ASSESSMENT OF THE ECONOMIC IMPACT OF TELECOMMUNICATIONS IN NIGER

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Telecom Advisory Services, LLC

Authors

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Summary of Findings

The direct positive relationship between information and communication technologies (ICT) and economic development is largely accepted. For decades, economists, social scientists, and policy makers have examined ICT's link to such measures of economic well being as GDP growth, job creation, and productivity. In the past, primarily due to limited data availability, studies examined cross-sectional samples of countries at the aggregate level. More recently, however, with increased information at their disposal, researchers have added a new dimension to the field, focusing on the economic impact of telephony and broadband within a single country. This trend continues in this study, which zeroes in on the effects that wireless telephony and broadband communications have had on the Nigerien economy.

As a landlocked country in sub-Saharan Africa, Niger's economy depends nearly entirely (85%) on the service and agriculture sectors. The instability that comes with droughts and natural disasters coupled with the country's growing population has only intensified the pressures on the economy, but a renewed exploitation of mineral resources and oil could offer a much-needed boost. Meanwhile, increased ICT adoption could serve to bolster the economy. A wide review of existing literature concludes that mobile phones positively affect all economies, regardless of their stage of development. Looking specifically at emerging African markets, these effects can include higher efficiency and lower prices, the introduction of basic financial and health services, more transparent governance, the development of new services, and increased employment opportunities. Similarly, broadband can also spur economic growth, raising productivity, employment, GDP, and household income.

Despite the dramatic, rapid increase in mobile telephony connections (over 16% annually), by mid-2013, wireless penetration in Niger hovered at 33.58% (or 19.78% of unique subscribers). Even with the rise in mobile subscriptions, however, the number of fixed lines also experienced a period of growth, demonstrating a much less-pronounced fixed-mobile substitution effect than many other emerging countries. At present, both fixed and broadband use in the country is negligible (3,669 fixed lines, 38,000 mobile connections), but demand will likely increase as competition increases.

The telecommunications sector has directly impacted the Nigerien economy, particularly influencing GDP and employment. Industry revenues in 2012 are estimated at US$ 373 million (or 5.7% of the country's GDP) while the sector generated an estimated 759 direct and 13,910 indirect jobs. Many positive externalities also came as a result of increased mobile adoption. To quantify the indirect benefits that wireless telephony and mobile broadband adoption had on the Nigerien economy, this study constructed a structural model consisting of four equations: an aggregate production function modeling the economy and, subsequently, three demand, supply, and output functions. However, given the still low penetration levels, the model cannot estimate the economic effect with statistical significance. To address this limitation, the authors integrated Niger's datasets within those of three other Francophone African countries (Senegal, Mali, and Cote d'Ivoire) to calculate a four-country coefficient. According to the four-countries model,

an increase of one percent in wireless penetration could trigger 0.028 percent contribution to each of the countries GDP growth rate. By relying on the four-country coefficient, the annual contribution of wireless technology to each of the countries' GDPs was estimated: $ 2.5 million. Considering that by 2017 wireless and broadband will reach penetration levels in line with the more advanced nations in the francophone zone (48% in wireless telephony, 4.56% in mobile broadband), the economic impact will be ascertained in a stand-alone fashion for Niger.

Given the observed direct and indirect benefits of the introduction of mobile phone services, Niger would benefit from policies that foster ICT adoption. Further support of a competitive market would likely encourage the decline of prices and increased operator investment in the sector. With a lagging broadband sector, the country needs stability and predictability in its regulatory framework to stimulate the capital expenditures necessary to encourage additional 3G deployments. Lastly, to spur additional demand, policies should promote the local development of applications, services, and content.

1. Introduction

The relationship between information and communication technologies (ICT) and economic development has long interested social scientists and policy makers alike. Since the mid-1970s, development banks and foundations, academics, and social scientists have worked not only to understand, but also to measure quantitatively ICT's economic contribution, focusing on such areas as GDP growth, job creation, and productivity.

