynomial curve (See Appendix B). The independent variable GDP was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Honduras. The response variable Honduras Mobile Telephone Subscriptions versus the covariate Gross National Expenditure (% of GDP) revealed a

weak positive correlational relationship scatterplot with an $R^2 = 0.37$ (See Appendix C). The best fitting curve of the data points was an exponential curve (See Appendix B). The independent variable Gross National Expenditure was not significant at the 0.05 alpha level and removed from the regression model for predicting mobile telephone subscriptions in Honduras. The response variable Honduras Mobile Telephone Subscriptions versus the covariate Gross National Income Growth (% of GDP) revealed a weak correlational negative relationship scatterplot with an $R^2 = 0.31$ (See Appendix C). The best fitting curve for the data points was a polynomial curve of second order (See Appendix B). The independent variable Gross National Income Growth was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Honduras.

The response variable Honduras Mobile Telephone Subscriptions versus the covariate Health Expenditure Per Capita (Current US$) revealed a strong positive correlational relationship scatterplot with an $R^2 = 0.90$ (See Appendix C). The best fitting curve for the data points was a polynomial curve of second order (See Appendix B). The independent variable Health Expenditure Per Capita (Current US$) was not significant at the 0.05 alpha level and removed from the regression model for predicting mobile telephone subscriptions in Honduras. The response variable Honduras Mobile Telephone Subscriptions versus the covariate Labor Force, Total revealed a strong positive correlational relationship scatterplot with an $R^2 = 0.92$ (See Appendix C). The best fitting curve for the data points was polynomial curve of second order. The independent variable Labor Force, Total was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Honduras. The

response variable Honduras Mobile Telephone Subscriptions versus the covariate Rural Population revealed a strong positive correlational relationship scatterplot with an R^2 = 0.95 (See Appendix C). The best fitting curve for the data points was an exponential curve (See Appendix B). The independent variable Rural Population was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Honduras. The response variable Honduras Mobile Telephone Subscriptions versus the covariate Urban Population revealed a strong positive correlational relationship scatterplot with an R^2 = 0.90 (See Appendix C). The best fitting curve for the data points was power curve (See Appendix B). The independent variable Urban Population was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Honduras.

4.7.1 Multiple Regression Model for Honduras' MTS Market.

The Honduran mobile telephone subscription model displayed three significant variables; the significant variables are Exports of Goods and Services (Current US$), Gross Domestic Product (Current US$), and Labor Force, Total. Interpreting the covariate, Exports of Goods and Services (Current US$) in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Exports of Goods and Services (Current US$) by one unit then the number of mobile telephone subscriptions in Honduras decreases by 1.0. The probability of the regression output coefficient for Exports of Goods and Services

(Current US$) happening by chance was 0.089%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Gross Domestic Product (Current US$) in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Gross Domestic Product (Current US$) by one unit then the number of mobile telephone subscriptions in Honduras increases by 3.61. The probability of the regression output coefficient for Gross Domestic Product (Current US$) happening by chance was 0.01%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Labor Force, Total in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Labor Force, Total by one unit then the number of mobile telephone subscriptions in Honduras decreases by 1.72. The probability of the regression output coefficient for Labor Force, Total happening by chance was 0.82%, and this is significantly less than the 5% allowed at the 95% confidence level. Furthermore, in regards to H3 on the population variable Labor Force, the following hypothesis is considered for the Honduras market:

H3: The covariate Labor Force, total is significant in predicting mobile telephone subscriptions for Honduras.

Answering H3 was done using probability via the p-value and Significance F of the model's output. The p-value showed it was a 0.82% probability of the regression output happening by chance and the Significance F test revealed that probability of the regression output happening by chance was 4.315E-08. The probabilities are less than

5% allowed at the 95% confidence level and demonstrate a likelihood of significance for the covariate in the regression model. The data was analyzed using the following mathematical equation:

Equation 7. Honduras Mobile Telephone Subscriptions Model

Honduras MTS = $\beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + E$

Table 24. Honduras Model Parameters

β_0	Intercept
β_1	Model output coefficient of X_1;
β_2	Model output coefficient of X_2;
β_3	Model output coefficient of X_3.

Table 25. Honduras Variables

X_1	Covariate$_1$, Gross Domestic Product;
X_2	Covariate$_2$, Exports of Goods and Services;
X_3	Covariate$_3$, Labor Force;
E	Residual error; the difference between the observed value of the dependent variable (Y) and predicted value ($\bar{Y}$).

Table 26. Honduras Model Summary

		Coefficients	Std. Err.	t Stat	P-value
Intercept		7.7277	2.7310	2.8296	0.0163
Gross Dom. Prod	***	3.6154	0.6157	5.8718	0.0001
Exp. of G&S	***	-1.0044	0.2224	-4.5145	0.0008
Labor Force, Total	**	-1.7257	0.5358	-3.2202	0.0081

* p<.05; ** p<.01; *** p<.001

Table 27. Honduras ANOVA Summary

	df	SS	MS	F	Sig. F
Regression	3	13.46727	4.489092	92.71168	4.31586E-08
Residual	11	0.532619	0.048419		
Total	14	13.99989			

4.8 Correlation Analysis for Nicaragua's MTS Market

Two covariates were eliminated from the Nicaragua Mobile Telephone Subscription model due to insufficient data; the independent variables eliminated were Enrollment in Primary Education, Both Sexes and Foreign Direct Investment, Net Outflows. The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Adjusted Net National Income Per Capita (Current US$) revealed a strong positive correlational relationship scatterplot with an $R^2 = 0.97$ (See Appendix C). The best fitting curve for the data points was a polynomial curve (See Appendix B). The independent variable Adjusted Net National Income Per Capita was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Nicaragua.

The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Adolescent Fertility Rate (Births Per 1,000 Women Ages 15-19) revealed a strong negative correlational scatterplot with an $R^2 = 0.99$ (See Appendix C). The best fitting curve for the data points was a second order polynomial curve (See Appendix B). The independent variable Adolescent Fertility Rate was not significant at the 0.05 alpha

level and removed from the regression model for predicting mobile telephone subscriptions in Nicaragua. The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Armed Forces Personnel, Total revealed a strong negative correlational scatterplot with an $R^2 = 0.83$ (See Appendix C). The best fitting curve for the data points is an exponential curve (See Appendix B). The independent variable Armed Forces Personnel, Total was not significant at the 0.05 alpha level and removed from the regression model for predicting mobile telephone subscriptions in Nicaragua. The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Exports of Goods and Services (Current US$) revealed a strong positive correlational scatterplot with an $R^2 = 0.98$ (See Appendix C). The best fitting curve for the data points was a second order polynomial curve (See Appendix B). The independent variable Exports of Goods and Services was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Nicaragua.

The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Foreign Direct Investment (FDI), Net Inflows (% of GDP) revealed a strong positive correlational scatterplot with an $R^2 = 0.71$ (See Appendix C). The best fitting curve for the data was a polynomial curve of second order (See Appendix B). The independent variable FDI, Net Inflows was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Nicaragua. The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Gross Domestic Product (GDP), (Current US$) revealed a strong positive correlational scatterplot with an $R^2 = 0.99$ (See Appendix C). The best fitting curve for the data points was polynomial curve (See Appendix B). The independent variable GDP was not

significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Nicaragua. The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Gross National Expenditure (% of GDP) revealed a weak negative correlational scatterplot with an $R^2 = 0.10$ (See Appendix C). The best fitting curve for the data points was a polynomial curve (See Appendix B). The independent variable Gross National Expenditure was not significant at the 0.05 alpha level and removed from the regression model for predicting mobile telephone subscriptions in Nicaragua. The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Gross National Income Growth (Annual %) revealed a weak correlational scatterplot with an $R^2 = 0.12$ (See Appendix C). The best fitting curve for the data points was polynomial curve (See Appendix B). The independent variable Gross National Income Growth was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Nicaragua.

The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Health Expenditure Per Capita (Current US$) revealed a strong positive correlational scatterplot with an $R^2 = 0.97$ (See Appendix C). The best fitting curve for the data points was a polynomial curve (See Appendix B). The independent variable Health Expenditure Per Capita was not significant at the 0.05 alpha level and removed from the regression model for predicting mobile telephone subscriptions in Nicaragua. The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Labor Force, Total revealed a strong positive correlational scatterplot with an $R^2 = 0.99$ (See Appendix C). The best fitting curve for the data points was polynomial curve (See Appendix B). The independent variable Labor Force, Total was not significant at the

0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Nicaragua. The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Rural Population revealed a strong positive correlational scatterplot with an R^2 = 0.99 (See Appendix C). The best fitting curve for the data points was polynomial curve (See Appendix B). The independent variable Rural Population was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Nicaragua. The response variable Nicaragua Mobile Telephone Subscriptions versus the covariate Urban Population revealed a strong positive correlational scatterplot with an R^2 = 0.99 (See Appendix C). The best fitting curve for the data points was polynomial curve (See Appendix B). The independent variable Urban Population was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Nicaragua.

4.8.1 Multiple Regression Model for Nicaragua's MTS Market.

The Nicaraguan mobile telephone subscription model displayed three significant variables; the significant variables are Exports of Goods and Services (Current US$), Rural Population, and Urban Population. Interpreting the covariate, Exports of Goods and Services (Current US$) in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Exports of Goods and Services (Current US$) by one unit then the number of mobile telephone subscriptions in Nicaragua increases by 0.321. The probability of the regression output coefficient for Exports of Goods and Services (Current US$) happening

by chance was 4.26%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Rural Population in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Rural Population by one unit then the number of mobile telephone subscriptions in Nicaragua decreases by 0.96. The probability of the regression output coefficient for Rural Population happening by chance was 0.77%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Urban Population in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Urban Population by one unit then the number of mobile telephone subscriptions in Nicaragua increases by 1.62. The probability of the regression output coefficient for Urban Population happening by chance was 0.20%, and this is significantly less than the 5% allowed at the 95% confidence level. Furthermore, in regards to H8 on the income variable Exports of Goods and Services, the following hypothesis is considered for the Nicaragua market:

H8: The covariate Exports of Goods and Services is significant in predicting mobile telephone subscriptions in Nicaragua.

Answering H8 was done using probability via the p-value and Significance F of the model's output. The p-value showed it was a 4.26% probability of the regression output happening by chance and the Significance F test revealed that probability of the regression output happening by chance was 1.60E-12. The probabilities are less than 5% allowed at the 95% confidence level and demonstrate a likelihood of significance for the

covariate in the regression model. The data was analyzed using the following mathematical equation:

Equation 8. Nicaragua Mobile Telephone Subscriptions:

Nicaragua MTS = $\beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + E$

Table 28. Nicaragua Model Parameters

β_0	Intercept
β_1	Model output coefficient of X_1;
β_2	Model output coefficient of X_2;
β_3	Model output coefficient of X_3.

Table 29. Nicaragua Variables

X_1	Covariate$_1$, Exports of Goods and Service;
X_2	Covariate$_2$, Rural Population;
X_3	Covariate$_3$, Urban Population;
E	Residual error; the difference between the observed value of the dependent variable (Y) and predicted value ($\bar{Y}$).

Table 30. Nicaragua Model Summary

		Coefficients	Std. Err.	t Stat	P-value
Intercept		11.67838	5.052176	2.311555	0.041185
Exp. of goods and services	*	0.321801	0.140416	2.291765	0.042645
Rural population	**	-0.96349	0.296478	-3.249787	0.007738
Urban population	**	1.626016	0.406065	4.004317	0.002070

* p<.05; ** p<.01; *** p<.001

Table 31. Nicaragua ANOVA Summary

	df	SS	MS	F	Sig. F
Regression	3	13.916910	4.638970	614.1394	1.6E-12
Residual	11	0.0830897	0.007553		
Total	14	14			

4.9 Correlation Analysis for Panama's MTS Market

The response variable is Panama Mobile Telephone Subscriptions. Most of the correlation plots for the response variable versus the covariates exhibited strong relationships. One covariate was eliminated from the development of the Panama Mobile Telephone Subscription regression model due to insufficient data; that independent variable eliminated was Armed Forces Personnel, Total. The independent variable Enrollment in Primary Education, Both Sexes is missing the value for year 2014, and to get the independent variable's value for year 2014, the mean is imputed for years 2012 and 2013 and used in its place. This imputed mean value for year 2014 is (436,625); and it's not a large difference from the values for year 2012 (437,277) and year 2013 (435,973), so the sample is not distorted.

The response variable Panama Mobile Telephone Subscriptions versus the covariate Adjusted Net National Income Per Capita (Current US$) revealed a strong positive correlational scatterplot with an $R^2 = 0.93$ (See Appendix C). The best fitting curve for the data points was a polynomial curve (See Appendix B). The independent variable Adjusted Net National Income Per Capita was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Panama. The response variable Panama Mobile Telephone Subscriptions versus the covariate Adolescent Fertility Rate (Births Per 1,000 Women Ages 15-19) revealed a strong negative correlational scatterplot with an $R^2 = 0.87$ (See Appendix C). The best fitting curve for the data points was an exponential curve (See Appendix B). The independent variable Adolescent Fertility Rate was not significant at the 0.05 alpha level and removed

from the regression model for predicting mobile telephone subscriptions in Panama. The response variable Panama Mobile Telephone Subscriptions versus the covariate Enrollment in Primary Education, Both Sexes revealed a strong positive correlational scatterplot with an $R^2 = 0.76$ (See Appendix C). The best fitting curve for the data points was an exponential curve (See Appendix B). The independent variable Enrollment in Primary Education was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Panama. The response variable Panama Mobile Telephone Subscriptions versus the covariate Exports of Goods and Services (% of GDP) revealed a strong positive correlational scatterplot with an $R^2 = 0.94$ (See Appendix C). The best fitting curve for the data points was a polynomial curve (See Appendix B). The independent variable Exports of Goods and Services was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Panama.

The response variable Panama Mobile Telephone Subscriptions versus the covariate Foreign Direct Investment (FDI), Net Inflows revealed a weak positive correlational scatterplot with an $R^2 = 0.23$ (See Appendix C). The best fitting curve for the data points was a power curve (See Appendix B). The independent variable FDI, Net Inflows was not significant at the 0.05 alpha level and removed from the regression model for predicting mobile telephone subscriptions in Panama. The response variable Panama Mobile Telephone Subscriptions versus the covariate Foreign Direct Investment, Net Outflows revealed a weak correlational scatterplot with an $R^2 = 0.37$ (See Appendix C). The best fitting curve for the data points was a polynomial curve (See Appendix B). The independent variable FDI, Net Outflows was not significant at the 0.05 alpha level in

the regression model for predicting mobile telephone subscriptions in Panama. The response variable Panama Mobile Telephone Subscriptions versus the covariate Gross Domestic Product (GDP), (Current US$) revealed a strong positive correlational with an $R^2 = 0.96$ (See Appendix C). The best fitting curve for the data points was a polynomial curve (See Appendix B). The independent variable GDP was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Panama. The response variable Panama Mobile Telephone Subscriptions versus the covariate Gross National Expenditure Per Capita (% of GDP) revealed a weak correlational scatterplot with an $R^2 = 0.21$ (See Appendix C). The best fitting curve for the data points was a polynomial curve (See Appendix B). The independent variable Gross National Expenditure Per Capita was not significant at the 0.05 alpha level and removed from the regression model for predicting mobile telephone subscriptions in Panama.

The response variable Panama Mobile Telephone Subscriptions versus the covariate Gross National Income Growth (Current US$) revealed a weak positive correlational scatterplot with an $R^2 = 0.18$ (See Appendix C). The best fitting curve for the data points was an exponential curve (See Appendix B). The independent variable Gross National Income Growth was not significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Panama. The response variable Panama Mobile Telephone Subscriptions versus the covariate Health Expenditure Per Capita (% of GDP) revealed a strong positive correlational scatterplot with an $R^2 = 0.98$ (See Appendix C). The best fitting curve for the data points was a polynomial curve (See Appendix B). The independent variable Health Expenditure Per Capita was not significant at the 0.05 alpha level and removed the regression model for

predicting mobile telephone subscriptions in Panama. The response variable Panama Mobile Telephone Subscriptions versus the covariate Labor Force, Total revealed a strong positive correlational scatterplot with an $R^2 = 0.93$ (See Appendix C). The best fitting curve for the data points was a power curve (See Appendix B). The independent variable Labor Force, Total was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Panama. The response variable Panama Mobile Telephone Subscriptions versus the covariate Rural Population revealed a strong positive correlational scatterplot with an $R^2 = 0.93$ (See Appendix C). The best fitting curve for the data points was a power curve (See Appendix B). The independent variable Rural Population was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Panama. The response variable Panama Mobile Telephone Subscriptions versus the covariate Urban Population revealed a strong positive correlational scatterplot with an $R^2 = 0.91$ (See Appendix C). The best fitting curve for the data points was a power curve (See Appendix B). The independent variable Urban Population was significant at the 0.05 alpha level in the regression model for predicting mobile telephone subscriptions in Panama.

4.9.1 Multiple Regression Model for Panama's MTS Market.

The Panamanian mobile telephone subscription model displayed seven significant variables; the significant variables are Gross Domestic Product, Exports of Goods and Services (US$), Labor Force Total, Rural Population, and Urban Population. Interpreting the covariate, Exports of Goods and Services (Current US$) in the optimized regression model shows that if you keep all other variables the same at current levels in the

regression model and only increase Exports of Goods and Services (Current US$) by one unit then the number of mobile telephone subscriptions in Panama increases by 1.36. The probability of the regression output coefficient for Exports of Goods and Services (Current US$) happening by chance was 0.175%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Gross Domestic Product (Current US$) in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase GDP by one unit then the number of mobile telephone subscriptions in Panama decreases by 5.61. The probability of the regression output coefficient for GDP happening by chance was 0.369%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Labor Force, Total in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Labor Force, Total by one unit then the number of mobile telephone subscriptions in Panama increases by 2.54. The probability of the regression output coefficient for Labor Force, Total happening by chance was 1.52%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Rural Population in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Rural Population by one unit then the number of mobile telephone subscriptions in Panama decreases by 23.69. The probability of the regression output coefficient for Rural Population happening by chance was 0.522%, and this is significantly less than the 5% allowed at the 95% confidence level.

Interpreting the covariate, Urban Population in the optimized regression model shows that if you keep all other variables the same at current levels in the regression model and only increase Urban Population by one unit then the number of mobile telephone subscriptions in Panama increases by 26.14. The probability of the regression output coefficient for Urban Population happening by chance was 0.712%, and this is significantly less than the 5% allowed at the 95% confidence level. Furthermore, in regards to H4 on the population variable Urban Population, the following hypothesis is considered for Panama's market:

H4: The covariate Urban Population is significant for predicting mobile telephone subscriptions in Panama.

Answering H4 was done using probability via the p-value and Significance F of the model's output. The p-value showed it was a 0.712% probability of the regression output happening by chance and the Significance F test revealed that probability of the regression output happening by chance was 4.25E-07. The probabilities are less than 5% allowed at the 95% confidence level and demonstrate a likelihood of significance for the covariate in the regression model. The data was analyzed using the following mathematical equation:

Equation 9. Panama Mobile Telephone Subscriptions Model:

$$\text{Panama MTS} = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \beta_5 * X_5 + E$$

Table 32. Panama Model Parameters

β_0	Intercept
β_1	Model output coefficient of X_1;
β_2	Model output coefficient of X_2;
β_3	Model output coefficient of X_3;
β_4	Model output coefficient of X_4;
β_5	Model output coefficient of X_5;

Table 33. Panama Variables

X_1	$Covariate_1$, Gross Domestic Product;
X_2	$Covariate_2$, Exports of Goods and Services;
X_3	$Covariate_3$, Labor Force;
X_4	$Covariate_4$, Rural Population;
X_5	$Covariate_5$, Urban Population
E	Residual error; the difference between the observed value of the dependent variable (Y) and predicted value ($\bar{Y}$).

Table 34. Panama Model Summary

		Coefficients	Std. Err.	T Stat	P-value
Intercept		291.0311	80.68635	3.60694	0.00568
Gross Domestic Product	**	-5.61552	1.444912	-3.8864	0.00369
Exports of goods and services	**	1.363759	0.310978	4.38538	0.00175
Labor force, total	*	2.549795	0.853842	2.98626	0.01529
Rural population	**	-23.6946	6.47086	-3.6617	0.00522
Urban population	**	26.1428	7.54825	3.46342	0.00712

* p<.05; ** p<.01; *** p<.001

Table 35. Panama ANOVA Summary

	df	SS	MS	F	Sig. F
Regression	5	13.67838	2.735676	76.55366	4.25E-07
Residual	9	0.321619	0.035735		
Total	14	14			

4.10 Summary

In summary, only correlation scatterplots of the response variable versus the independent variable are shown; the correlation scatterplots of each independent variable versus the other independent variable was not shown in this section due to the vast

amount of plots constructed. In these correlation plots R-squared was used to tell the strength of correlation between the response variable and covariates; in addition to this, the line of best fit or curve of the line was found for the data points in the scatterplot (See Appendix B and Appendix C). The significant covariates of each regression model was interpreted and the information from the model summary and ANOVA table were both used for responding to the hypothesis of each market. It was determined that population and income contribute to mobile telephone subscription growth. Each SICA market has either a population or an income variable that showed significance in the number of mobile telephone subscriptions. The mathematical equation of each market's regression model was displayed along with a description of the parameters and significant variables.