Through these investigations, research has leaned toward study cross-sectional samples of countries, typically limiting the scope to OECD countries or worldwide analysis due to data availability restrictions. This methodology admittedly offered a great deal of knowledge to the field and current work continues to employ this approach. That said, enabled by improved data availability, modern research has started to extend its reach, shifting from a global view to hone in on more country-specific data and findings. As an example, to understand broadband's economic impact, the authors have conducted studies for Germany (Katz et al., 2010), the United States (Katz and Suter, 2009; Katz et al, 2011), Costa Rica (Katz, 2011b), Chile (Katz, 2012), Colombia (Katz et al., 2011c), and Philippines (Katz et al, 2012).

The following study analyzes the impact of wireless and broadband communications on the Nigerien economy. Timing, existing adoption conditions, and market maturity all determine ICT's economic effect. As supported by multiple studies (Hardy, 1980; Jorgenson et al., 2006; Karner and Onyeji, 2007), the introduction of a new technology does not immediately produce significant economic effects.

The Nigerien telecommunications sector has grown rapidly in recent years, largely due to the adoption of mobile telephony as well as a rise in the number of fixed-line subscriptions. While the number of fixed lines quadrupled between 2004 and 2012, the number of unique mobile subscribers multiplied from just 82,000 at the start of 2012 to more than 3,410,000 at the end of the second quarter of 2013[1]. Despite this growth, however, mobile penetration in the country is just 33,58% and Niger ranks last of all countries in the West Africa region, which has an average penetration rate of 71.7%.

Even still, the telecommunications sector contributed more than 6% to national GDP (US$ 373 million) and US$ 230 million in terms of value-added. To understand the implications and the relationship between ICT and the Nigerien economy, this study employed a structural model that depends on four equations modeling the market operation, taking into account:

- Endogenous growth from existing capital and labor together with the ICT infrastructural metrics
- Demand for telecommunications services depending on the price and adoption patterns

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[1] Or 5,789,000 wireless connections (Source: GSMA Intelligence).

- Supply and competition of telecommunications taking into account the regulatory and infrastructural investments in ICT
- Revenues and outputs of the telecoms market as a proxy for the 'health' and sustainability of the market

However, low relative penetration levels prevented the estimation of statistically significant results. Expected industry growth will allow the determination of economic effects in a more robust manner in the future.

To offer a context for its approach, this study first provides a brief literature review of established research surrounding the economic impact of telecommunications (Section 2). An overview of Niger's economy (Section 3) follows and is complemented by an explanation of the key characteristics of the country's telecommunications market (Section 4). ICT's direct and indirect economic contributions the Nigerien economy follows (Section 5), along with a discussion of the study's methodology and findings. The implications derived from these findings conclude the study (Section 6).

2. Impact of Mobile Telephony and Broadband on the economy: a review of the literature

Whether driving innovation in more advanced economies or addressing the lack of traditional fixed-line services in emerging countries, mobile phones affect all economies regardless of their stage of development. As mobile infrastructure becomes permanent, so, too, do its effects on the market and the economy. A review of the literature indicates that mobile telephony and broadband access can lead to more informed markets, increased employment opportunities, and GDP growth.

Multiple micro-economic studies from emerging countries show that enhanced communication results in more efficient markets, which ultimately improves consumer welfare. For instance, in Kerala (India), the introduction of mobile telephony led to a more informed and demand-driven fishery market (Jensen, 2007). Similarly, in Niger, prices in the grain market fell, resulting in increased profits and, ultimately, consumer welfare improvements (Aker, 2008). Rural Ugandan banana farmers producing perishable crops benefitted as the costs of crop marketing decreased as a result of mobile coverage (Muto, 2008).

Mobile networks can also address lack of access to traditional services. In Kenya and Tanzania, the launch of financial services and micropayments via mobile phones reduced both the cost of banking services and the transactional burdens, leading to a reduction of the countries' "unbanked" population. Similarly, the introduction of mHealth mobile applications in such countries as Ghana and Cape Verde resulted in more accessible,

affordable, and higher quality healthcare services in developing countries (Kelly and Minges, 2012).[2]

In some instances, the introduction of mobile networks can lead to the development of new markets and services. When a region received wireless network coverage in South Africa, for example, employment significantly increased (Klonner and Nolen, 2010); in Malawi, female labor participation increased (Batziillis et al., 2010). On a related note, the mobile applications that assist with the job search and application process are particularly beneficial in instances of low digital literacy or where the employment process is largely informal (Donner, Gitau, and Marsden, 2011).[3] In many cases, the higher-quality jobs are listed online, where only those citizens with digital literacy skills and Internet access can apply for them.

Additionally, it is important to note that multiple studies (see Waverman, Meschi and Fuss, 2005; Shiu and Lam, 2008; Kathuria, Uppal and Mamta, 2009; Andrianaivo and Kpodra, 2011) find initial increasing returns to economic growth as a result of the "return to scale effect" when it comes to mobile telephony's effects on the economy. In other words, wireless telecommunications' economic impact is maximized once the infrastructure reaches a critical mass point, which in developed countries typically correlates with penetration. As Gruber and Koutroumpis (2011) show, mobile telephony's effects on GDP growth correlate with wireless penetration growth up until penetration rates reach 60%, at which point effects tend to subside.

Like mobile networks, broadband can also affect economic growth.   Through the introduction of new services and applications, new forms of commerce, mass customization of products, reduction of excess inventories, and optimization of supply chains, growth in business revenue (Varian et al., 2002; Gillett et al., 2006), and growth in service industries (Crandall et al., 2007), broadband can positively impact output and employment.

While many studies that examine the relationship between broadband access and the economy focus on data from the United States, additional research has emerged confirming positive effects of broadband penetration growth in Germany (Katz et al., 2010a) as well as in Brazil, Chile, India, Saudi Arabia, Indonesia, and the Dominican Republic (Katz, 2011). That said, while all of these countries witnessed a significant employment increase, the growth varied widely. Explanations could include migratory trends (Crandall), local effects (Gillett et al., 2006), and industry sector differences (Shideler et al, 2007). For example, the new jobs that opened as a result of broadband tended to occur in the service industries, although some studies also found a presence in the manufacturing sector as well (Crandall et al, 2007). Only the accommodations and

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[2] Kelly, Tim, and Michael Minges, eds. *Maximizing Mobile*. Rep. The World Bank, 2012. Web. <http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGI ES/Resources/IC4D-2012-Report.pdf>.
[3] Donner, Jonathan, Shikoh Gitau, and Gary Marsden. "Exploring Mobile-only Internet Use: Results of a Training Study in Urban South Africa." *International Journal of Communication* 5 (2011): 574-97. *IJOC*. Web. 26 Jan. 2012. <http://ijoc.org/ojs/index.php/ijoc/article/view/750/543>.

food services industry saw a decline in employment opportunities, likely due to the strong capital / labor substitution process whereby the realized productivity gains led to a lower need for labor (Thompson and Garbacz, 2008).

Broadband can also make government services more accessible, reducing government expenditures and keeping citizens more informed, amongst other benefits. As Zenghelis (2011) found, by establishing more accountable institutions, all countries – particularly developing countries – can benefit from more "inclusive, efficient, and transparent" governance, which then spur total-factor productivity and overall prosperity.[4]

The effects of broadband introduction on the economy mimic the effects of infrastructure deployment. Beyond GDP growth, broadband can impact infrastructure investment (Katz et al., 2009a; Katz et al, 2010a), productivity growth, and the elasticity of supply as well as household income. In the OECD countries, for instance, research has demonstrated that broadband adoption led to a significant rise in per capita GDP (Czernich et al., 2009; Koutroumpis, 2009; Katz et al., 2010a). The countries with higher broadband penetration rates saw higher GDP growth rates (Koutroumpis, 2009). A study of ASEAN countries also concluded that broadband deployment positively impacts GDP growth (Ng, Lye, and Lim, 2013),[5] as did an examination of Indonesia and Malaysia (Katz, 2012).[6] The same held true at a global level, where broadband adoption had less of an effect on economic growth in countries with lower broadband penetration rates (Katz, 2012).