Chapter V. Conclusions, Future Work, and Limitations

5.1 Conclusions

In this research, mobile telephone subscription growth in the full member markets of the Central American Integration System markets were studied. The mobile telephone subscription markets studied in this research were Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama. The main research question and research sub-questions were "*What's causing mobile telephone subscription growth in the full member markets of the Central American Integration System?*"; "*Why are some countries above 100% mobile telephone penetration rate?"* and *"Why are some countries not above 100% mobile telephone penetration rate?"* There are factors in each market that can play a role in a market's number of mobile telephone subscriptions. These factors coupled with the significant covariate(s) identified from the multiple regression model increases or decreases the number of mobile telephone subscriptions in a market. The Belizean mobile telephone subscription market has factors such as an increasing rural population, lack of infrastructure in areas throughout its rural and urban areas, as well as high unemployment that limits its mobile telephone subscription growth below 100% MPR. The Costa Rican mobile telephone subscription market has factors such as telecom infrastructure expansion by its government, increasing urban population, and a decline in landline use that contributes to its greater than 100% MPR. The Dominican Republic mobile telephone subscription market has factors such as high unemployment, increasing landline subscription service,

lack of infrastructure in rural areas, and high costs of owning the mobile device. The El Salvadorian mobile telephone subscription market is increasing mobile telephone subscriptions and the market hasn't reached its peaked, landline subscriptions are declining, the market has a declining youth population which suggests the family size is decreasing so more money can be spent on owning a mobile device. The Guatemalan mobile telephone subscription market has factors that leads to a high number of mobile telephone subscriptions such as a decline in landline subscriptions and a high prepaid mobile telephone market. Despite an increasing rural population and lack of infrastructure in the rural areas, Guatemala's mobile telephone subscription market is above 100% MPR. The Honduran mobile telephone subscription market has factors that contribute to its decline below 100% MPR such as an increasing rural population and lack of mobile telephone service infrastructure in those rural areas. The Nicaraguan mobile telephone subscription market continues to hover above 100% MPR; the market has factors such as an increasing rural and urban population that both have demand for mobile services as well as a decrease in youth population, which could allow extra income spent on a luxury device such as the mobile telephone.

The significance of the research is that it confirms prior literature results that population and income are determinants of mobile telephone adoption. This research also demonstrates that the poorer markets (MHD) tend to be almost double the market size of the HHD markets but the MPR was almost equal. For instance, the MHDI markets El Salvador, Guatemala, Honduras, and Nicaragua have a mobile penetration rate of 112% and the HHDI markets Belize, Costa Rica, Dominican Republic, and Panama have a mobile penetration rate of 110%. In 2000, at the start of the mobile telephone

subscription rise for the SICA markets, Panama had the highest mobile telephone penetration rate with 0.13; however from 2001 through 2003 Belize had the highest mobile telephone penetration rate with 0.15, 0.20, and 0.23 respectively. In 2004, 2005, and 2006 Panama had the highest mobile telephone penetration rate with 0.38, 0.51, and 0.63 respectively. In 2007 and 2008 El Salvador had the highest mobile telephone penetration rate and became the first market to reach 100% mobile telephone penetration rate with 1.00 and 1.12 respectively. The market with the highest mobile telephone penetration rate from 2009 to 2014 was Panama with 1.67, 1.80, 1.80, 1.63, 1.62, and 1.58 respectively. When observing the unemployment rate for year 2014 in each market, it appears that countries with highest income per capita tend to have the highest mobile telephone penetration rate. Although income is a contributor to the number of mobile telephone subscriptions in the SICA markets, it doesn't always mean when the unemployment rate is high that the mobile telephone penetration rate will be low for a particular country. For instance, Costa Rica, a HHDI market, had a mobile telephone penetration rate of 143% in 2014, however the unemployment rate was 9.60. This is 3.83% higher than the world average unemployment rate and yet Costa Rica's mobile telephone subscription market is able to thrive in high unemployment conditions. Belize, however has a high unemployment rate as well as the lowest mobile telephone penetration rate among all full member SICA markets. Three of the four markets that have the highest unemployment for year 2014 are HHDI markets; those markets are Belize, Costa Rica, and Dominican Republic. Costa Rica is the only market of the three to have a mobile telephone penetration rate above 100%. On the contrary, there are three MHDI markets that have the lowest unemployment rates among the full member SICA

markets. Those markets are Guatemala, Honduras, and Nicaragua. Guatemala and Nicaragua both have mobile telephone penetration rates above 100%. EL Salvador, a MHDI market had an unemployment rate of 5.9%, and this is only 0.02% higher than the world average. In addition to its low unemployment rate, El Salvador has a 144% mobile telephone penetration rate; this is the second highest mobile telephone penetration rates among all SICA markets. The results of the regression analysis show the covariates, Adjusted Net National Income per Capita, Exports of Goods and Services, Gross Domestic Product, and Urban Population are the best contributing variables to mobile telephone subscription growth in the full member markets of the Central American Integration System. These variables show significant contributions to the growth of mobile telephone subscriptions to both MHD and HHD markets in the Central American Integration System. MHD markets are likely to have the income covariate Exports of Goods and Services as a significant covariate when explaining mobile telephone subscription growth. HHD markets are likely to have Adjusted Net National Income per Capita, Gross Domestic Product, and Urban Population as significant covariates when explaining mobile telephone subscription growth. The income variable Gross National Income Growth was the least likely covariate to be a contributor to the growth of mobile telephone subscriptions in a HHD market.

In conclusion, mobile telephone penetration rate and growth of mobile telephone subscriptions were both shown to be influenced by population and income variables in the full member SICA markets; and the number of mobile telephone subscriptions will increase or decrease based on other factors when coupled with the significant variables. Multiple regression analysis was used to identify those population and income covariates

that are significant variables. The significant covariates and unemployment rate shows a correlation to the number of mobile telephone subscriptions and mobile telephone penetration rate but this does not necessarily mean it's explaining all increase in the number of mobile telephone subscriptions and all increase in the mobile telephone penetration rate for the full member SICA markets. This research is distinguished from prior studies due to the difference in covariates used in the study and the difference in region studied. Very little and no research at all in some markets has been conducted on mobile telephone subscriptions and mobile penetration rates throughout the Central American Integration System. The event of mobile telephone subscriptions outnumbering the global population has to first occur on the local and regional level. This dissertation studies mobile telephone subscriptions on the regional level; and finding out why this phenomenon is occurring on the regional level helps to understand the phenomenon on the global level.

5.2 Future Work

Exploring prices of mobile telephones as a variable in the mobile telephone subscription market is an option for future work. In particular, the question that would be asked when conducting this future work on the Belizean and Dominican Republic mobile telephone subscription markets is "if prices of mobile telephones were reduced in Belize and the Dominican Republic, would this increase the MPR and the number of mobile telephone adopters?" If not, then these households may be very satisfied with using the landline for its telephony needs. Additional future research includes studying Panama's

high mobile telephone penetration rate. Only six markets globally have a higher mobile penetration rate than Panama. Urban Population was a significant covariate in the Panamanian MTS model. This covariate will be looked further in detail at its adult and young adult population. In addition, the investigation of female and male smartphone use in Panama will be studied. Future research also includes focusing particularly on smartphone adoption and use of the device in these SICA markets. The goal of this research is to find the specific needs of the majority of smartphone users in SICA markets; then assemble a prototype of the device that can be tested on networks. Also exploring capacity expansion planning of the mobile network is a future direction of research. Finally, getting this research published is a future goal. This involves dividing the dissertation into at least two academic papers and submitting these papers to an academic journal; the other option is to have one book published where the topics of discussion are mobile telephone subscriptions and mobile penetration rate in the full member markets of the Central American Integration System.

5.3 Business Implications

Telecommunications network operators and mobile telephone manufacturers can capitalize on the sparseness of mobile telephone service infrastructure and smartphones in some of the full member markets of the Central American Integration System. Belize, Dominican Republic, El Salvador, Guatemala, Honduras, and Nicaragua are markets that have lack of telecommunications infrastructure. This lack of infrastructure is an opportunity for the current licensed network operators to build infrastructure in each

market and expand its presence in the marketplace. The telecommunications infrastructure expansion should take place in rural areas as well as in the urban areas. In addition to network expansion mobile telephone manufacturers can take advantage of the lack of smartphone adoption in these markets. Just as the basic feature mobile telephone phased out the landline, the Smartphone is gradually phasing out the basic feature mobile telephone. Smartphones and the data usage on the mobile device is the future direction of the mobile device. Mobile telephone manufacturers who quickly take advantage of the lack of Smartphone adoption by proliferating its device at a reasonable price throughout the markets can start early to create a brand and build a loyal customer base. However, the telecommunications infrastructure needs to be in place prior to the proliferation of the Smartphone.

5.4 Limitations

The International Telecommunications Union allows 90 days of inactive service of a mobile telephone number before that mobile telephone subscription becomes not counted as an active mobile telephone subscription. GSMA does not include the inactive service accounts. GSMA only counts unique mobile subscribers, which are current mobile telephone subscriber accounts. These two organizations derive a different number when counting the number of mobile telephone subscribers globally. However, in this research all dependent variable data used for the statistical models are from the International Telecommunications Union's database. Due to the ITU's count of inactive mobile telephone service accounts there could be a number of inactive mobile telephone

subscriptions included in a full member SICA markets' count of mobile telephone subscriptions. Finally having a 100% accurate count of the number of mobile telephone subscriptions globally is difficult to track at this point due to the uncertainty that people may or may not have two mobile telephones or the users are sharing a mobile telephone but switch SIM cards when personally using another person's mobile phone.

VI. Appendices

Appendix A: Correlation Tables

Belize

	Belize MTS	Health exp per cap (US$)	GDP (current US$)	GNI growth (%)	Fdi, net outflows (% of GDP)	Adj net nat inc per cap (US$)	Adolescent fert rate	Armed forces, personnel	Enr in prim edu	Exp of G. & S (US$)	Fdi, net inflows (% of GDP)	Gross nat exp (% of GDP)	Labor force, total	Rural pop	Urban pop
Belize MTS	1.00														
Health exp per cap (US$)	0.94	1.00													
GDP (US$)	0.92	0.97	1.00												
GNI growth (%)	-0.50	-0.49	-0.52	1.00											
Fdi, net outflows (% of GDP)	-0.32	-0.28	-0.26	0.62	1.00										
Adj net nat inc per cap (US$)	0.78	0.88	0.94	-0.40	-0.28	1.00									
Adolescent fert rate	-0.95	-0.96	-0.98	0.58	0.35	-0.90	1.00								
Armed forces personnel	-0.39	-0.26	-0.37	0.57	0.23	-0.28	0.48	1.00							
Enr in prim edu	0.91	0.86	0.89	-0.58	-0.32	0.78	-0.95	-0.64	1.00						
Exp of G & S (US$)	0.88	0.93	0.99	-0.52	-0.20	0.93	-0.95	-0.38	0.86	1.00					
Fdi, net inflows (% of GDP)	0.39	0.32	0.40	-0.56	-0.16	0.30	-0.46	-0.81	0.60	0.41	1.00				
Gross nat exp (% of GDP)	-0.84	-0.75	-0.80	0.68	0.45	-0.73	0.88	0.64	-0.92	-0.80	-0.53	1.00			
Labor force	0.92	0.99	0.99	-0.49	-0.25	0.93	-0.97	-0.28	0.86	0.96	0.34	-0.77	1.00		
Rural pop	0.93	0.98	0.99	-0.51	-0.28	0.94	-0.98	-0.32	0.88	0.97	0.36	-0.79	1.00	1.00	
Urban pop	0.93	0.98	1.00	-0.52	-0.29	0.94	-0.98	-0.34	0.89	0.97	0.37	-0.80	1.00	1.00	1.00

Costa Rica Correlations

	Costa Rica MTS	GDP (US$)	GNI growth (%)	Fdi, net outflows (% of GDP)	Adj net nat inc per cap (US$)	Adolescent fert rate	Enr in prim edu	Exp of G&S (US$)	Fdi, net inflows (% of GDP)	Health exp per cap (US$)	Labor force	Rural Pop	Urban pop
Costa Rica MTS	1.00												
GDP (US$)	0.97	1.00											
GNI growth (%)	-0.36	-0.37	1.00										
Fdi, net outflows (% of GDP)	0.72	0.72	0.08	1.00									
Adj net nat inc per cap (US$)	0.85	0.94	-0.32	0.61	1.00								
Adolescent fert rate	-0.83	-0.91	0.42	-0.58	-0.92	1.00							
Enr in prim edu	-0.99	-0.97	0.36	-0.70	-0.88	0.82	1.00						
Exp of G&S (US$)	0.94	0.99	-0.31	0.69	0.95	-0.95	-0.94	1.00					
Fdi, net inflows (% of GDP)	0.56	0.63	0.05	0.60	0.66	-0.75	-0.54	0.73	1.00				
Health exp per cap (US$)	0.95	1.00	-0.39	0.71	0.95	-0.91	-0.96	0.97	0.61	1.00			
Labor force	0.89	0.95	-0.45	0.62	0.94	-0.99	-0.89	0.97	0.72	0.95	1.00		
Rural Pop	-0.93	-0.98	0.43	-0.64	-0.94	0.98	0.92	-0.99	-0.68	-0.97	-0.99	1.00	
Urban pop	0.91	0.97	-0.44	0.63	0.94	-0.98	-0.91	0.98	0.69	0.96	1.00	-1.00	1.00

Dominican Republic Correlations

	Dominican Republic MTS	GDP (US$)	GNI growth (%)	Fdi, net outflows (% of GDP)	Adj net nat inc per cap (US$)	Adolescent fert rate	Armed forces personnel	Enr in prim edu	Exp of G&S (US$)	Fdi, net inflows (% of GDP)	Gross nat exp (% of GDP)	Health exp per cap (US$)	Labor force	Urban pop	Rural Pop
Dominican Republic MTS	1.00														
GDP (US$)	0.96	1.00													
GNI growth (%)	0.07	0.17	1.00												
Fdi, net outflows (% of GDP)	-0.28	-0.18	0.41	1.00											
Adj net nat inc per cap (US$)	0.96	0.99	0.19	-0.20	1.00										
Adolescent fert rate	-0.86	-0.93	0.04	0.27	-0.89	1.00									
Armed forces personnel	0.40	0.53	0.36	0.57	0.47	-0.51	1.00								
Enr in prim edu	-0.52	-0.50	-0.32	-0.17	-0.45	0.48	-0.52	1.00							
Exp of G&S (US$)	0.83	0.93	0.13	-0.02	0.89	-0.95	0.68	-0.58	1.00						
Fdi, net inflows (% of GDP)	0.05	0.07	0.05	0.47	0.11	0.11	0.18	-0.12	0.02	1.00					
Gross nat exp (% of GDP)	0.44	0.46	0.37	-0.07	0.56	-0.19	0.01	0.01	0.21	0.44	1.00				
Health exp per cap (US$)	0.87	0.96	0.16	-0.17	0.97	-0.89	0.51	-0.32	0.87	0.10	0.57	1.00			
Labor force	0.96	0.96	0.10	-0.17	0.94	-0.92	0.55	-0.61	0.92	0.01	0.27	0.86	1.00		
Urban pop	0.96	0.97	0.09	-0.18	0.95	-0.94	0.55	-0.60	0.94	0.00	0.28	0.88	1.00	1.00	
Rural Pop	-0.96	-0.98	-0.09	0.19	-0.96	0.95	-0.56	0.58	-0.95	0.00	-0.30	-0.90	-0.99	-1.00	1.00

El Salvador Correlations

	El Salvador MTS	GDP (US$)	GNI growth (%)	Fdi, net outflows (% of GDP)	Adj net nat inc per cap (US$)	Adolescent fert rate	Armed forces personnel	Enr in prim edu	Fdi, net inflows (% of GDP)	Gross nat exp (% of GDP)	Health exp per cap (US$)	Labor force	Rural pop	Urban pop
El Salvador MTS	1.00													
GDP (US$)	0.98	1.00												
GNI growth (%)	-0.34	-0.24	1.00											
Fdi, net outflows (% of GDP)	0.26	0.30	0.12	1.00										
Adj net nat inc per cap (US$)	0.99	1.00	-0.24	0.29	1.00									
Adolescent fert rate	-0.98	-0.99	0.30	-0.26	-0.98	1.00								
Armed forces personnel	0.66	0.61	-0.28	0.15	0.61	-0.58	1.00							
Enr in prim edu	-0.64	-0.65	0.35	-0.09	-0.61	0.69	-0.65	1.00						
Fdi, net inflows (% of GDP)	-0.08	-0.07	0.27	0.27	-0.04	0.17	-0.01	0.45	1.00					
Gross nat exp (% of GDP)	0.45	0.51	0.43	0.31	0.54	-0.40	0.15	0.14	0.53	1.00				
Health exp per cap (US$)	0.94	0.95	-0.31	0.24	0.94	-0.98	0.62	-0.82	-0.26	0.27	1.00			
Labor force	0.97	0.98	-0.32	0.28	0.97	-0.99	0.65	-0.75	-0.21	0.36	0.99	1.00		
Rural pop	-0.97	-0.99	0.29	-0.30	-0.98	1.00	-0.59	0.70	0.16	-0.40	-0.98	-0.99	1.00	
Urban pop	0.97	0.99	-0.28	0.31	0.98	-1.00	0.56	-0.66	-0.14	0.43	0.97	0.99	-1.00	1.00

Guatemala Correlations

	Guatemala MTS	GDP (US$)	GNI growth (%)	Fdi, net outflows (% of GDP)	Adj net nat inc per cap (US$)	Adolescent fert rate	Armed forces personnel	Enr in prim edu	Exp of G & S (US$)	Fdi, net inflows (% of GDP)	Gross nat exp (% of GDP)	Health exp per cap (US$)	Labor force	Rural pop	Urban pop
Guatemala MTS	1.00														
GDP (US$)	0.94	1.00													
GNI growth (%)	0.04	0.15	1.00												
Fdi, net outflows (% of GDP)	0.62	0.59	0.08	1.00											
Adj net nat inc per cap (US$)	0.94	1.00	0.17	0.61	1.00										
Adolescent fert rate	-0.96	-0.98	-0.10	-0.71	-0.98	1.00									
Armed forces personnel	-0.68	-0.53	-0.11	-0.64	-0.55	0.64	1.00								
Enr in prim edu	0.88	0.76	-0.05	0.83	0.77	-0.87	-0.82	1.00							
Exp of G & S (US$)	0.95	0.99	0.16	0.61	0.98	-0.98	-0.55	0.81	1.00						
Fdi, net inflows (% of GDP)	0.71	0.69	0.17	0.98	0.71	-0.80	-0.69	0.87	0.71	1.00					
Gross nat exp (% of GDP)	-0.42	-0.39	0.46	0.17	-0.37	0.30	-0.07	-0.13	-0.34	0.13	1.00				
Health exp per cap (US$)	0.94	0.98	0.16	0.68	0.98	-0.99	-0.65	0.85	0.98	0.77	-0.25	1.00			
Labor force	0.96	0.99	0.12	0.66	0.99	-1.00	-0.61	0.84	0.99	0.75	-0.35	0.99	1.00		
Rural pop	0.95	0.98	0.10	0.71	0.98	-1.00	-0.63	0.87	0.98	0.79	-0.30	0.99	1.00	1.00	
Urban pop	0.95	0.99	0.10	0.66	0.99	-1.00	-0.58	0.83	0.99	0.75	-0.35	0.99	1.00	1.00	1.00

Honduras Correlations

	Honduras MTS	GDP (US$)	GNI growth (%)	Fdi, net outflows (% of GDP)	Adj net nat inc per cap (US$)	Adolescent fert rate	Exp of G&S (US$)	Fdi, net inflows (% of GDP)	Gross nat exp (% of GDP)	Health exp per cap (current US$)	Labor force	Urban pop	Rural Pop
Honduras MTS	1.00												
GDP (US$)	0.93	1.00											
GNI growth (%)	-0.55	-0.40	1.00										
Fdi, net outflows (% of GDP)	-0.08	0.15	0.27	1.00									
Adj net nat inc per cap (US$)	0.96	0.99	-0.43	0.14	1.00								
Adolescent fert rate	-0.92	-0.99	0.36	-0.15	-0.98	1.00							
Exp of G&S (US$)	0.84	0.96	-0.18	0.26	0.95	-0.96	1.00						
Fdi, net inflows (% of GDP)	0.02	0.18	0.68	0.68	0.17	-0.22	0.36	1.00					
Gross nat exp (% of GDP)	0.42	0.40	0.30	0.42	0.45	-0.46	0.48	0.80	1.00				
Health exp per cap (current US$)	0.92	0.99	-0.44	0.18	0.99	-0.98	0.95	0.16	0.39	1.00			
Labor force	0.91	0.99	-0.39	0.15	0.98	-0.98	0.95	0.17	0.36	0.98	1.00		
Urban pop	0.92	0.99	-0.36	0.16	0.98	-1.00	0.96	0.22	0.43	0.98	0.99	1.00	
Rural Pop	0.91	0.94	-0.31	0.14	0.95	-0.98	0.92	0.27	0.55	0.94	0.92	0.97	1.00