In sum, multiple studies looking at both advanced and emerging economies conclude that mobile network and broadband access have positive economic effects. Wireless access can result in a more efficient market, with benefits realized by both vendors and consumers. Wireless services can also address lack of access to other traditional services, such as banking or healthcare. These new services can even create new markets and increased employment opportunities, further spurring economic activity. Broadband access can also lead to job creation, as confirmed in studies examining multiple countries. Lastly, broadband access can also result in a rise in GDP, productivity growth, supply elasticity, and an increase in household income. While most studies tend to focus on developed economies, more recent studies offer evidence of these benefits in the case of emerging countries. This study will provide additional insights regarding the economic impact of telecommunications on the economy of Niger.

3. The economy of Niger

A landlocked nation in sub-Saharan Africa, Niger's economy depends on subsistence crops, livestock, and uranium deposits, which are some of the world's largest. In 2013,

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[4] Zenghelis, Dimitri. *The Economics of Network-Driven Growth*. Rep. Cisco, Jan. 2011. Web.
<http://www.cisco.com/web/about/ac79/docs/Economics_NPG_FINALFINAL.pdf>.
[5] Ng, Tuan Hock, Chun Teck Lye, and Ying San Lim. "Broadband Penetration and Economic Growth in ASEAN Countries: A Generalized Method of Moments Approach." *Applied Economics Letters* 20.9 (2013): 857-62. Web.
<http://www.tandfonline.com/doi/abs/10.1080/13504851.2012.754538?journalCode=rael20#preview>.
[6] http://www.itu.int/ITU-D/treg/broadband/ITU-BB-Reports_Impact-of-Broadband-on-the-Economy.pdf

the UN ranked Niger last on its list of 187 countries measured in the Human Development Index, a report that takes such factors as education, health, and income dimensions into account.[7] The report did reveal, however, that despite the country claiming the lowest human development score in the world, it did show the 10th fastest average human development growth between 2000 and 2012 (2.2%).[8]

Combined, the service and agriculture sectors account for nearly 85% of Niger's gross domestic product (GDP). The country will likely see a significant increase in oil production, refining, and exports through 2016, although oil revenue to the government has fallen below the budgeted level. High levels of population growth coupled with drought and desertification can largely explain the nation's suffering economy, but the governmental implementation of an economic development program that focuses on increasing infrastructure spending could offer future relief.

Foreign donor resources comprise nearly half of the government budget. In December 2000, the International Monetary Fund approved Niger to receive enhanced debt relief through its Highly Indebted Poor Countries (HIPC) program. The subsequent relief significantly reduced the annual debt obligations, meaning the country could spend more of its budget on basic health care and HIV/AIDS prevention, primary education, rural infrastructure, and general poverty reduction. Five years later, Niger received 100% relief through the Multilateral Debt Relief Initiative (MDRI), which forgave approximately US$ 86 million in debt. Per the IMF, prior to these two initiatives, Niger's public nominal external debt declined from 80% of GDP in 2002 to about 17 % in 2010. In 2010, the government received a 650 million yuan loan to finance the construction of a new uranium mine, extending a guarantee of 40% of a US$ 880 million loan to the Soraz oil refinery. This action led to an increase in external debt to 22% of GDP at year-end 2011.[9]

The IMF's latest Debt Sustainability Analysis reflects lower-than-expected GDP growth, fiscal revenue, and exports for 2011 and 2012. Meanwhile, the development of the new uranium mine, which could double current uranium production, has been postponed by two years, meaning that it will likely not have an impact on the short- to medium-term.