Nicaragua Correlations

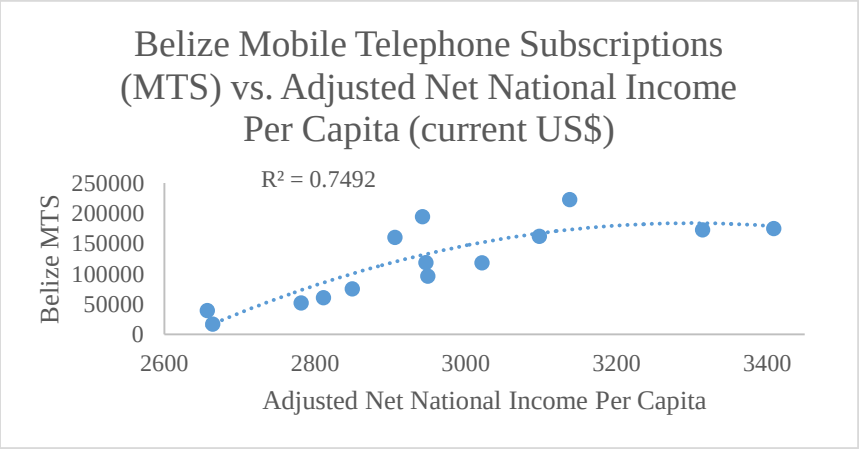
	Nicaragua MTS	GDP (US$)	GNI growth (%)	Adj net nat inc per cap (US$)	Adolescent fert rate	Armed forces personnel	Exp of G&S (US$)	Fdi, net inflows (% of GDP)	Gross nat exp (% of GDP)	Health exp per cap (US$)	Labor force	Rural pop	Urban pop
Nicaragua MTS	1.00												
GDP (US$)	0.99	1.00											
GNI growth (%)	0.21	0.20	1.00										
Adj net nat inc per cap (US$)	0.98	1.00	0.19	1.00									
Adolescent fert rate	-0.98	-0.98	-0.18	-0.98	1.00								
Armed forces personnel	-0.83	-0.85	0.02	-0.86	0.91	1.00							
Exp of G&S (US$)	0.99	0.99	0.27	0.98	-0.97	-0.82	1.00						
Fdi, net inflows (% of GDP)	0.82	0.84	0.36	0.85	-0.80	-0.74	0.85	1.00					
Gross nat exp (% of GDP)	-0.27	-0.24	0.53	-0.20	0.25	0.20	-0.25	0.02	1.00				
Health exp per cap (US$)	0.98	0.98	0.21	0.97	-0.94	-0.79	0.96	0.76	-0.27	1.00			
Labor force	0.98	0.98	0.18	0.98	-1.00	-0.90	0.96	0.79	-0.22	0.94	1.00		
Rural pop	0.95	0.96	0.16	0.96	-0.99	-0.92	0.94	0.78	-0.19	0.92	1.00	1.00	
Urban pop	0.98	0.98	0.18	0.98	-1.00	-0.90	0.97	0.80	-0.24	0.95	1.00	0.99	1.00

Panama Correlations

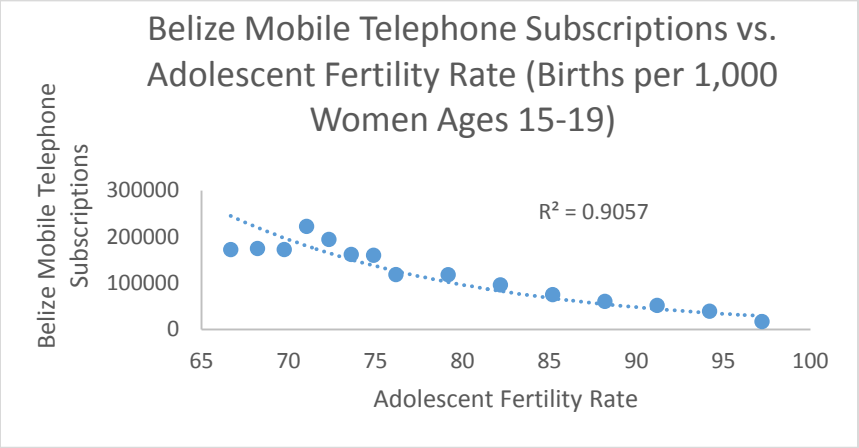
	Panama MTS	GDP (US$)	GNI growth (%)	Fdi, net outflows (% of GDP)	Adj net nat inc per cap (US$)	Adolescent fert rate	Enr in prim edu	Exp of G&S (US$)	Fdi, net inflows (% of GDP)	Gross nat exp (% of GDP)	Health exp per cap (current US$)	Labor force	Rural pop	Urban pop
Panama MTS	1.00													
GDP (US$)	0.89	1.00												
GNI growth (%)	0.31	0.34	1.00											
Fdi, net outflows (% of GDP)	-0.12	-0.04	0.55	1.00										
Adj net nat inc per cap (US$)	0.93	0.98	0.33	-0.09	1.00									
Adolescent fert rate	-0.91	-0.94	-0.40	0.05	-0.96	1.00								
Enr in prim edu	0.71	0.56	0.54	-0.07	0.66	-0.79	1.00							
Exp of G&S (US$)	0.94	0.97	0.45	-0.04	0.97	-0.93	0.64	1.00						
Fdi, net inflows (% of GDP)	0.32	0.32	0.68	0.55	0.35	-0.41	0.50	0.37	1.00					
Gross nat exp (% of GDP)	0.13	0.21	0.53	0.43	0.19	-0.11	0.03	0.26	0.36	1.00				
Health exp per cap (current US$)	0.89	0.99	0.26	-0.04	0.97	-0.92	0.51	0.95	0.26	0.21	1.00			
Labor force	0.96	0.95	0.39	-0.09	0.97	-0.99	0.77	0.96	0.39	0.15	0.94	1.00		
Rural pop	0.95	0.94	0.42	-0.06	0.97	-0.99	0.79	0.96	0.43	0.15	0.93	1.00	1.00	
Urban pop	0.95	0.96	0.41	-0.06	0.98	-0.99	0.76	0.97	0.41	0.16	0.94	1.00	1.00	1.00

Appendix B: Correlation Plots

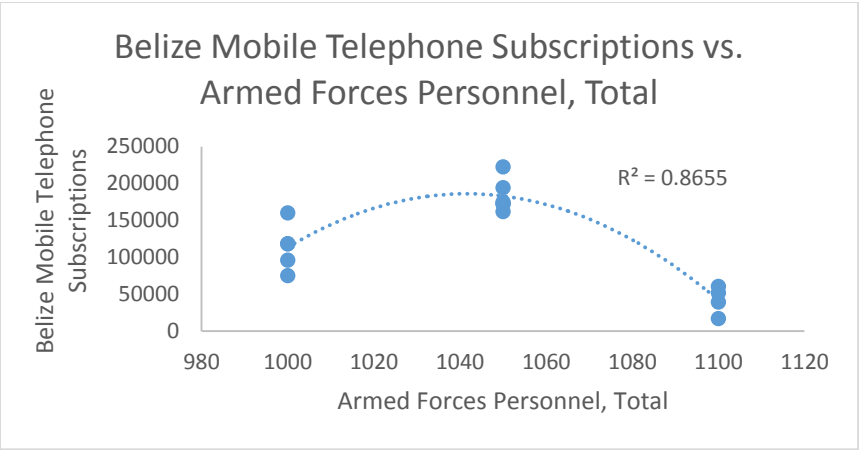
Belize MTS vs. Adjusted Net National Income Per Capita



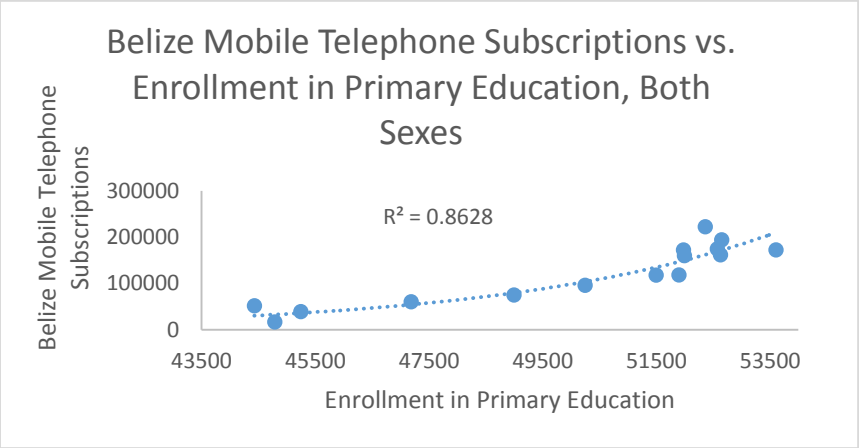
Belize MTS vs. Adolescent Fertility Rate



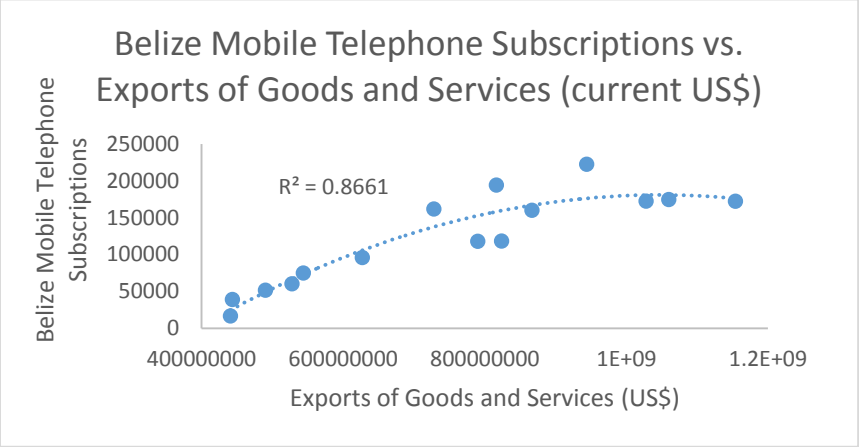
Belize MTS vs. Armed Forces Personnel, Total



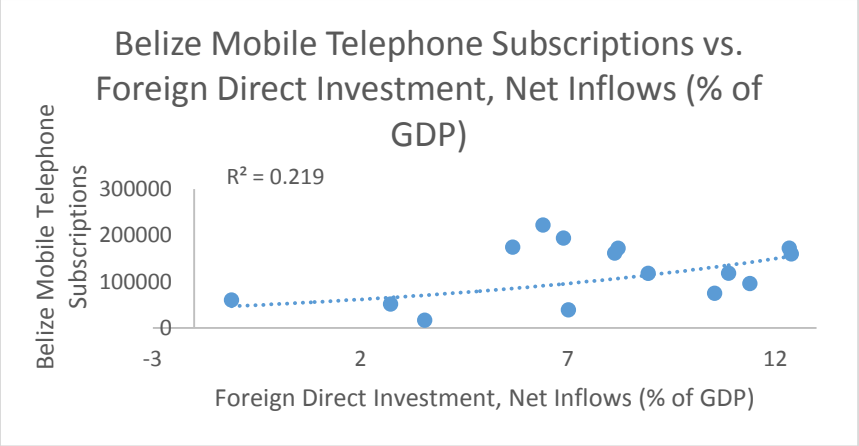
Belize MTS vs. Enrollment in Primary Education, Both Sexes



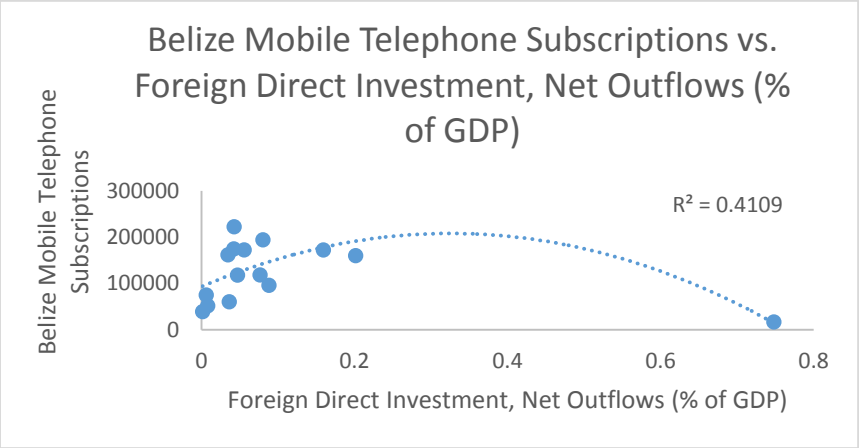
Belize MTS vs. Exports of Goods and Services



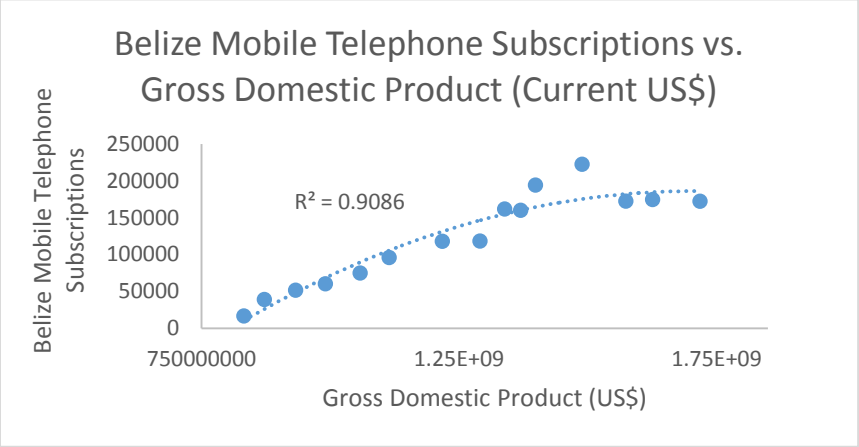
Belize MTS vs. Foreign Direct Investment, Net Inflows



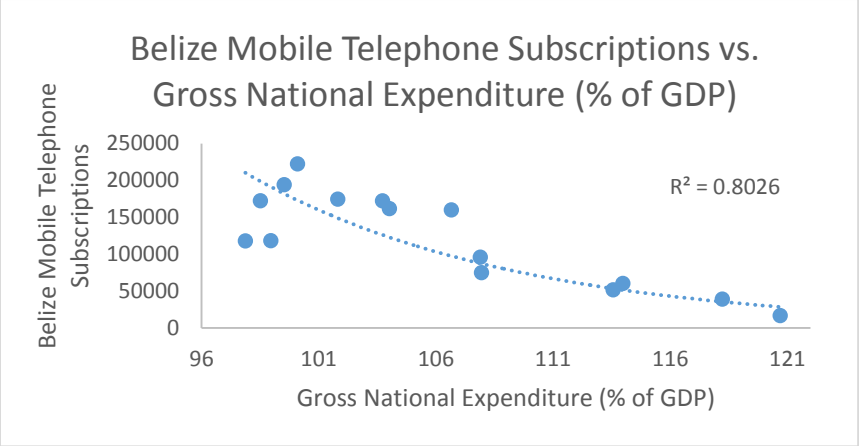
Belize MTS vs. Foreign Direct Investment, Net Outflows



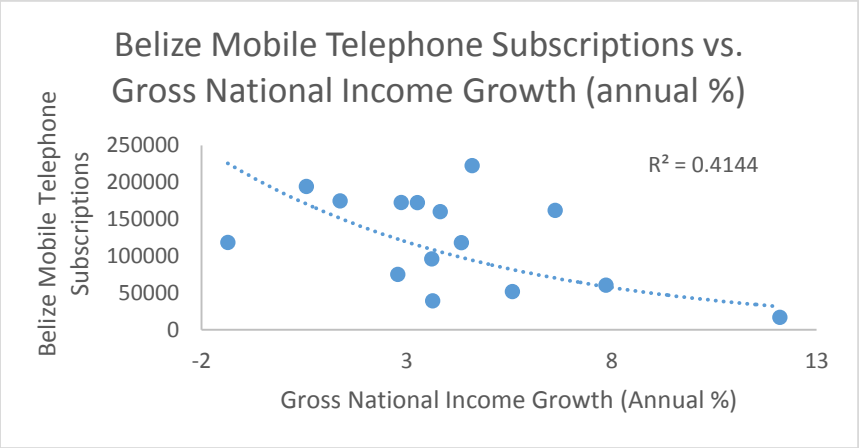
Belize MTS vs. Gross Domestic Product



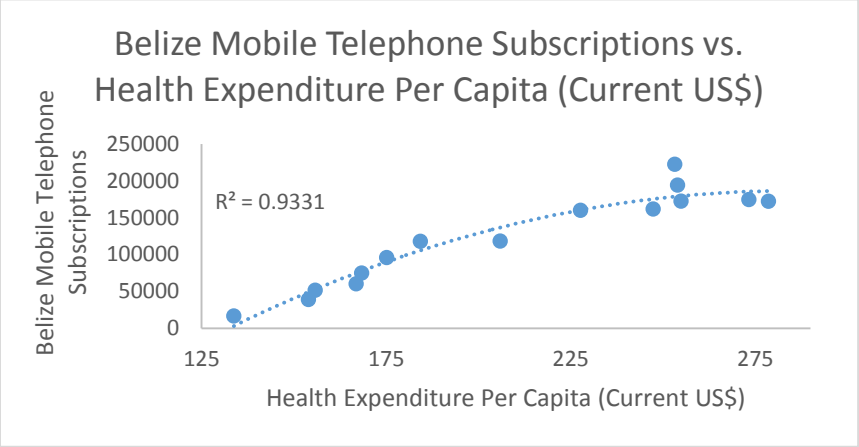
Belize MTS vs. Gross National Expenditure



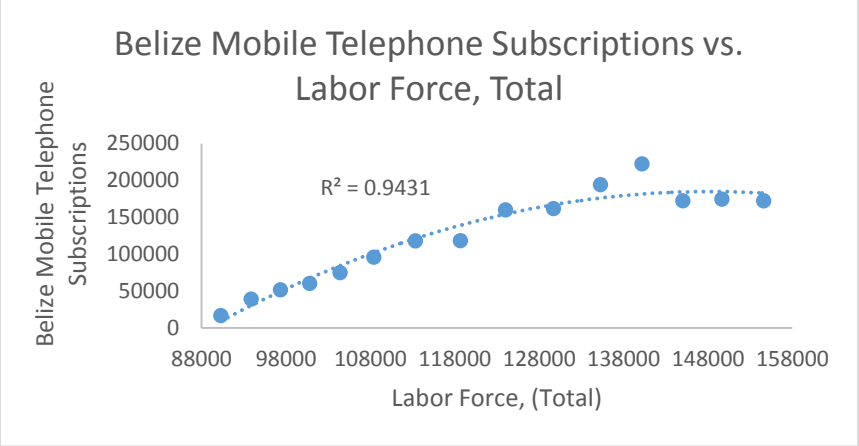
Belize MTS vs. Gross National Income Growth



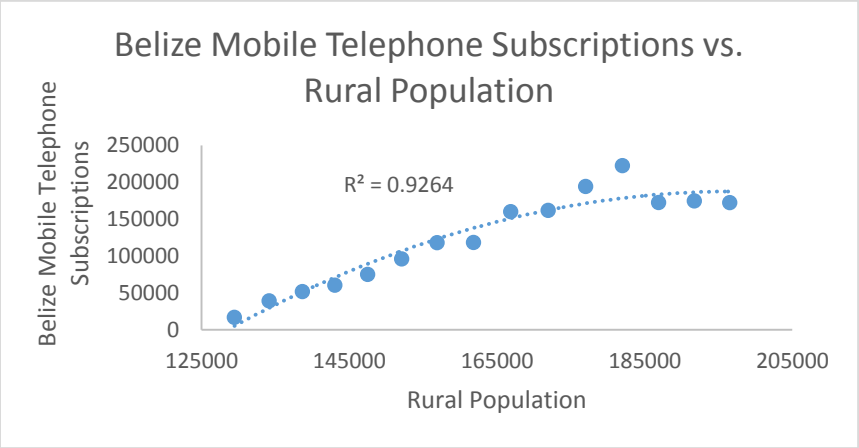
Belize MTS vs. Health Expenditure Per Capita



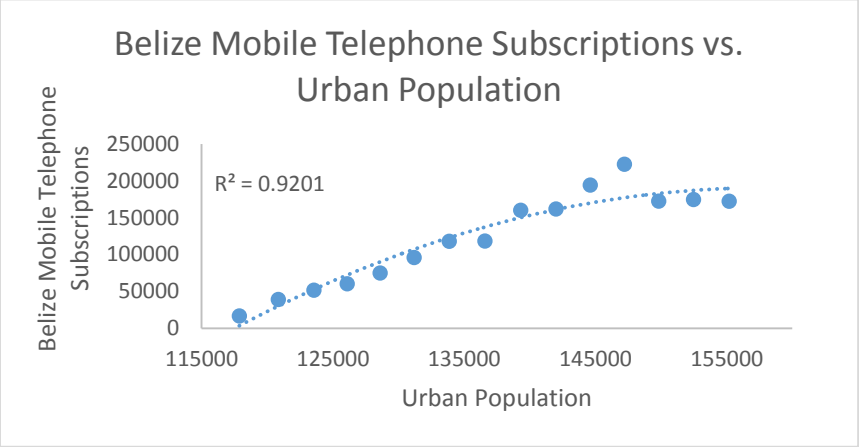
Belize MTS vs. Labor Force, Total



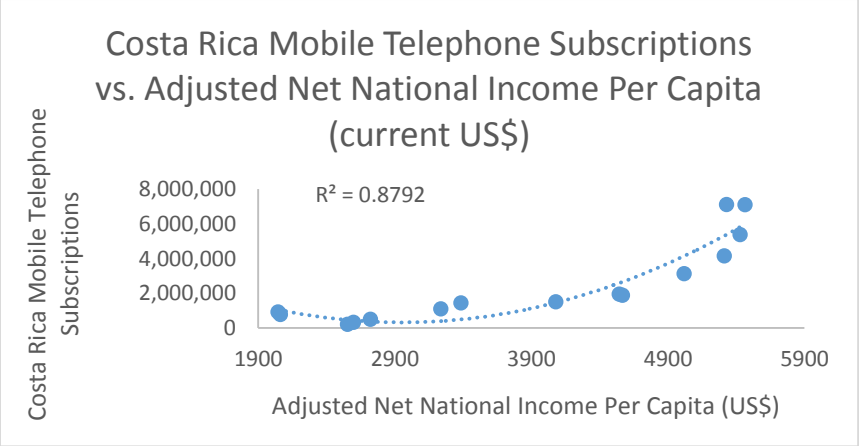
Belize MTS vs. Rural Population



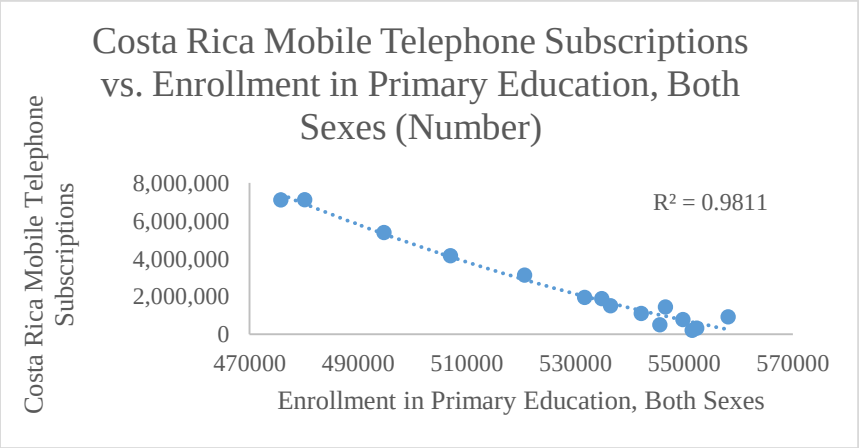
Belize MTS vs. Urban Population



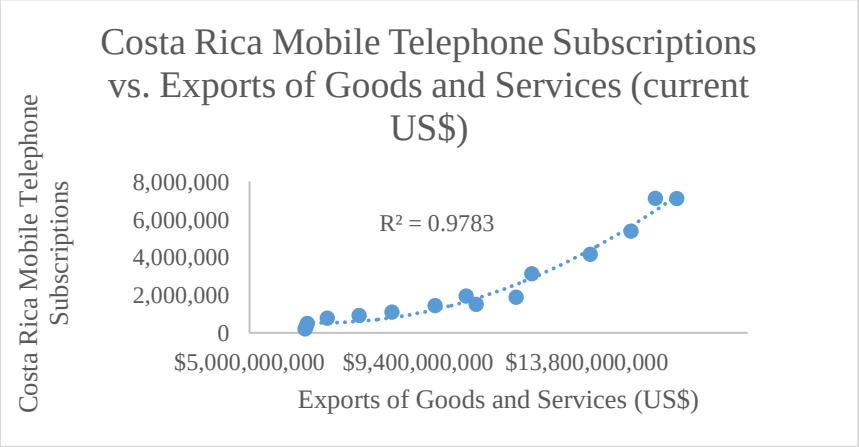
Costa Rica MTS vs. Adjusted Net National Income Per Capita