	2010	2011	2012	2013	2014	2015
Annual % Change GDP at Market Prices ($2005)	8.0	2.3	11.2	6.2	6.1	5.0
Current Account Balance / GDP (%)	-21.0	-18.9	-25.3	-23.5	-20.7	-21.1

Table 1: Niger: Economic Growth
Source: World Bank Global Economic Prospects (June 2013)

The service (43%) and agricultural (40%) sectors have the largest impact on Niger's gross domestic product. While the country has many natural resources that have encouraged moderate growth, it lacks the economic diversity necessary to foster stable,

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[7] United Nations http://www.un.org/apps/news/story.asp?NewsID=44372#.UkLr6M0jv48
[8] The Guardian http://www.theguardian.com/global-development/datablog/2013/mar/14/un-human-development-index-2013-data
[9] IMF DSA http://www.imf.org/external/pubs/ft/dsa/pdf/2013/dsacr13104.pdf

long-term development.[10] That said, as natural resources continue to support GDP growth, the IMF believes that the government will spend the increased revenue to improve the business climate, which will in turn lead to increased economic diversification.

Without this diversification, as seen in recent years, factors such as a bad agricultural harvest can have a serious negative impact on Niger's economy. Commodity price fluctuations, regional flooding, and climatic shocks that can result in food crises all play a part in the country's unpredictable economic future.[11] Political stability also influences Niger's shaky economy and the poorly enforced rule of law and systemic corruption results in a high degree of legal uncertainty, making it difficult for the private sector to get off the ground and flourish.[12]

The global recession hit the economy hard, with GDP growth falling from 9.59% in 2008 to -0.91% in 2009 and then -7.96% in 2010. This trend seems to be reversing, however, with GDP growth reaching 11.2% in 2012.[13]
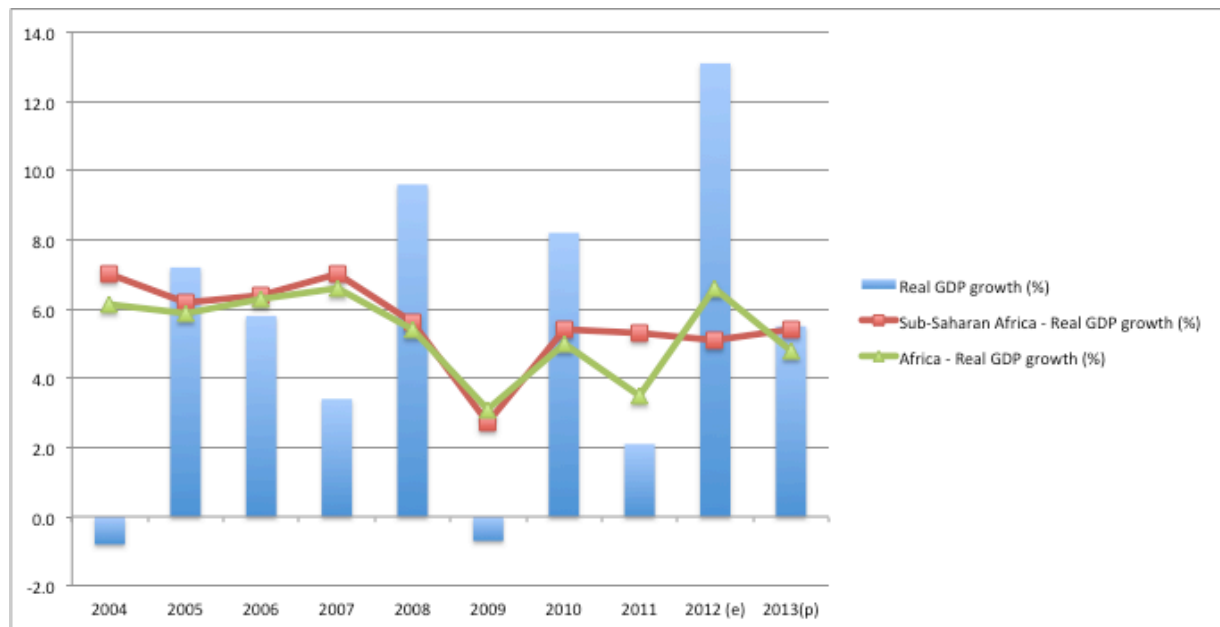