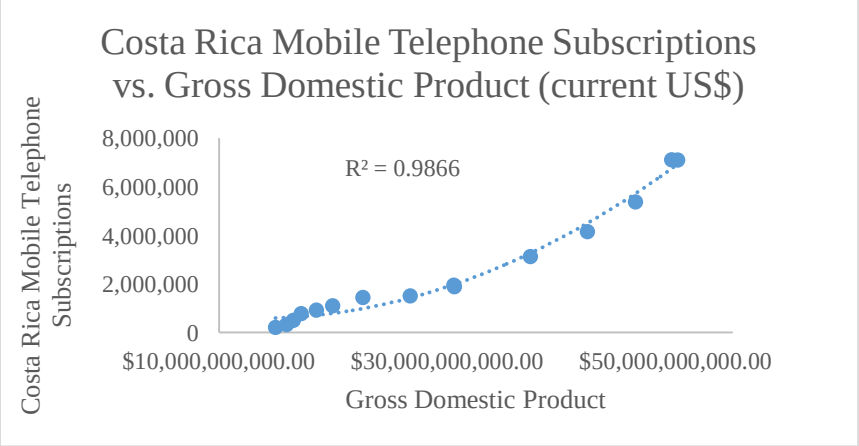
Costa Rica MTS vs. Enrollment in Primary Education



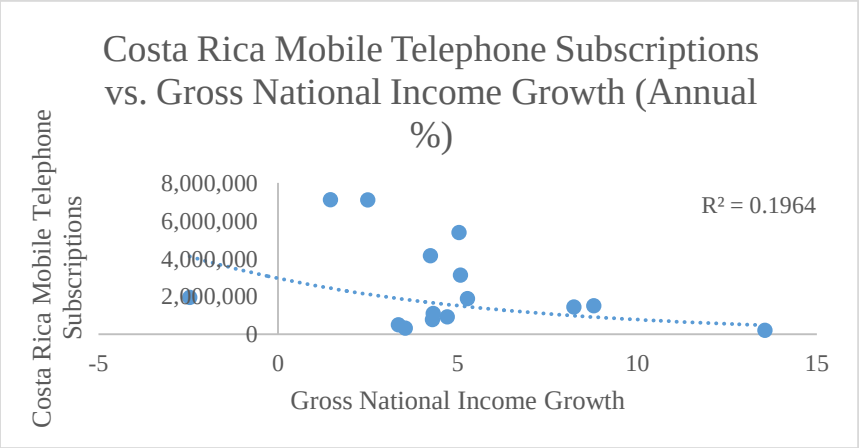
Costa Rica MTS vs. Exports of Goods and Services



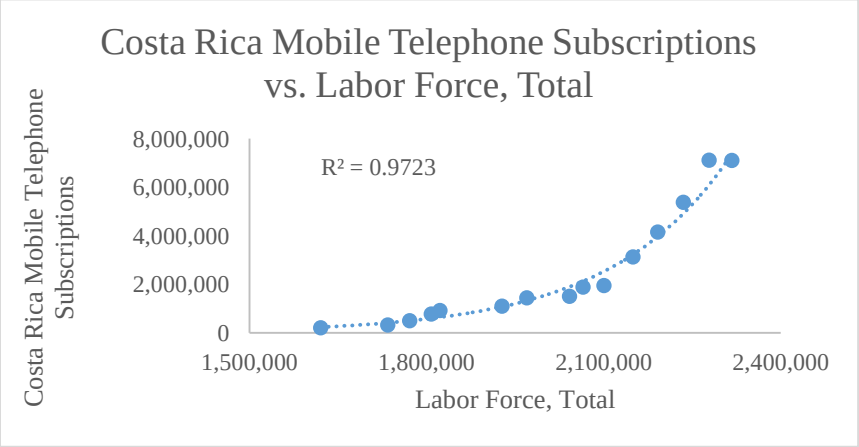
Costa Rica MTS vs. Gross Domestic Product



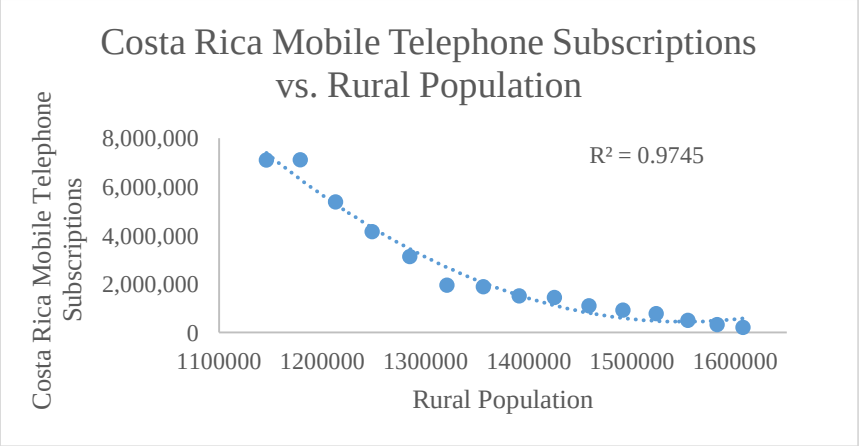
Costa Rica MTS vs. Gross National Income Growth



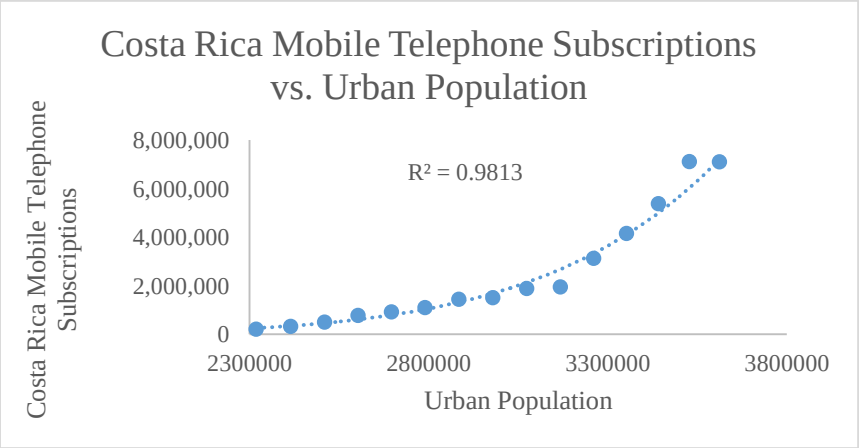
Costa Rica MTS vs. Labor Force, Total



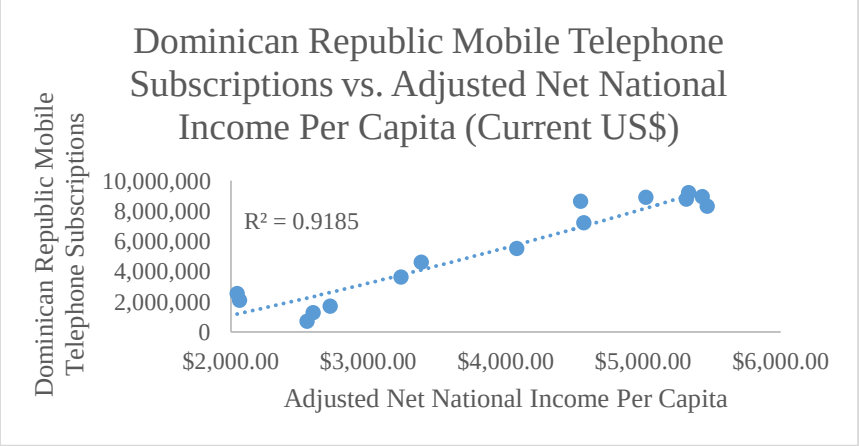
Costa Rica MTS vs. Rural Population



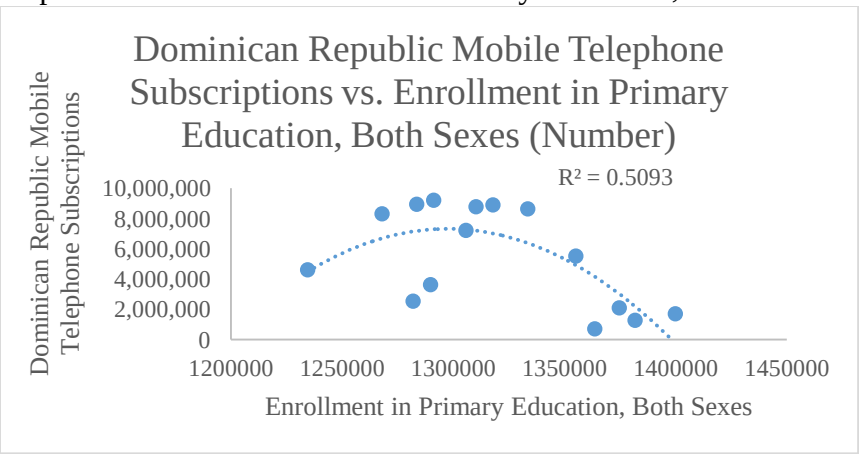
Costa Rica MTS vs. Urban Population



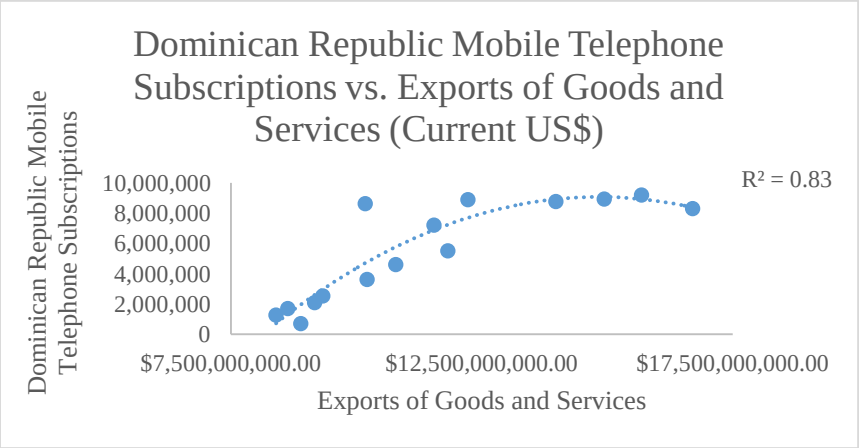
Dominican Republic MTS vs. Adjusted Net National Income Per Capita



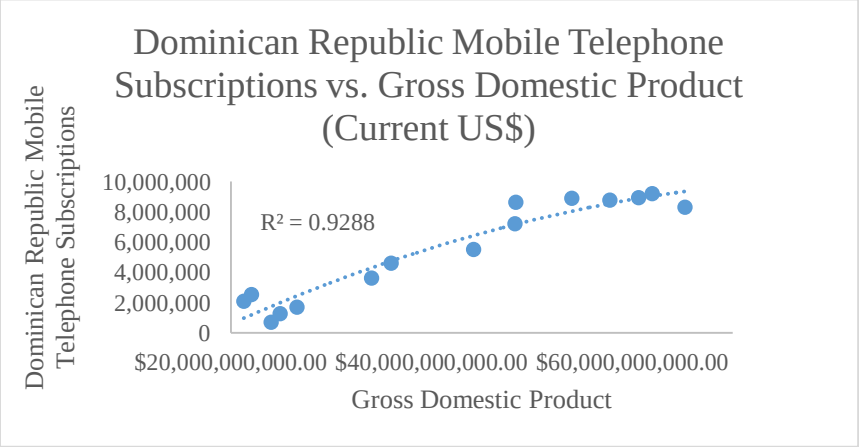
Dominican Republic MTS vs. Enrollment in Primary Education, Both Sexes



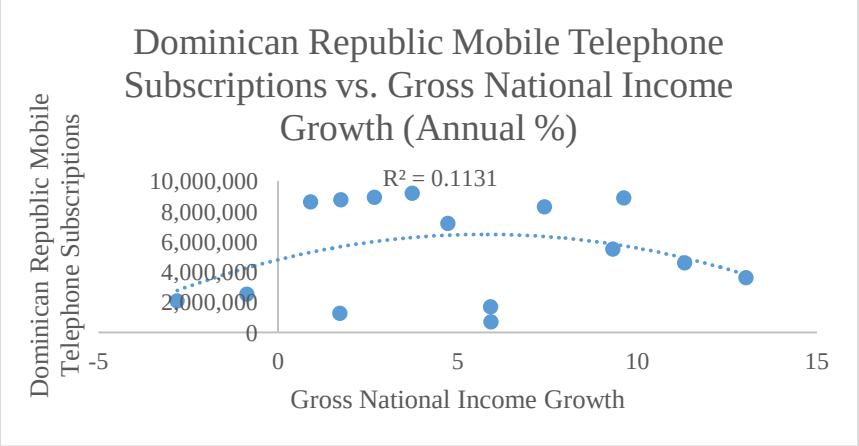
Dominican Republic MTS vs. Exports of Goods and Services



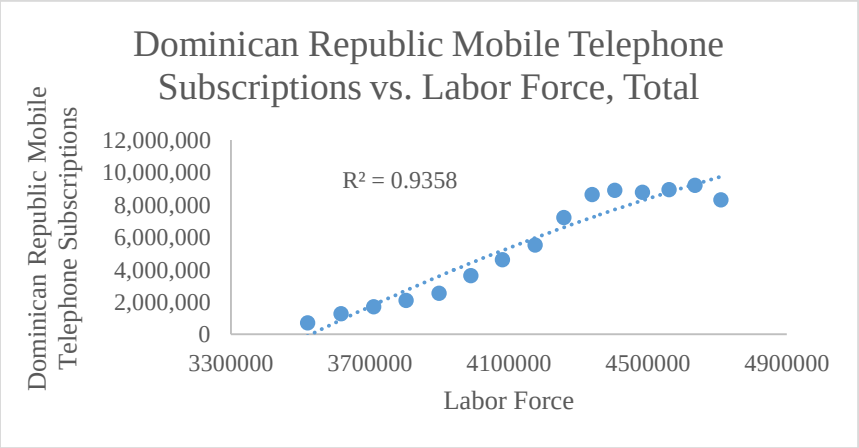
Dominican Republic MTS vs. Gross Domestic Product



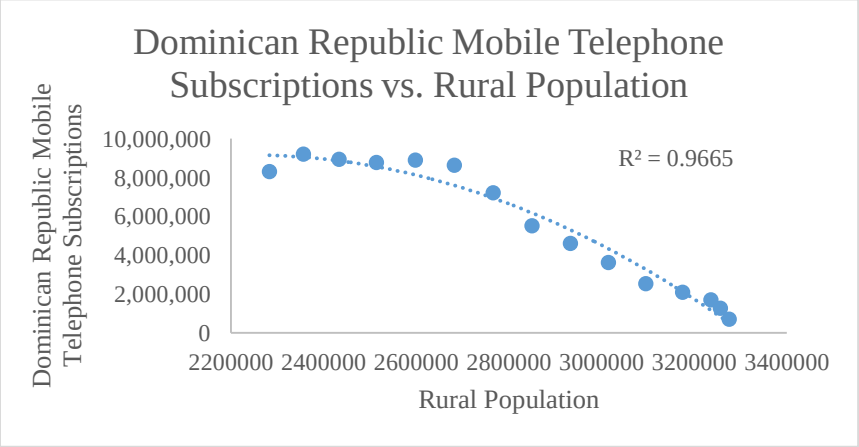
Dominican Republic MTS vs. Gross National Income Growth



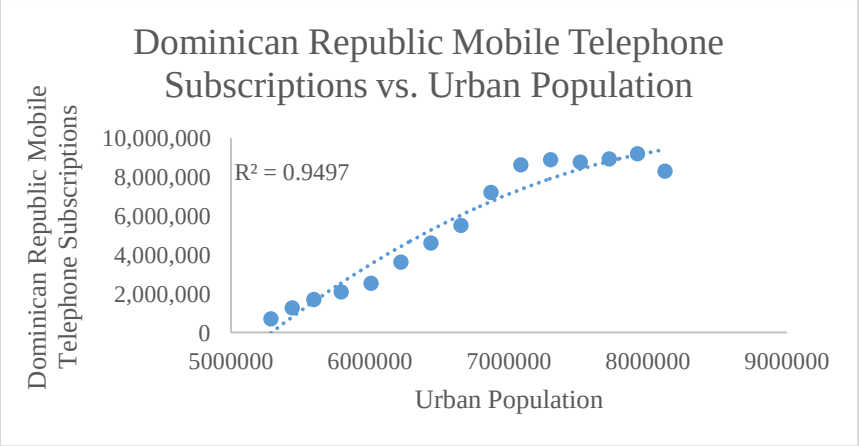
Dominican Republic MTS vs. Labor Force, Total



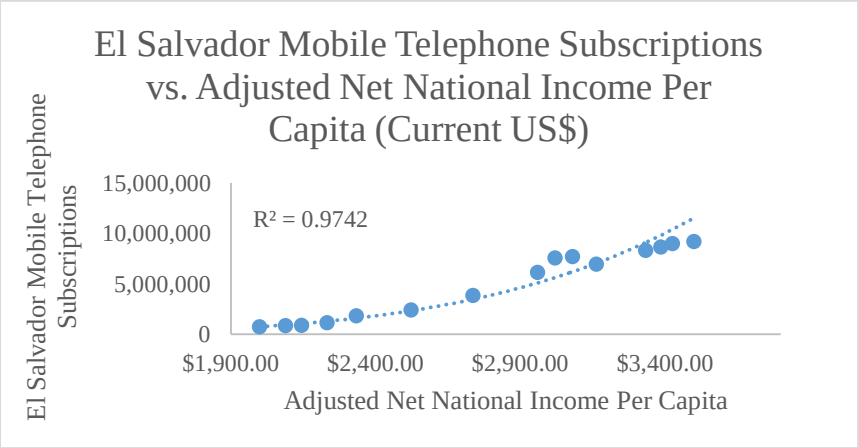
Dominican Republic MTS vs. Rural Population



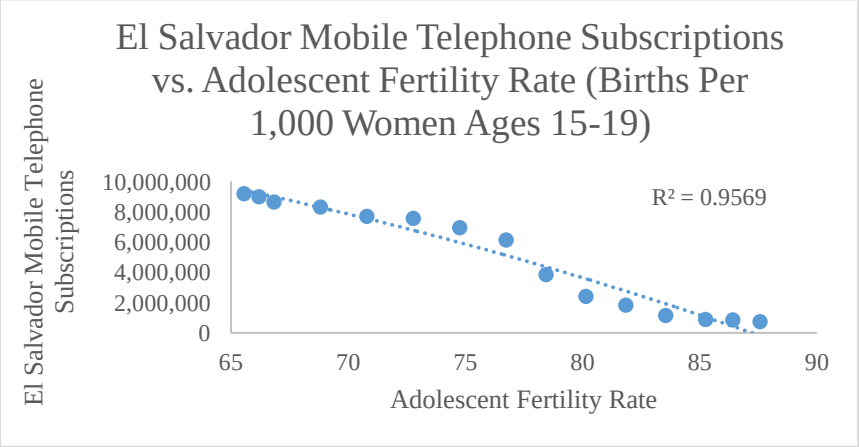
Dominican Republic MTS vs. Urban Population