Figure 1. Niger: Economic Growth
Source: African Economic Outlook; IMF's Regional Economic Outlook

Population growth has remained stable at approximately 3.8% over the last 10 years. If this trend continues, the United Nations predicts that the Nigerien population could increase fivefold by the end of the century,[14] which has serious implications for a country

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[10] Heritage Foundation http://www.heritage.org/index/country/niger
[11] IMF http://www.imf.org/external/pubs/ft/dsa/pdf/2013/dsacr13104.pdf
[12] Heritage Foundation http://www.heritage.org/index/country/niger
[13] World Bank Data http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG
[14] The Guardian http://www.theguardian.com/global-development/2013/jun/13/nigeria-larger-population-us-2050

where 75% of the population lives on just $2 per day.[15] GDP per capita has remained somewhat steady, dropping from US$ 364 in 2008 to US$ 340 in 2010 but rising to US$ 382 by 2012.

Inflation declined rapidly from 11% in 2008 to .8% in 2010 to .5% in 2012. The IMF predicts that the inflation rate will remain low and stable in coming years, however, averaging 1.9% over the next twenty years (see Figure 2).
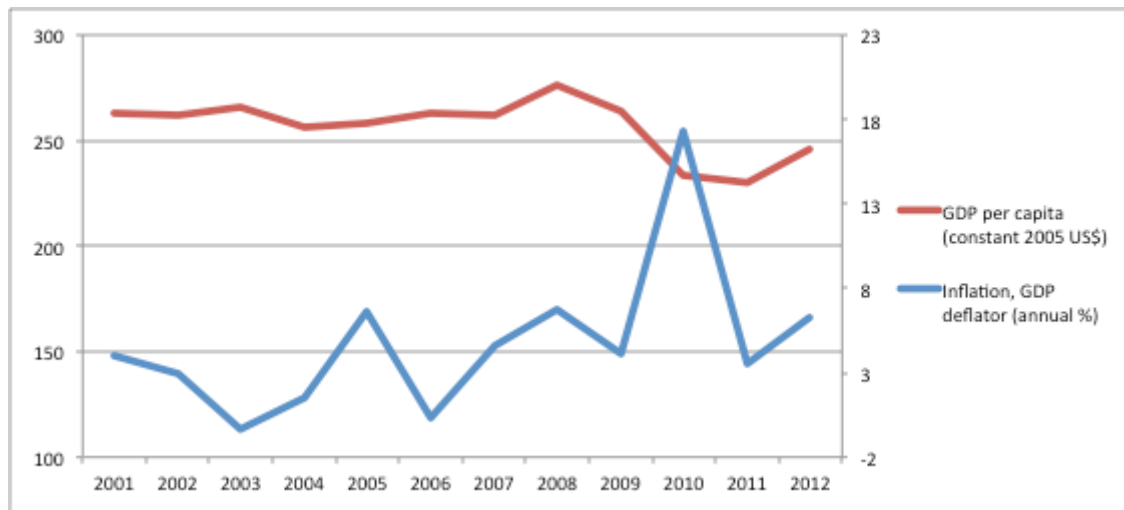

Figure 2. Niger: GDP Growth and Inflation
Source: World Bank (2013)

Imports of goods and services as a percent of Nigerien GDP have steadily increased from 36% in 2008 to 53% in 2012. Exports as a percent of GDP have also increased, rising from 19% in 2008 to 23% in 2012. The IMF believes that this percent will continue to grow through 2028 as a result of increased economic diversification. Niger currently has a crude oil export project under development, which could influence future revenue and exports, but with so much uncertainty, it is difficult to make more pinpointed projections (see Figure 3).