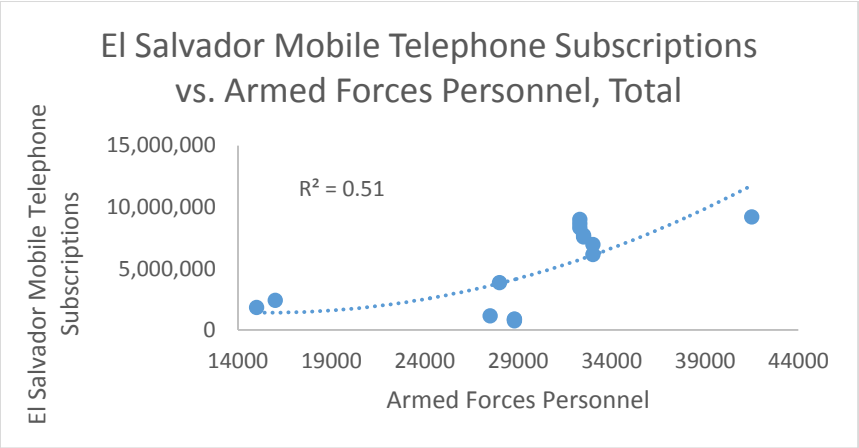
El Salvador MTS vs. Adjusted Net National Income Per Capita



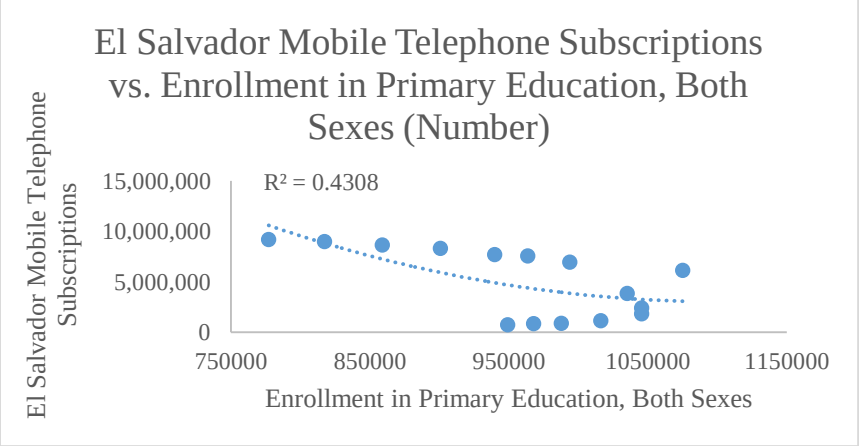
El Salvador MTS vs. Adolescent Fertility Rate



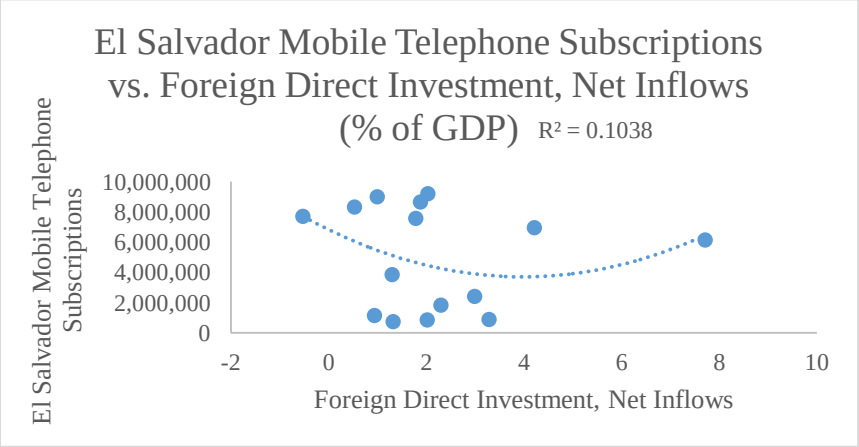
El Salvador MTS vs. Armed Forces Personnel, Total



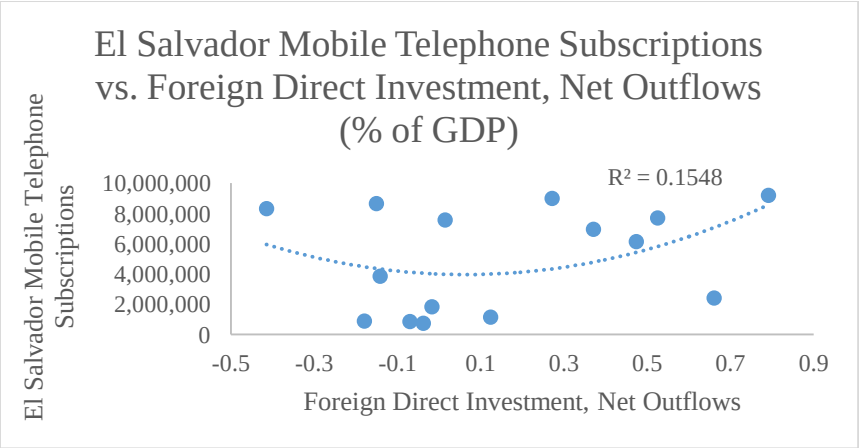
El Salvador MTS vs. Enrollment in Primary Education, Both Sexes



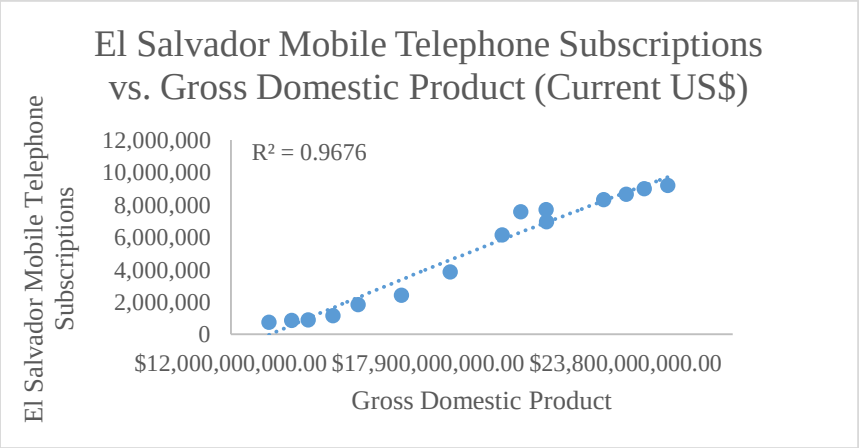
El Salvador MTS vs. Foreign Direct Investment, Net Inflows



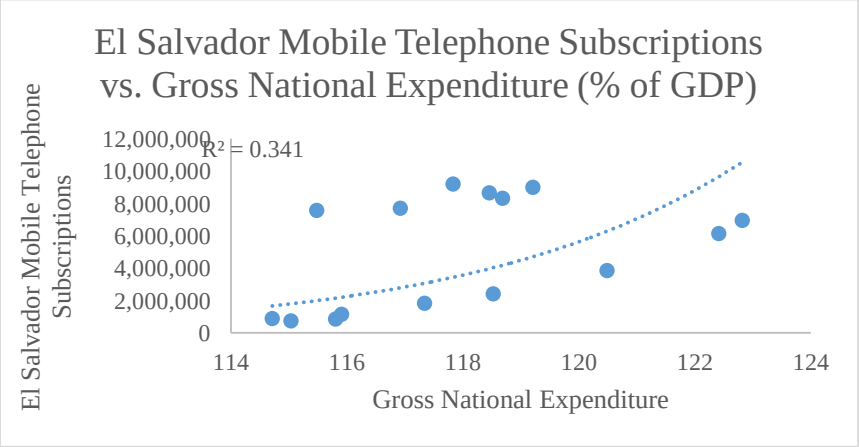
El Salvador MTS vs. Foreign Direct Investment, Net Outflows



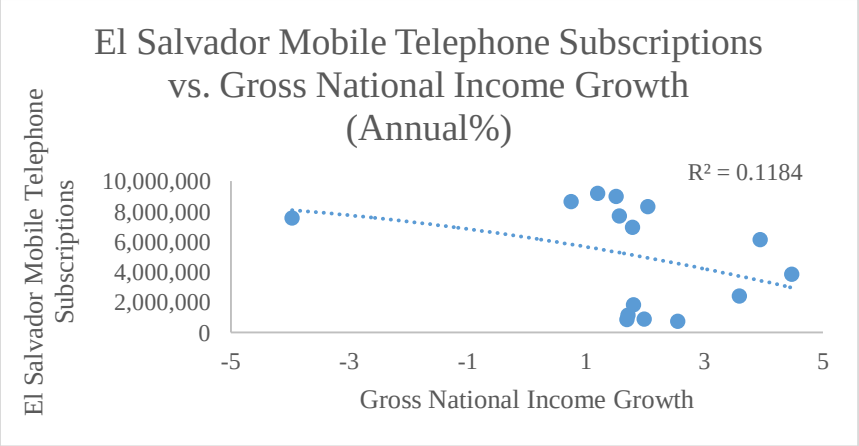
El Salvador MTS vs. Gross Domestic Product



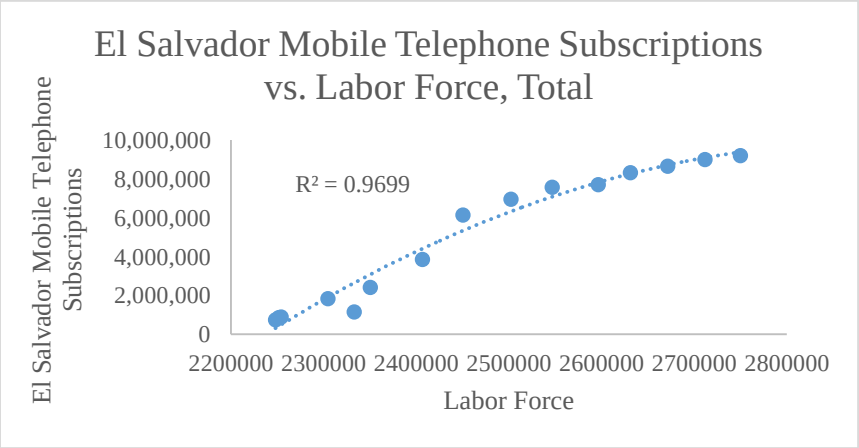
El Salvador MTS vs. Gross National Expenditure



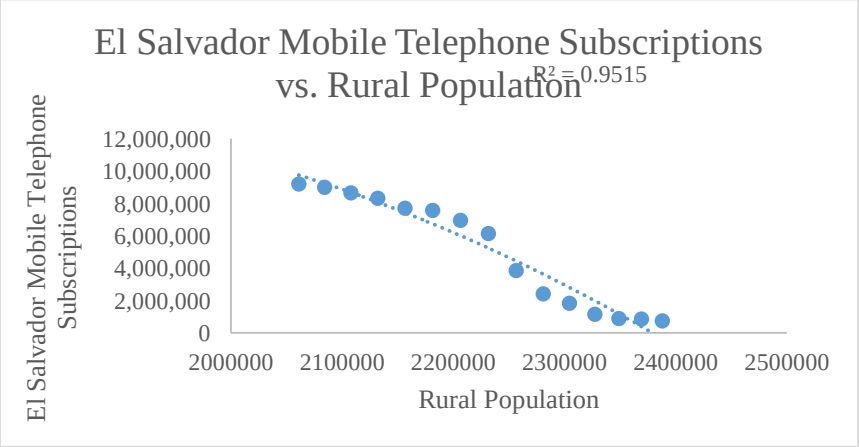
El Salvador MTS vs. Gross National Income Growth



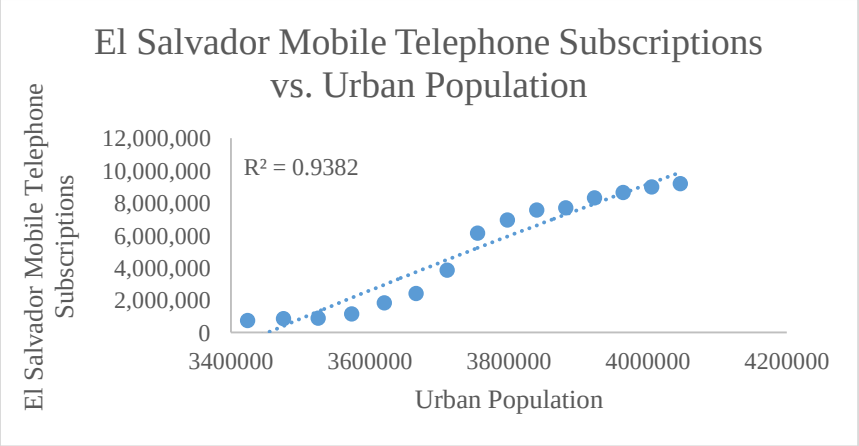
El Salvador MTS vs. Labor Force, Total



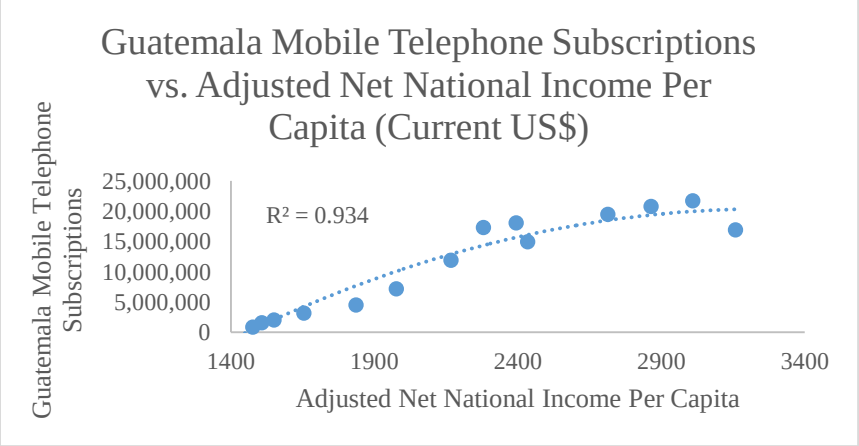
El Salvador MTS vs. Rural Population



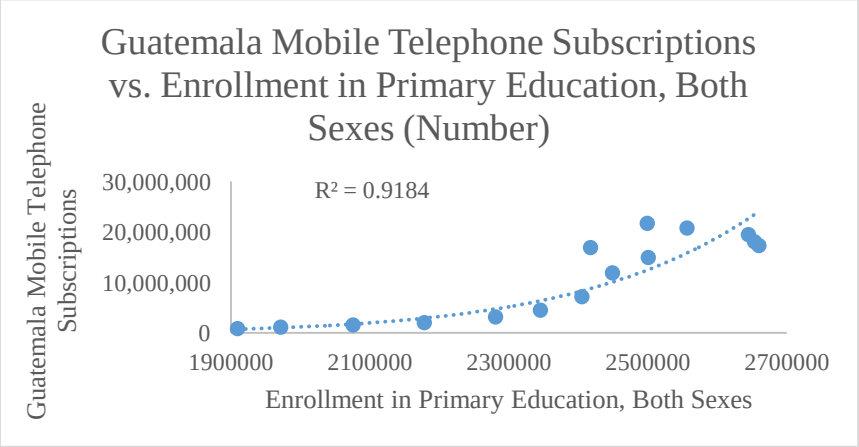
El Salvador MTS vs. Urban Population



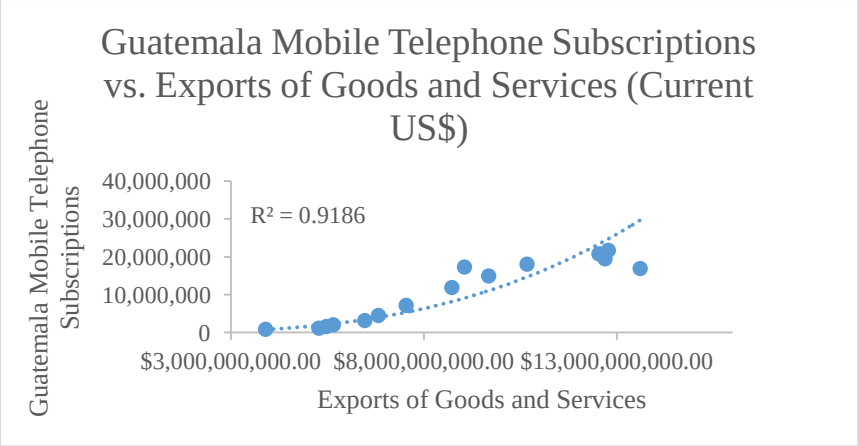
Guatemala MTS vs. Adjusted Net National Income Per Capita



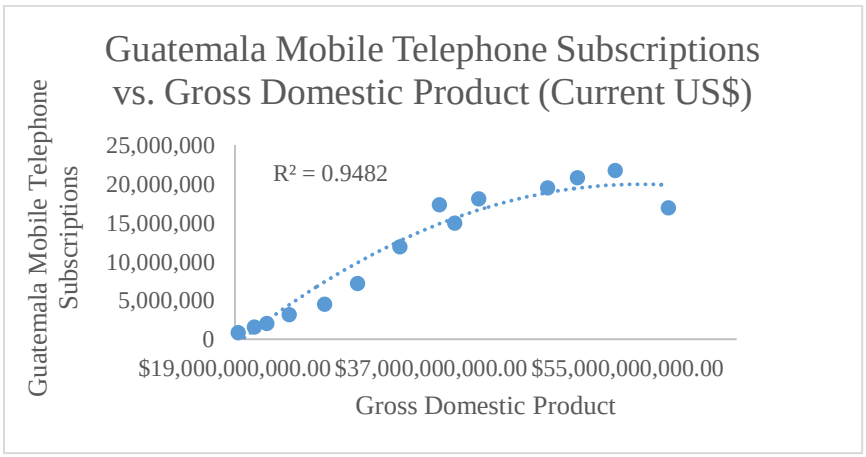
Guatemala MTS vs. Enrollment in Primary Education, Both Sexes



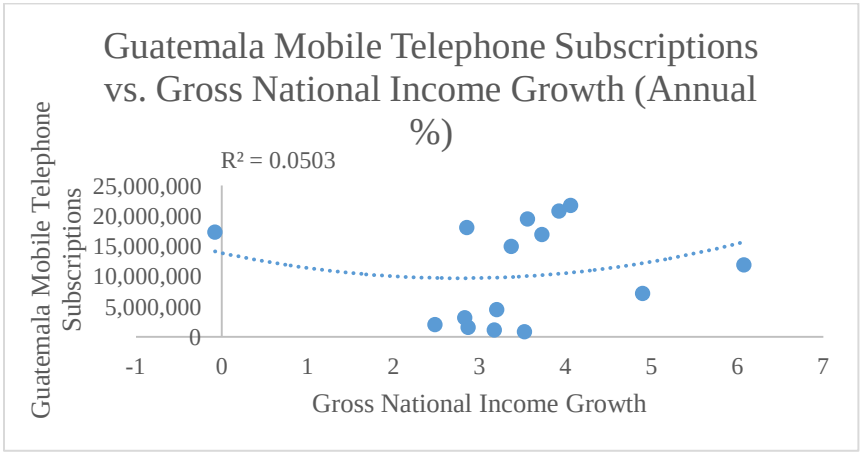
Guatemala MTS vs. Exports of Goods and Services



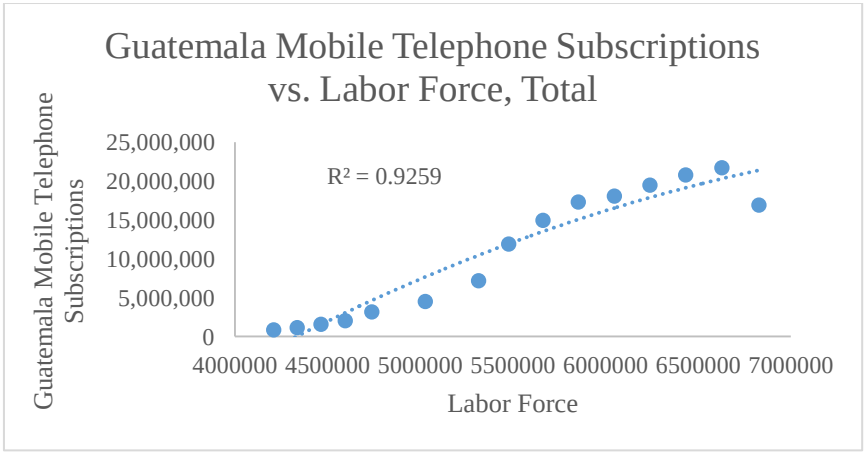
Guatemala MTS vs. Gross Domestic Product



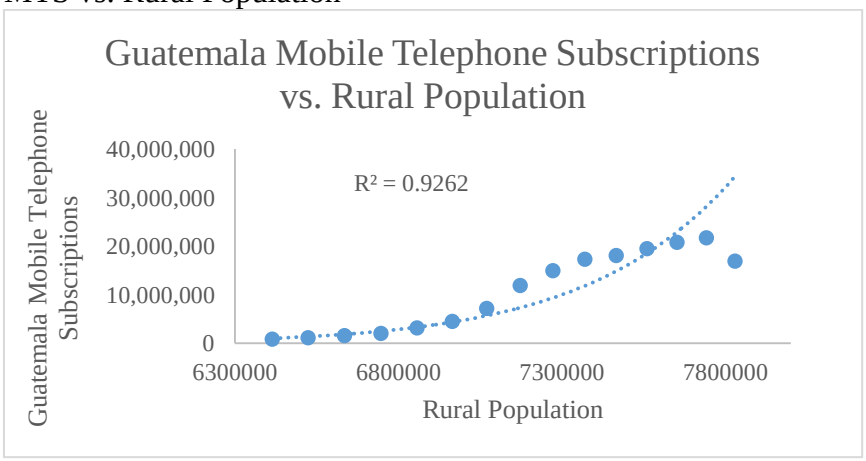
Guatemala MTS vs. Gross National Income Growth



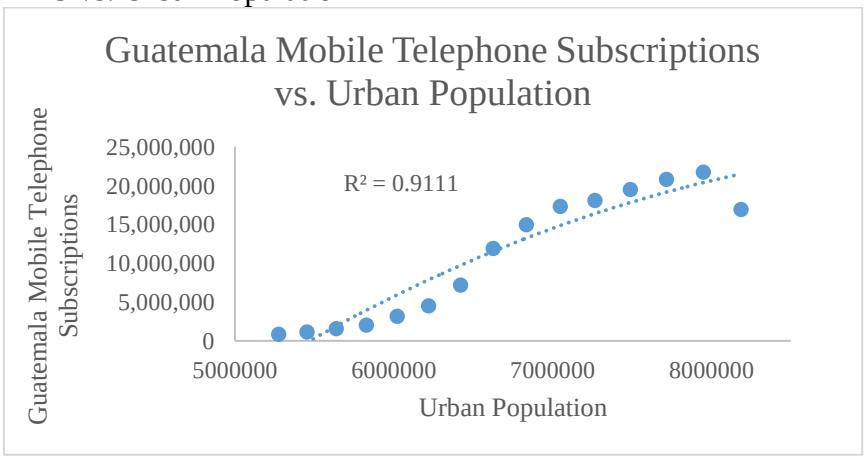
Guatemala MTS vs. Labor Force, Total



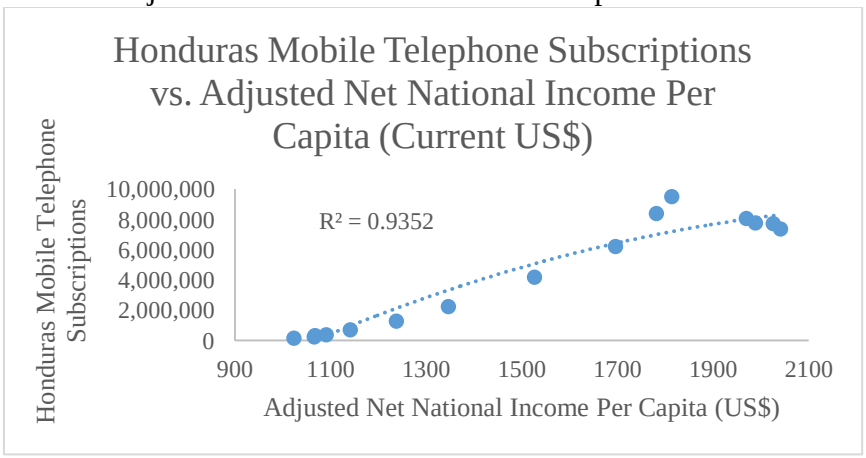
Guatemala MTS vs. Rural Population



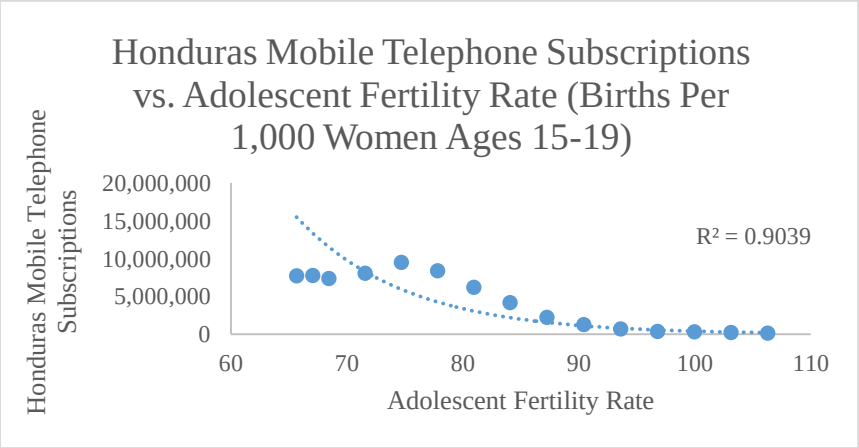
Guatemala MTS vs. Urban Population



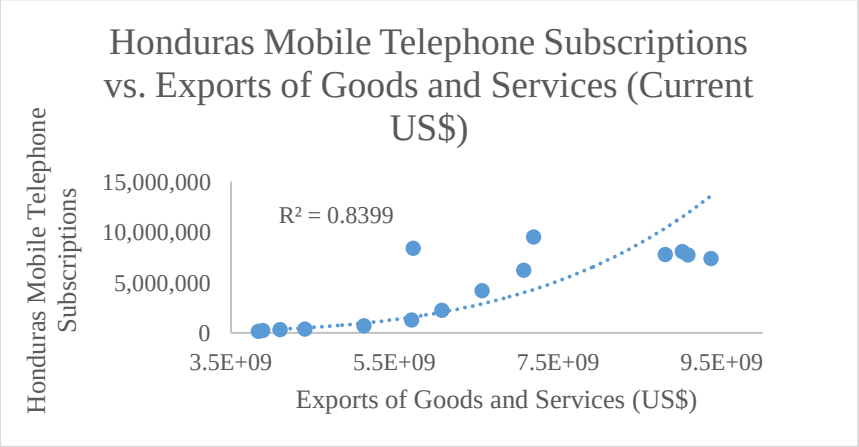
Honduras MTS vs. Adjusted Net National Income Per Capita



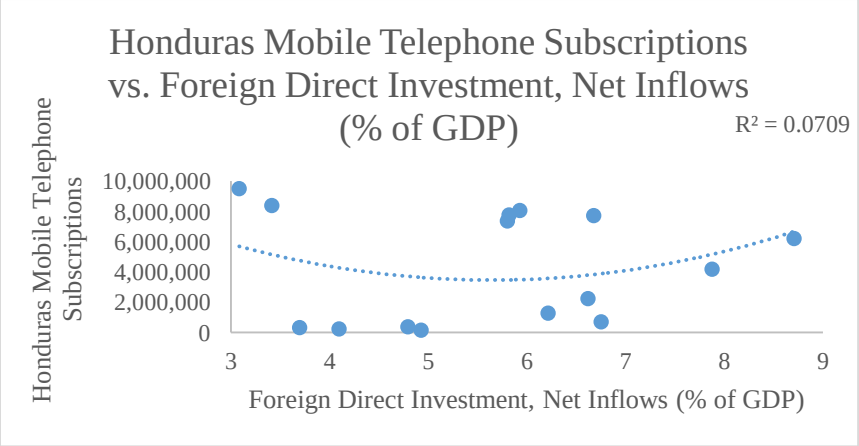
Honduras MTS vs. Adolescent Fertility Rate



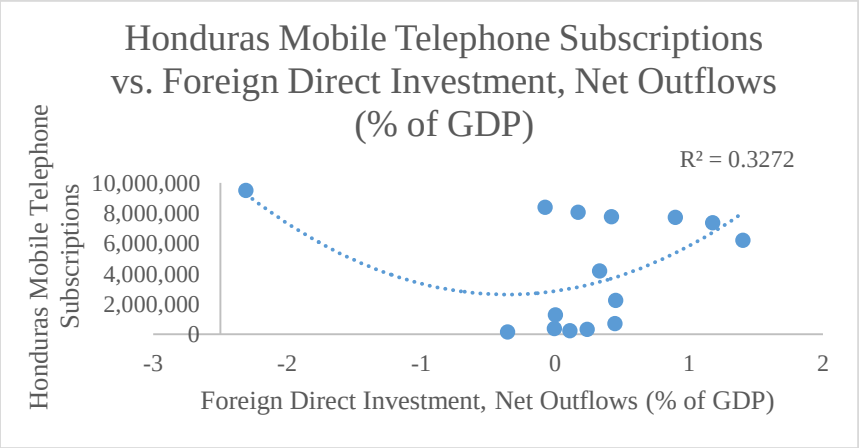
Honduras MTS vs. Exports of Goods and Services



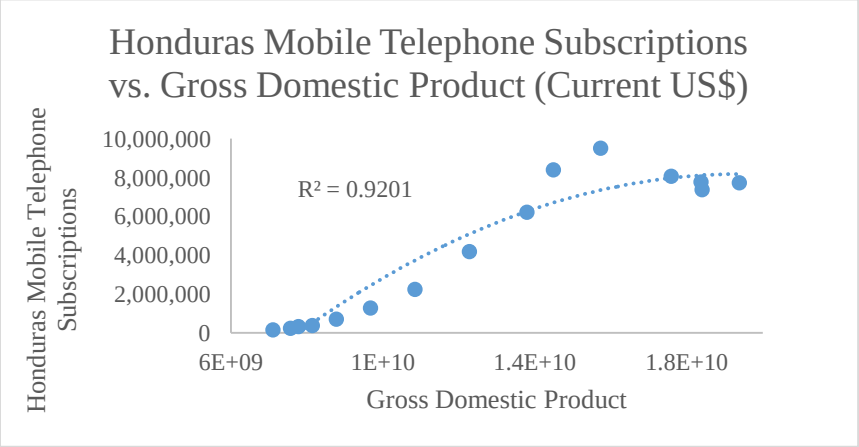
Honduras MTS vs. Foreign Direct Investment, Net Inflows



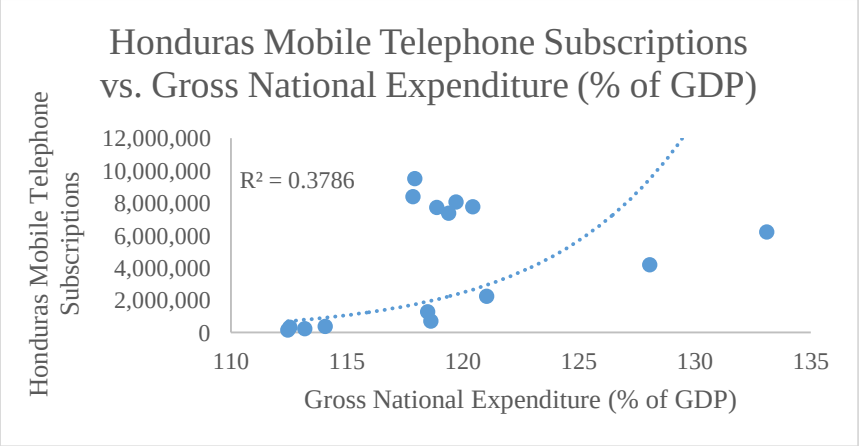
Honduras MTS vs. Foreign Direct Investment, Net Outflows



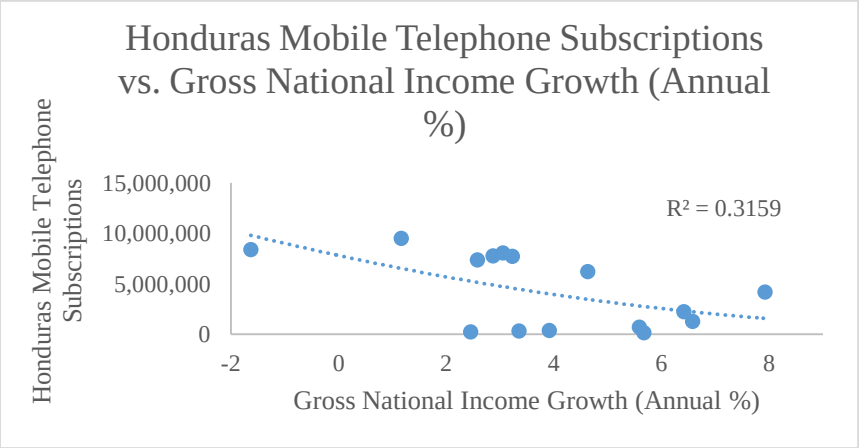
Honduras MTS vs. Gross Domestic Product



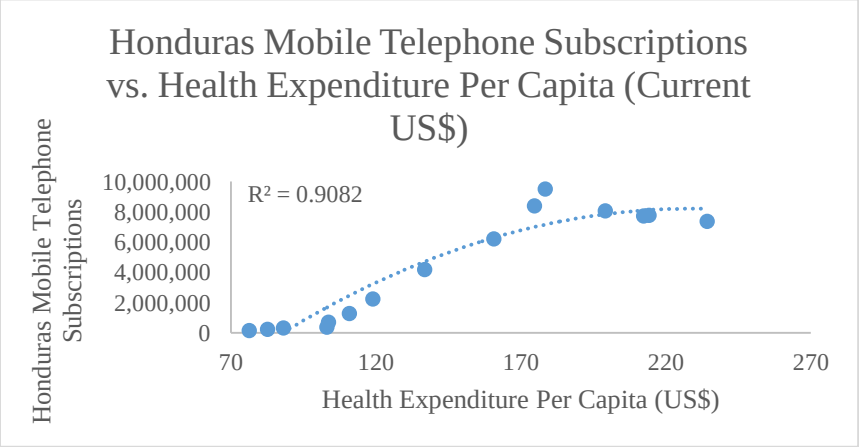
Honduras MTS vs. Gross National Expenditure



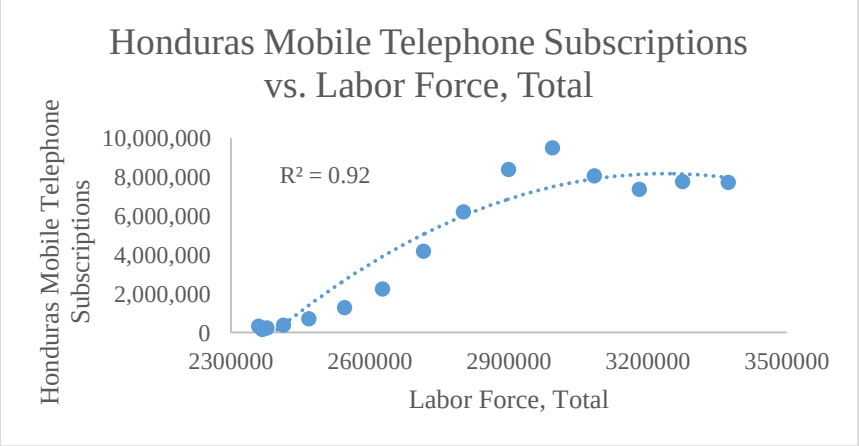
Honduras MTS vs. Gross National Income Growth



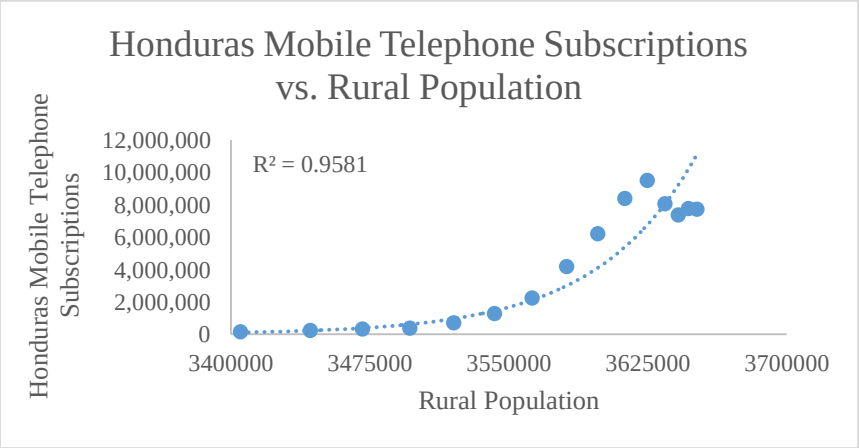
Honduras MTS vs. Health Expenditure Per Capita



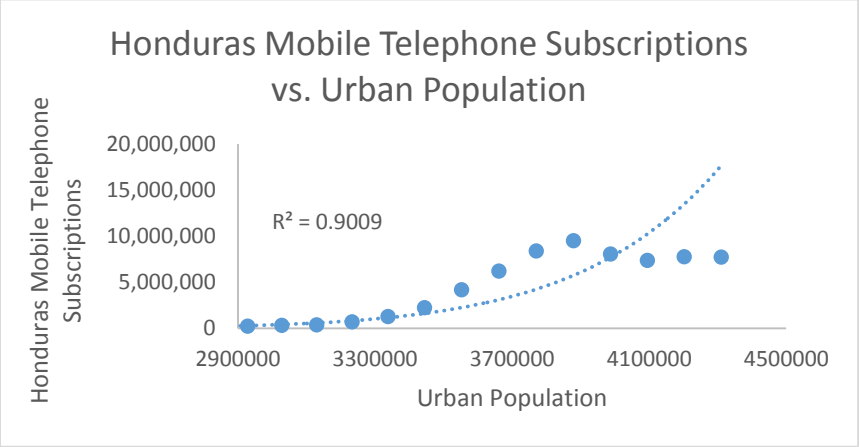
Honduras MTS vs. Labor Force, Total



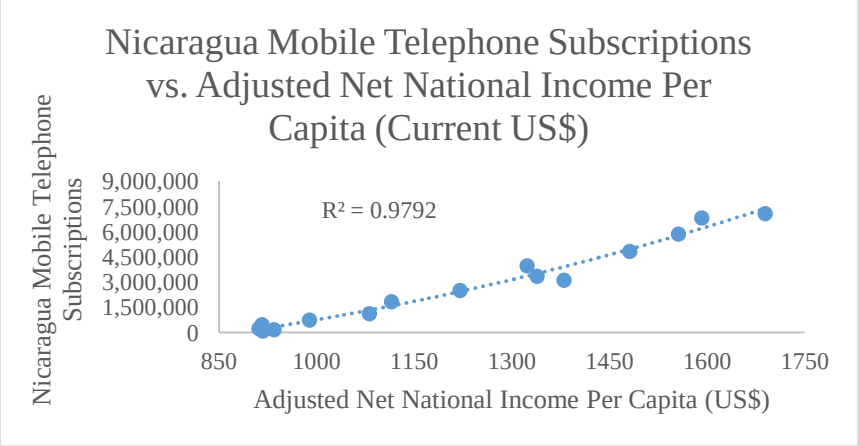
Honduras MTS vs. Rural Population



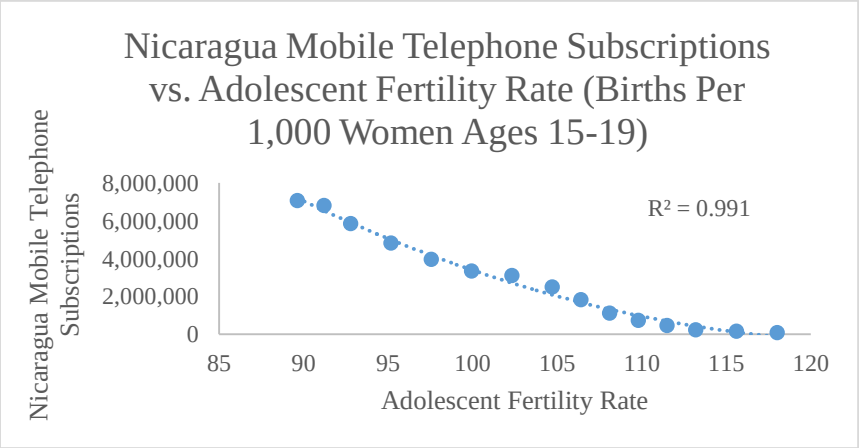
Honduras MTS vs. Urban Population



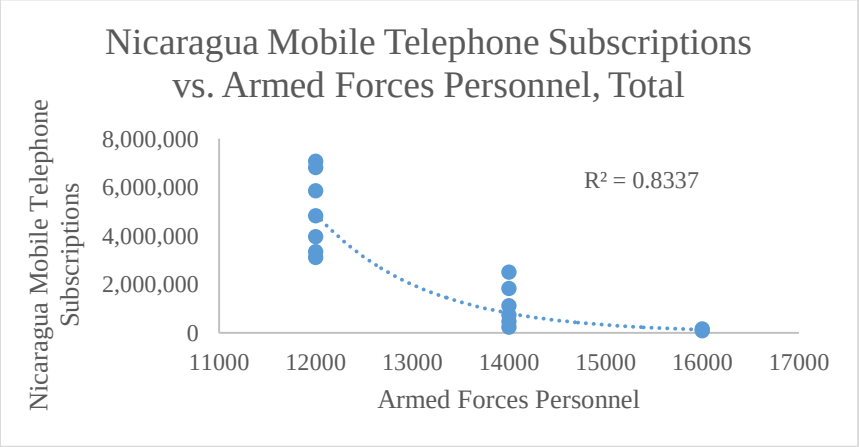
Nicaragua MTS vs. Adjusted Net National Income Per Capita



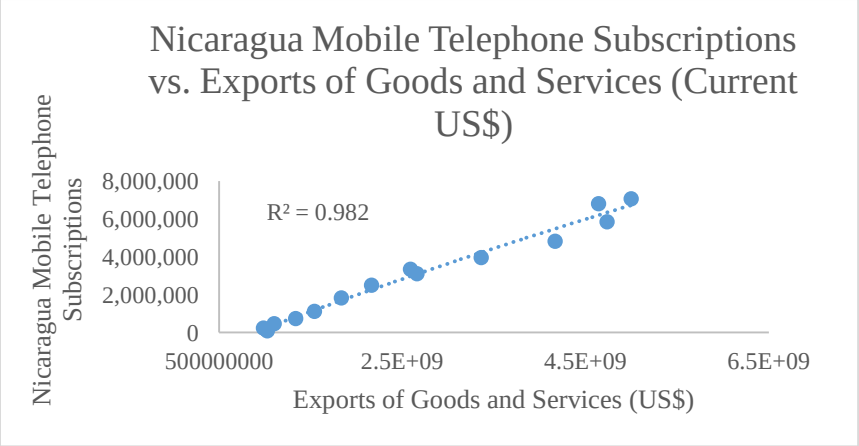
Nicaragua MTS vs. Adolescent Fertility Rate



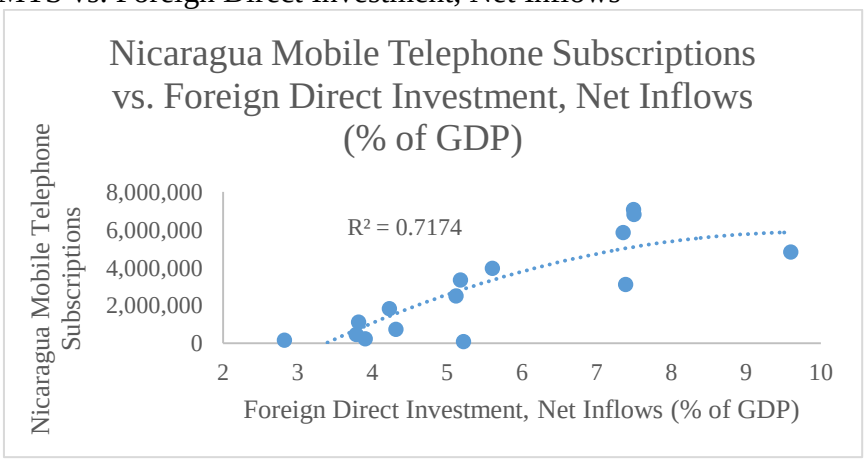
Nicaragua MTS vs. Armed Forces Personnel, Total



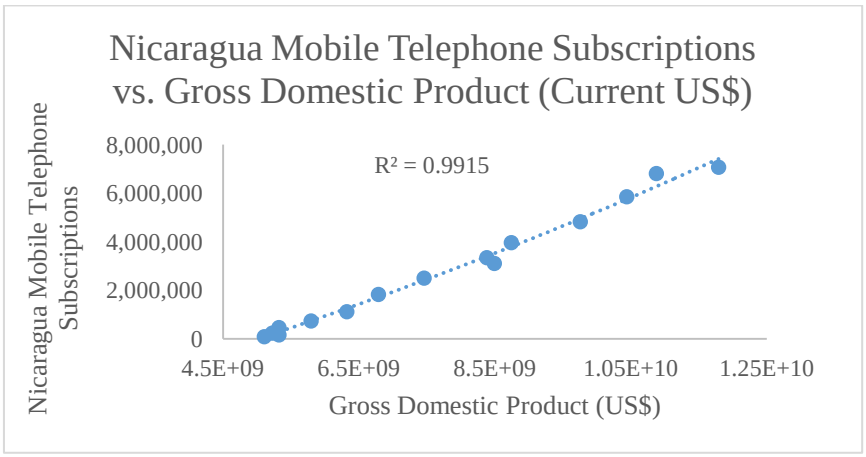
Nicaragua MTS vs. Exports of Goods and Services



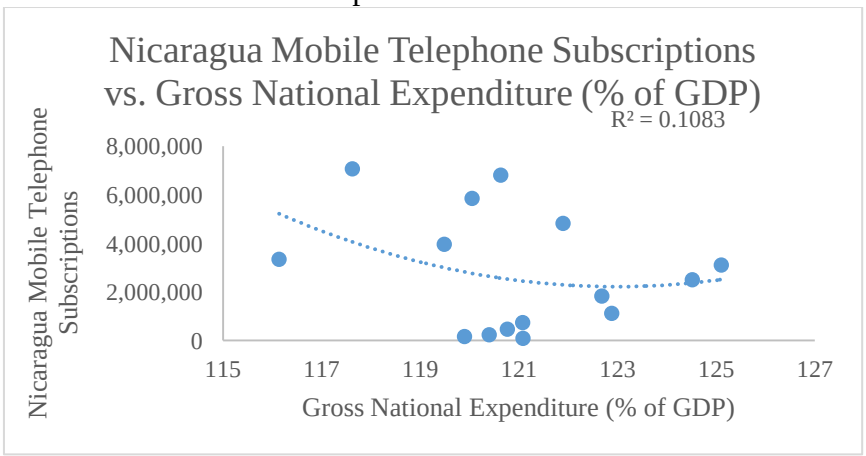
Nicaragua MTS vs. Foreign Direct Investment, Net Inflows



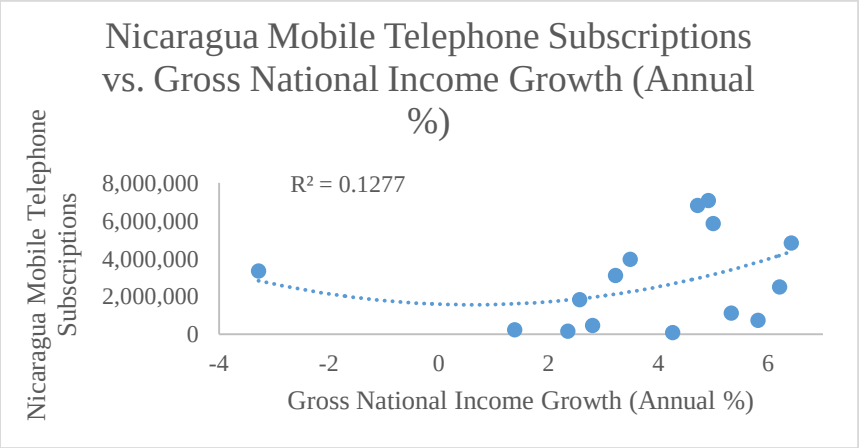
Nicaragua MTS vs. Gross Domestic Product



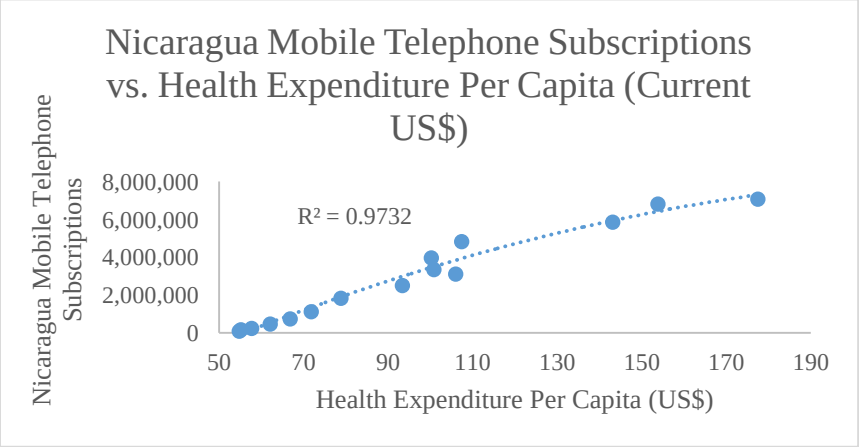
Nicaragua MTS vs. Gross National Expenditure



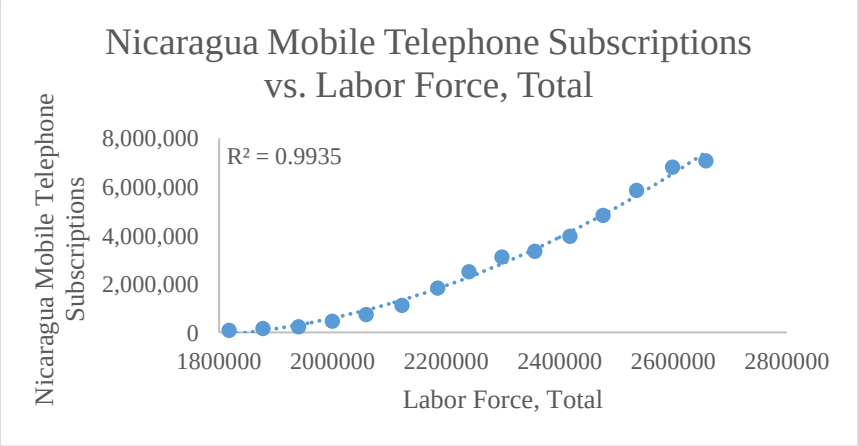
Nicaragua MTS vs. Gross National Income Growth



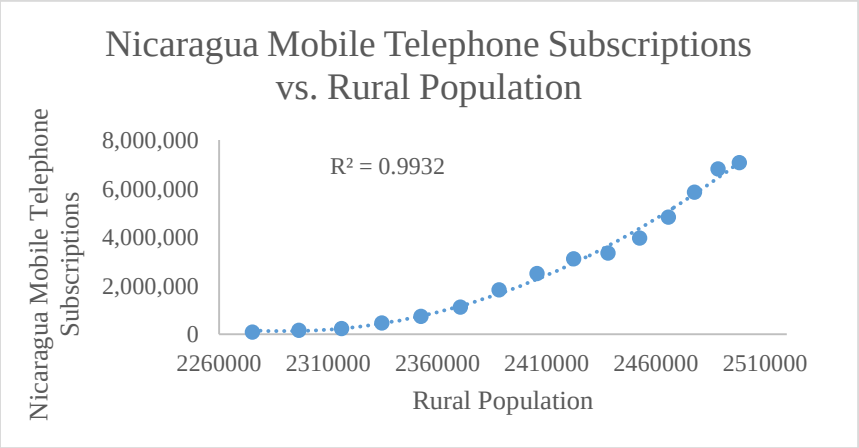
Nicaragua MTS vs. Health Expenditure Per Capita



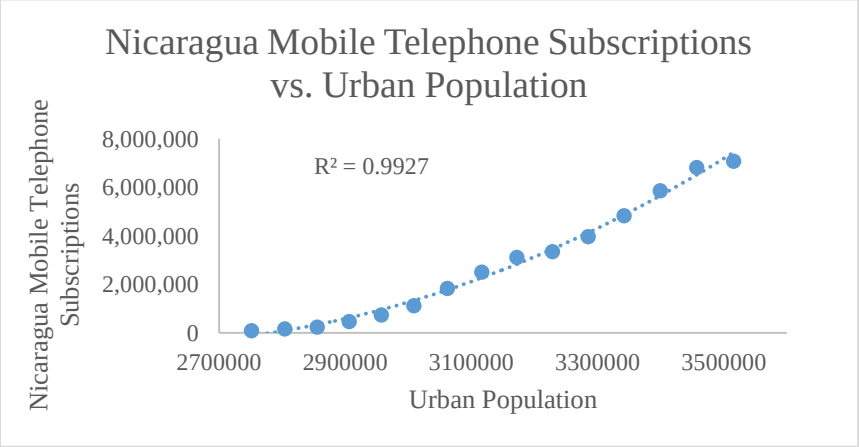
Nicaragua MTS vs. Labor Force, Total



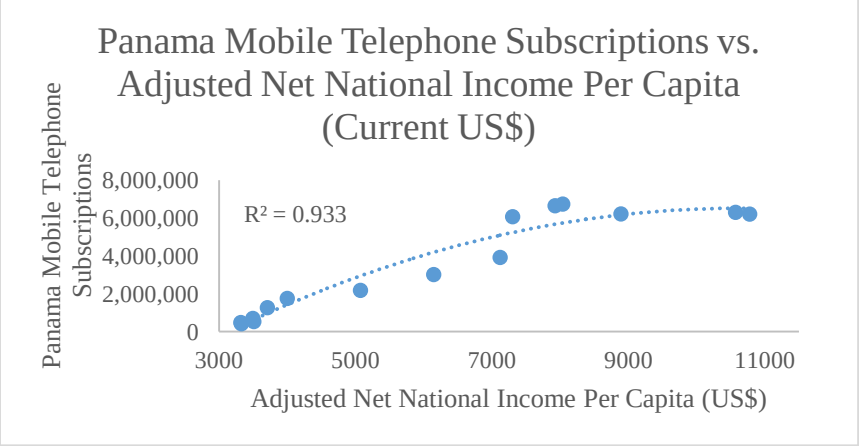
Nicaragua MTS vs. Rural Population



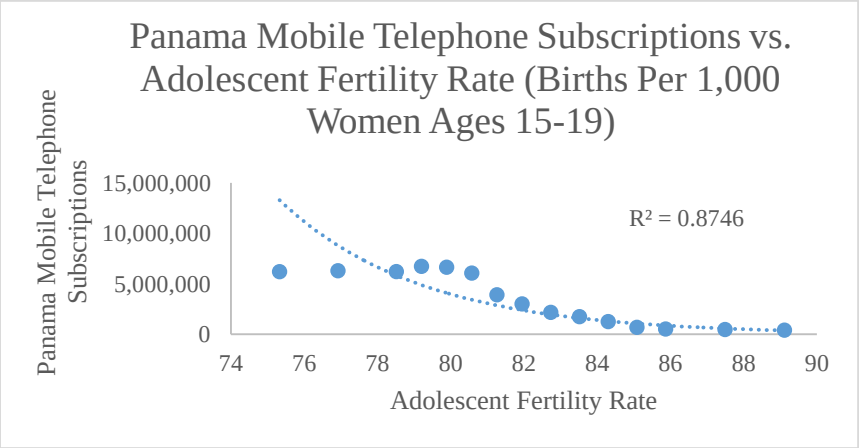
Nicaragua MTS vs. Urban Population



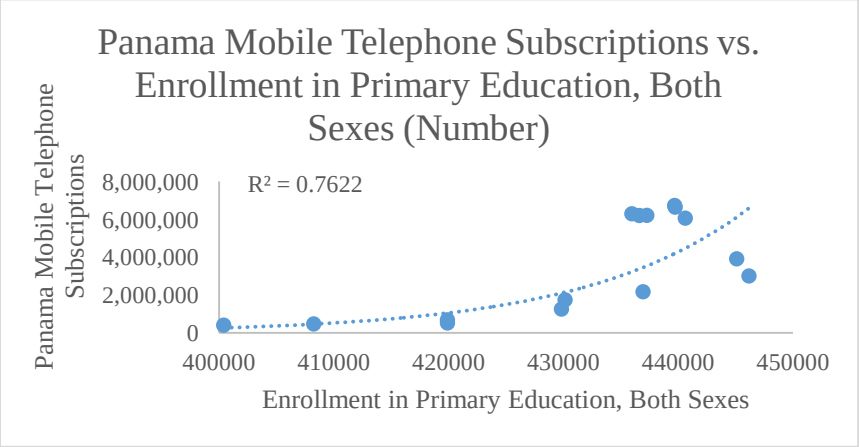
Panama MTS vs. Adjusted Net National Income Per Capita



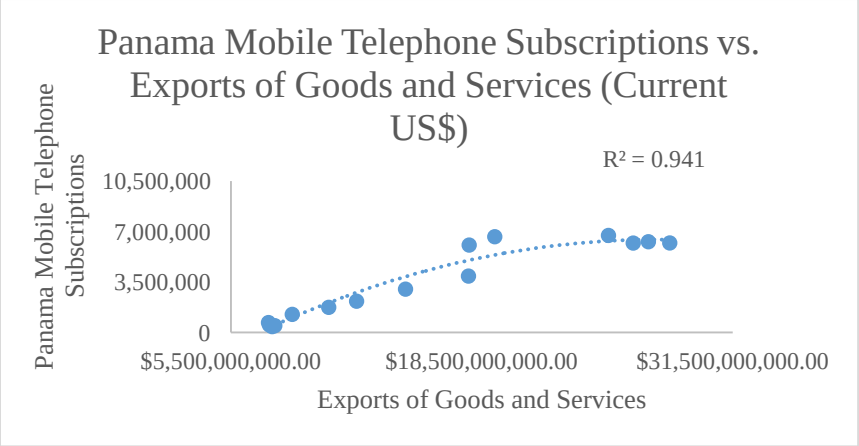
Panama MTS vs. Adolescent Fertility Rate



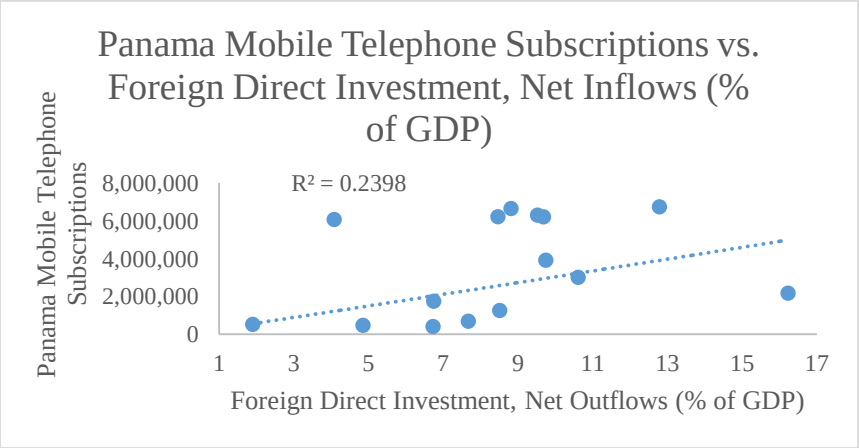
Panama MTS vs. Enrollment in Primary Education, Both Sexes



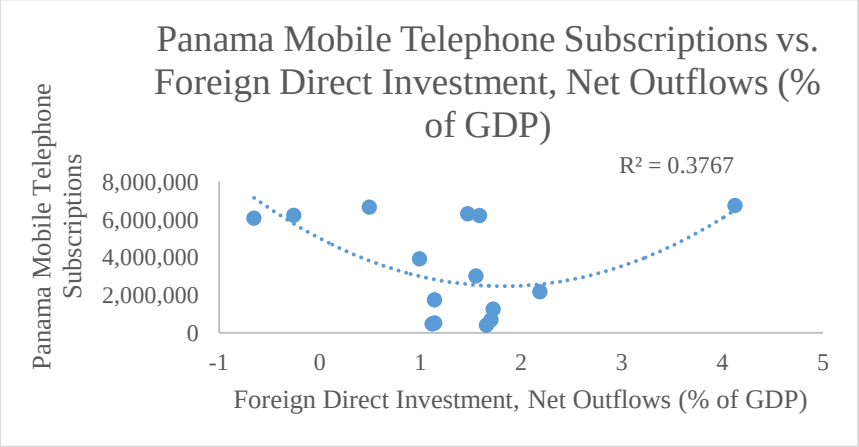
Panama MTS vs. Exports of Goods and Services



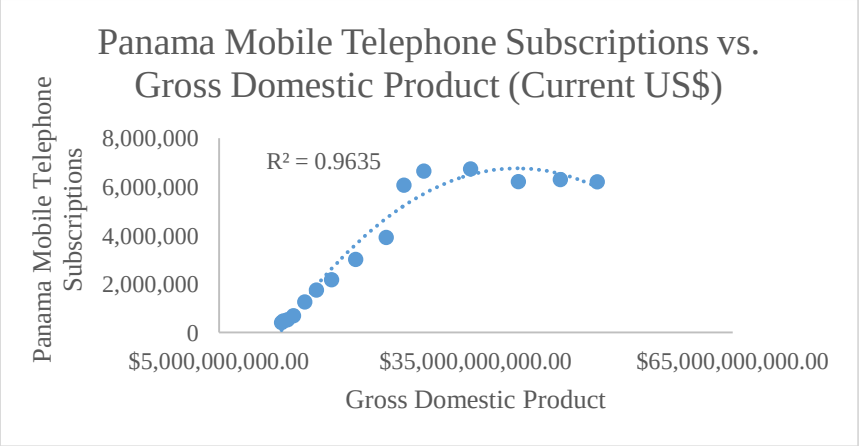
Panama MTS vs. Foreign Direct Investment, Net Inflows



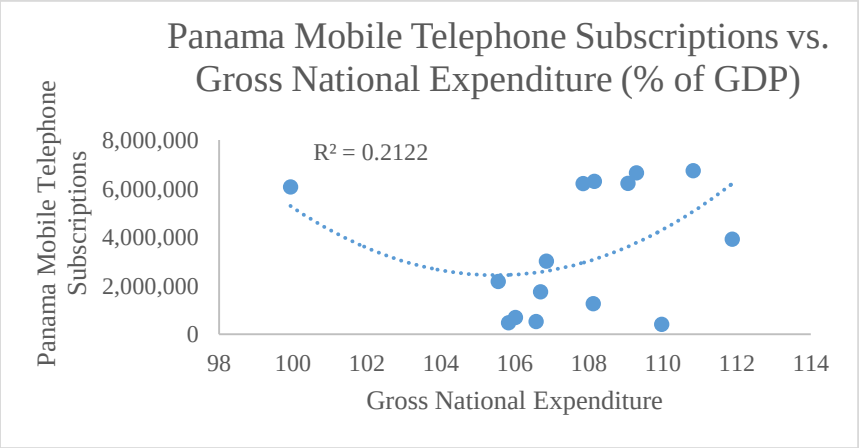
Panama MTS vs. Foreign Direct Investment, Net Outflows



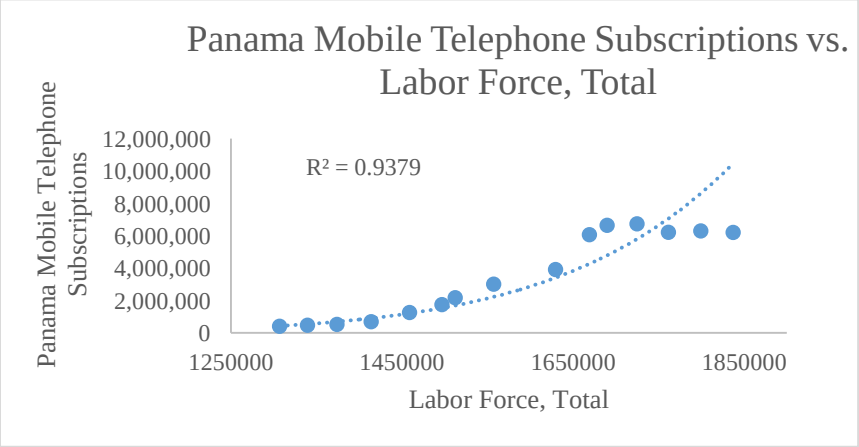
Panama MTS vs. Gross Domestic Product



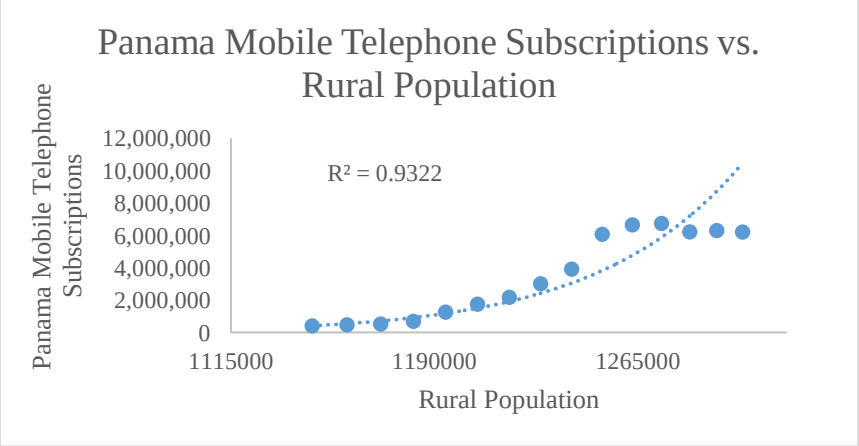
Panama MTS vs. Gross National Expenditure



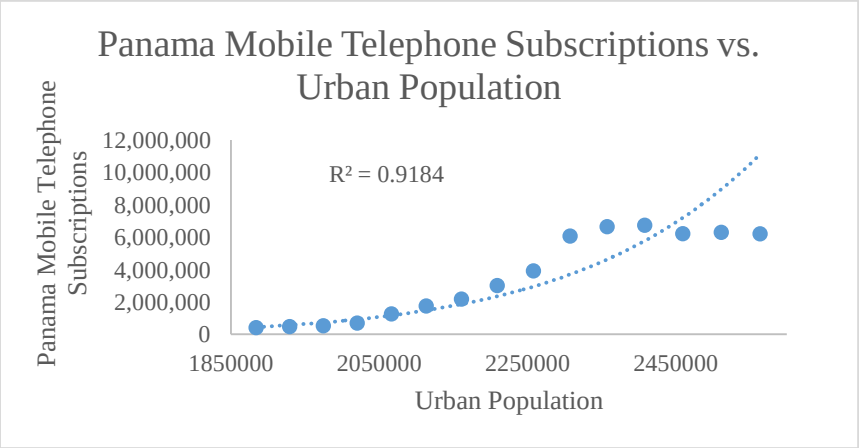
Panama MTS vs. Labor Force, Total



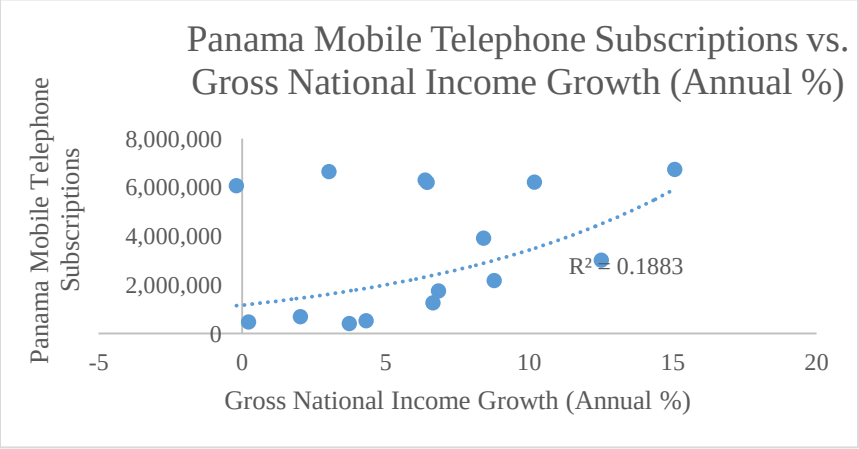
Panama MTS vs. Rural Population



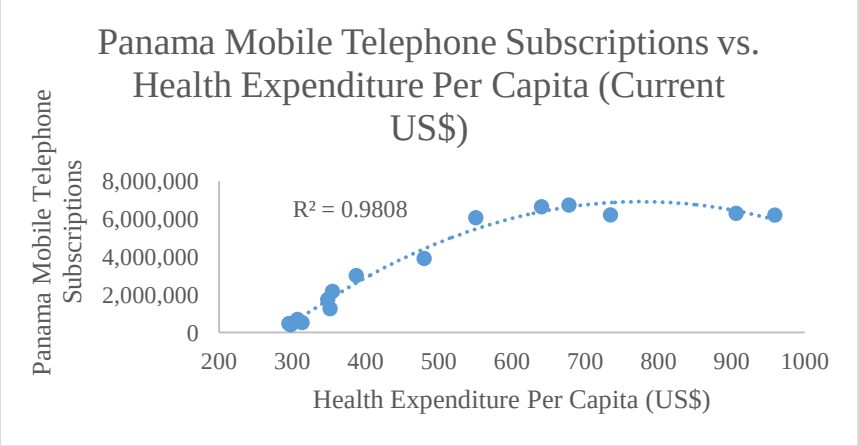
Panama MTS vs. Urban Population



Panama MTS vs. Gross National Income Growth



Panama MTS vs. Health Expenditure Per Capita



Appendix C: Raw data for model

Belize Model

Year	*Belize Mobile Telephone Subscriptions*	*Adjusted Net National Income per Capita*	*Urban population*
2000	16812	2664	117876
2001	39155	2656	120844
2002	51729	2781	123555
2003	60403	2811	126091
2004	75000	2849	128600
2005	96000	2949	131189
2006	118000	3021	133865
2007	118314	2947	136582
2008	160032	2905	139308
2009	161783	3097	141995
2010	194201	2942	144605
2011	222407	3137	147209
2012	172423	3314	149821
2013	174615	3408	152471
Std. dev.	63097	241	11848

Costa Rica Model

Year	*Costa Rica Mobile Telephone Subscriptions*	*GDP*	*Adjusted net national income per capita*	*Enrollment in primary education, both sexes*
2000	211614	1.49E+10	2553.238	551465
2001	326944	1.59E+10	2597.12	552302
2002	502478	1.65E+10	2721.259	545509
2003	778299	1.72E+10	2061.876	549758
2004	923084	1.85E+10	2044.615	558084
2005	1101305	2E+10	3236.481	542087
2006	1443717	2.26E+10	3383.971	546542
2007	1508219	2.67E+10	4078.594	536436
2008	1886570	3.06E+10	4566.564	534816
2009	1950318	3.06E+10	4543.073	531665
2010	3128372	3.73E+10	5018.169	520609
2011	4153067	4.23E+10	5312.268	506961
2012	5378082	4.65E+10	5428.007	494720
2013	7111981	4.96E+10	5328.893	480125
Std. Dev.	2360276	1.29E+10	1292	26893

Dominican Republic Model

Year	*Dominican Republic Mobile Telephone Subscriptions*	*GDP*	*Adjusted net national income per capita*	*Urban population*	*Exports of goods and services*
2000	705431	2.4E+10	2553.238	5287077	8.89E+09
2001	1270082	2.49E+10	2597.12	5440575	8.40E+09
2002	1700609	2.66E+10	2721.259	5596225	8.63E+09
2003	2091914	2.13E+10	2061.876	5792814	9.17E+09
2004	2534063	2.20E+10	2044.615	6007523	9.33E+09
2005	3623289	3.40E+10	3236.481	6222793	1.02E+10
2006	4605659	3.60E+10	3383.971	6438574	1.08E+10
2007	5512859	4.42E+10	4078.594	6654556	1.18E+10
2008	7210483	4.83E+10	4566.564	6870529	1.15E+10
2009	8629815	4.84E+10	4543.073	7085614	1.02E+10
2010	8892783	5.40E+10	5018.169	7299960	1.22E+10
2011	8770780	5.77E+10	5312.268	7513236	1.40E+10
2012	8934196	6.06E+10	5428.007	7721788	1.49E+10
2013	9200410	6.20E+10	5328.893	7925115	1.57E+10
Std. Dev.	3254763	1.59E+10	1292	931677	2.70E+09

El Salvador Model

Year	*El Salvador Mobile Telephone Subscriptions*	*GNI growth*	*Adjusted net nat. income per capita*	*Enrollment in primary education, both sexes*	*Rural population*	*Urban population*
2000	743628	2.54	1998	949077	2387967	3423869
2001	857782	1.68	2088	967748	2369223	3475515
2002	888818	1.98	2143	987676	2348898	3525403
2003	1149790	1.70	2231	1016098	2327267	3573662
2004	1832579	1.80	2332	1045485	2304445	3620644
2005	2411753	3.58	2522	1045484	2280872	3666334
2006	3851611	4.47	2735	1035100	2256512	3711044
2007	6137381	3.94	2959	1075041	2231556	3754858
2008	6950703	1.78	3162	993795	2206423	3797776
2009	7566245	-3.96	3019	963524	2181361	3840007
2010	7700336	1.56	3080	939726	2156521	3881785
2011	8316150	2.04	3332	900681	2132039	3923169
2012	8649000	0.74	3385	858864	2107854	3964379
2013	8991899	1.50	3425	817275	2084181	4005463
Std.Dev	3400235	1.89	533	87296	106704	197371

Guatemala Model

Year	*Guatemala Mobile Telephone Subscriptions*	*Adjusted net national income per capita*	*Enrollment in primary education, both sexes*
2000	856831	1475	1909389
2001	1146441	1398	1971539
2002	1577085	1507	2075694
2003	2034776	1549	2178200
2004	3168256	1653	2280706
2005	4510067	1835	2345301
2006	7178745	1976	2405041
2007	11897563	2166	2448976
2008	14948640	2433	2500575
2009	17307459	2279	2659776
2010	18067970	2393	2653483
2011	19479105	2713	2644683
2012	20787080	2863	2556314
2013	21716357	3009	2499076
Std. Dev.	8062409	591	242139

Honduras Model

Year	*Honduras Mobile Telephone Subscriptions*	*GDP*	*Exports of goods and services*	*Labor force, total*
2000	155271	7.1E+09	3833929938	2367333
2001	237629	7.57E+09	3887476514	2377592
2002	326508	7.78E+09	4099842755	2359678
2003	379362	8.14E+09	4403406751	2413144
2004	707201	8.77E+09	5124963677	2467974
2005	1281462	9.67E+09	5707061075	2545026
2006	2240756	1.08E+10	6077289219	2627053
2007	4184834	1.23E+10	6568495479	2715531
2008	6210711	1.38E+10	7077615645	2801722
2009	8390755	1.45E+10	5726406454	2899155
2010	9505071	1.57E+10	7197713455	2993957
2011	8062229	1.76E+10	9015251729	3084270
2012	7370034	1.84E+10	9366389334	3181474
2013	7767235	1.84E+10	8807893833	3274863
Std. Dev	3644226	4.45E+09	1974870155	351707

Nicaragua Model

Year	*Nicaragua Mobile Telephone Subscriptions*	*Exports of goods and services*	*Rural population*	*Urban population*
2000	90294	1.03E+09	2275277	2751515
2001	164509	1.01E+09	2296562	2804188
2002	237248	9.85E+08	2316110	2855626
2003	466706	1.10E+09	2334548	2906328
2004	738624	1.34E+09	2352464	2957239
2005	1119379	1.54E+09	2370508	3008819
2006	1830220	1.83E+09	2388231	3061986
2007	2502281	2.16E+09	2405601	3116518
2008	3108002	2.66E+09	2422373	3172151
2009	3344563	2.59E+09	2438109	3228486
2010	3962247	3.36E+09	2452589	3285133
2011	4823534	4.17E+09	2465754	3342033
2012	5851723	4.73E+09	2477699	3399335
2013	6808930	4.64E+09	2488491	3457155
Std. Dev.	2447131	1.48E+09	72415	243831

Panama Model

Year	*Panama Mobile Telephone Subscriptions*	*GDP*	*Exports of goods and services*	*Labor force, total*	*Rural population*	*Urban population*
2000	410401	1.23E+10	7.63E+09	1306762	1144928	1883823
2001	475141	1.25E+10	7.77E+09	1339414	1157768	1929119
2002	525845	1.3E+10	7.49E+09	1373864	1170185	1974543
2003	692406	1.37E+10	7.44E+09	1413897	1182271	2020240
2004	1259948	1.5E+10	8.67E+09	1458752	1194134	2066477
2005	1748740	1.64E+10	1.06E+10	1496661	1205935	2113366
2006	2174451	1.81E+10	1.2E+10	1512168	1217647	2160953
2007	3010635	2.1E+10	1.45E+10	1557150	1229193	2209205
2008	3915246	2.45E+10	1.78E+10	1629491	1240632	2258047
2009	6066683	2.66E+10	1.78E+10	1669100	1251913	2307488
2010	6646348	2.89E+10	1.92E+10	1689814	1263014	2357492
2011	6735429	3.44E+10	2.51E+10	1724768	1273781	2408198
2012	6213564	4E+10	2.82E+10	1761503	1284185	2459576
2013	6297604	4.49E+10	2.71E+10	1799354	1294161	2511522
Std. Dev.	2606859	1.23E+10	7.85E+09	172974	50933	217121

Appendix D: Normalized data for model

Belize normalized data

Year	*Belize Mobile Telephone Subscriptions*	*Adjusted Net Nat. Income Per Capita*	*Urban Population*
2000	0.266444	11.04468	9.948549
2001	0.620545	11.01497	10.19904
2002	0.819824	11.53122	10.42785
2003	0.957293	11.65412	10.64188
2004	1.188633	11.81265	10.85364
2005	1.52145	12.22815	11.07215
2006	1.870115	12.52631	11.298
2007	1.875092	12.21771	11.52731
2008	2.536257	12.0472	11.75738
2009	2.564007	12.84179	11.98415
2010	3.077782	12.1989	12.20443
2011	3.524803	13.00884	12.42421
2012	2.732635	13.73981	12.64466
2013	2.767374	14.13144	12.86831
2014	2.730685	14.12839	13.09754

Costa Rica normalized data

Year	*Costa Rica Mobile Telephone Subscriptions*	*GDP*	*Adjusted Net Nat. Income per Capita*	*Enrollment in Primary Education*
2000	0.089656	1.159039	1.975576	20.50584
2001	0.138519	1.233766	2.009530	20.53697
2002	0.212889	1.279620	2.105583	20.28437
2003	0.329749	1.333199	1.595383	20.44237
2004	0.391091	1.436617	1.582028	20.75197
2005	0.466600	1.546895	2.504237	20.15713
2006	0.611673	1.752216	2.618359	20.32278
2007	0.639001	2.073458	3.155826	19.94700
2008	0.799300	2.373427	3.533394	19.88676
2009	0.826309	2.369506	3.515217	19.76959
2010	1.325426	2.889445	3.882825	19.35848
2011	1.759568	3.276635	4.110384	18.85099
2012	2.278581	3.603071	4.199938	18.39582
2013	3.013198	3.848579	4.123248	17.85311
2014	3.008924	3.889506	4.227887	17.68973

Dominican Republic normalized data

Year	*Dominican Republic Mobile Telephone Subscriptions*	*GDP*	*Adjusted net national income per capita*	*Urban population*	*Exports of goods and services*
2000	0.216738	1.508250	1.975576	5.674794	3.296337
2001	0.390223	1.564596	2.009530	5.839548	3.113021
2002	0.522499	1.670135	2.105583	6.006613	3.200093
2003	0.642724	1.337357	1.595383	6.217618	3.398626
2004	0.778571	1.385256	1.582028	6.448072	3.459015
2005	1.113227	2.137292	2.504237	6.679129	3.786399
2006	1.415052	2.259783	2.618359	6.910733	3.998146
2007	1.693782	2.776244	3.155826	7.142554	4.383045
2008	2.215363	3.035158	3.533394	7.374365	4.280564
2009	2.651442	3.040664	3.515217	7.605223	3.772473
2010	2.732237	3.391265	3.882825	7.835287	4.531284
2011	2.694752	3.629614	4.110384	8.064204	5.181182
2012	2.744960	3.809815	4.199938	8.288049	5.538470
2013	2.826753	3.894812	4.123248	8.506287	5.814028
2014	2.551195	4.100036	4.227887	8.718665	6.191633

El Salvador normalized data

Year	*El Salvador Mobile Telephone Subscriptions*	*GNI growth*	*Adjusted net nat. income per capita*	*Enrollment in primary education, both sexes*	*Rural population*	*Urban population*
2000	0.218699	1.341632	3.742754	10.87193	22.37921	17.34730
2001	0.252271	0.889516	3.910848	11.08582	22.20355	17.60897
2002	0.261399	1.043196	4.014789	11.31410	22.01307	17.86173
2003	0.338150	0.898849	4.179676	11.63968	21.81035	18.10624
2004	0.538957	0.947924	4.369031	11.97631	21.59647	18.34428
2005	0.709290	1.889954	4.723540	11.97630	21.37555	18.57577
2006	1.132749	2.355885	5.123966	11.85735	21.14726	18.80230
2007	1.804987	2.075040	5.542066	12.31489	20.91338	19.02429
2008	2.044183	0.939307	5.922496	11.38419	20.67784	19.24173
2009	2.225212	-2.08977	5.655151	11.03743	20.44297	19.45570
2010	2.264648	0.822274	5.768313	10.76482	20.21018	19.66737
2011	2.445758	1.075547	6.241518	10.31755	19.98074	19.87705
2012	2.543648	0.393155	6.339831	9.838520	19.75408	20.08584
2013	2.644493	0.793605	6.414968	9.362107	19.53223	20.29400
2014	2.704002	0.629089	6.553889	8.901238	19.31541	20.50273

Guatemala normalized data

Year	*Guatemala Mobile Telephone Subscriptions*	*Adjusted net nat. income per capita*	*Enrollment in primary education, both sexes*
2000	0.106275	2.49	7.885495
2001	0.142196	2.36	8.142165
2002	0.195610	2.54	8.572310
2003	0.252378	2.61	8.995645
2004	0.392966	2.79	9.418979
2005	0.559394	3.10	9.685747
2006	0.890397	3.33	9.932465
2007	1.475683	3.66	10.11391
2008	1.854116	4.11	10.32701
2009	2.146686	3.85	10.98448
2010	2.241014	4.04	10.95849
2011	2.416040	4.58	10.92215
2012	2.578272	4.83	10.55720
2013	2.693532	5.08	10.32082
2014	2.097613	5.33	9.983625

Honduras normalized data

Year	*Honduras Mobile Telephone Subscriptions*	*GDP*	*Exports of goods and services*	*Labor force, total*
2000	0.0426074	1.595002	1.941357981	6.7309789
2001	0.065207	1.698816	1.968471954	6.760148059
2002	0.089596	1.745789	2.076006235	6.709213629
2003	0.1040995	1.827791	2.229719629	6.861232174
2004	0.1940607	1.969673	2.595088929	7.017128946
2005	0.3516417	2.171724	2.889841167	7.236208977
2006	0.6148784	2.434364	3.077310780	7.469434301
2007	1.1483464	2.756298	3.326039163	7.721001592
2008	1.7042606	3.096298	3.583838474	7.966066314
2009	2.3024792	3.252668	2.899636940	8.243095134
2010	2.608255	3.531881	3.644651490	8.512643297
2011	2.2123295	3.949171	4.564984541	8.769427998
2012	2.0223866	4.131594	4.742787422	9.045805708
2013	2.1313812	4.125225	4.459986298	9.311336323
2014	2.1198168	4.351734	4.599658066	9.591760014

Nicaragua normalized data

Year	*Nicaragua Mobile Telephone Subscriptions*	*Exports of goods and services*	*Rural population*	*Urban population*
2000	0.036897896	0.692376283	31.41961232	11.28447996
2001	0.067225241	0.683368319	31.71353981	11.50050183
2002	0.096949431	0.663807457	31.98348082	11.71145873
2003	0.190715544	0.742955997	32.2380937	11.91939716
2004	0.301832583	0.901007686	32.4854982	12.12819273
2005	0.457424962	1.039097728	32.73467027	12.339732
2006	0.747904252	1.237077636	32.97940961	12.55777986
2007	1.022536417	1.459102806	33.21927432	12.78142584
2008	1.270059289	1.793564047	33.45088117	13.00958722
2009	1.366727984	1.745551067	33.66818176	13.24062764
2010	1.619139437	2.265887347	33.86813806	13.47294763
2011	1.97109724	2.80977724	34.04993536	13.70630522
2012	2.391258164	3.191908075	34.2148855	13.94131149
2013	2.78241288	3.129238277	34.36391371	14.17844217
2014	2.888222481	3.36918679	34.49853899	14.41843548

Panama normalized data

Year	*Panama Mobile Telephone Subscriptions*	*GDP*	*Exports of goods and services*	*Labor force, total*	*Rural population*	*Urban population*
2000	0.157431	0.996755	0.971582	7.554653	22.47866	8.676337
2001	0.182266	1.012786	0.989196	7.743421	22.73075	8.884957
2002	0.201716	1.052667	0.95376	7.942584	22.97454	9.094167
2003	0.265609	1.109347	0.947573	8.174022	23.21183	9.304634
2004	0.48332	1.216232	1.1044	8.433338	23.44474	9.517588
2005	0.670823	1.326487	1.344911	8.652498	23.67643	9.733545
2006	0.834127	1.469654	1.528707	8.742147	23.90637	9.952717
2007	1.15489	1.697804	1.851542	9.002197	24.13306	10.17495
2008	1.501902	1.98654	2.266936	9.420415	24.35764	10.3999
2009	2.3272	2.154335	2.27161	9.649402	24.57913	10.62761
2010	2.549562	2.342578	2.440475	9.769154	24.79707	10.85792
2011	2.583733	2.784618	3.190695	9.97123	25.00847	11.09145
2012	2.383544	3.236729	3.594896	10.1836	25.21273	11.32809
2013	2.415782	3.633793	3.454033	10.40243	25.40859	11.56733
2014	2.38035	3.982912	3.353868	10.62124	25.59526	11.80842

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