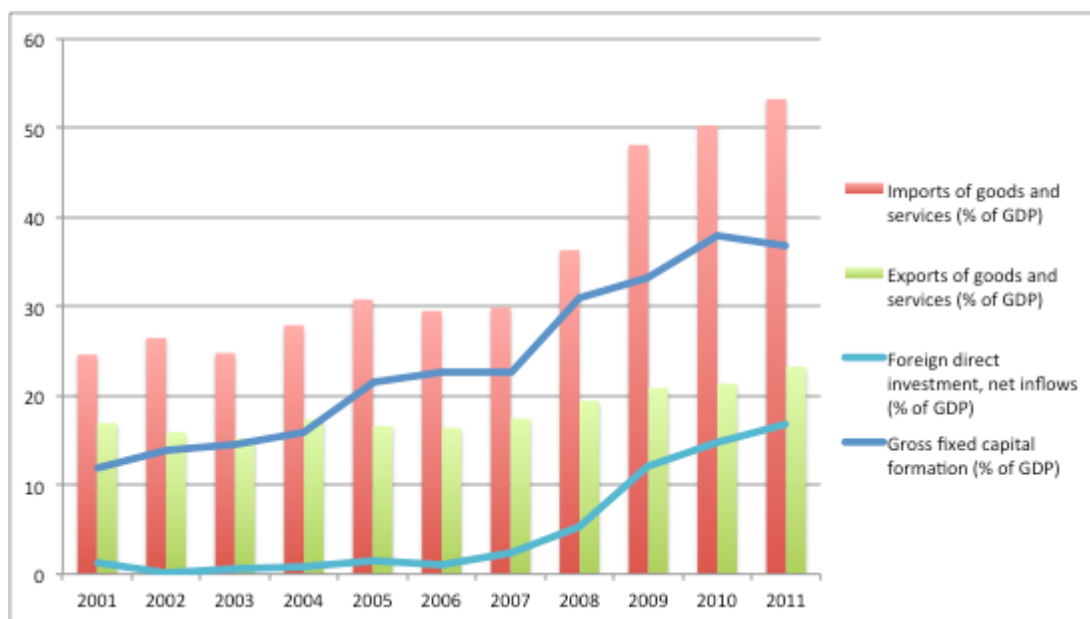[15] World Bank Data http://data.worldbank.org/indicator/SI.POV.2DAY

Figure 3. Niger: Foreign Trade and Gross Capital Formation
Source: World Bank (2013)

Niger exhibits a high cost of trade, with a 9.1% trade-weighted average tariff and extensive non-tariff barriers. While the financial sector has made steps toward modernization, businesses still have limited financing options.[16] Foreign Direct Investment in Niger has increased significantly in recent years, with FDI as a percent of GDP more than doubling from 5.2% in 2008 to 12.0% in 2009, reaching 16.8% in 2011. FDI inflow exceeded US$ 1 billion in 2011, up from just US$ 281 million in 2008. FDI finances Niger's current account deficit, as do capital grants, which will comprise an average 17% of exports throughout the next 20 years. The IMF predicts that the country's current account deficit will likely improve as a result of increased petroleum production.

Meanwhile, the IMF also predicts that Niger's public debt exposure will rise significantly as the government increases its involvement in natural resource projects. For instance, the state recently contracted a loan with EXIM Bank of China for US$ 880 million to refinance the new refinery, for which the government will assume liability for the total amount. As a result, public external debt is expected to increase from 24% of GDP in 2012 to 33.5% in 2013. Because private external debt will in turn decrease by 60%, total external debt should not be affected. Further, the rate of external public debt accumulation will likely remain stable.

In the context of the Nigerien economic conditions, telecommunications infrastructure can play an important role. On the economic side, telecommunications can increase the inter-linkages among Nigerien enterprises as well as facilitate their exports. Additionally, telecommunications can improve the productivity of small farmers by enhancing their access to inputs while facilitating increased market reach. From a social standpoint, both

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[16] Heritage Foundation http://www.heritage.org/index/country/niger

wireless telephony and broadband should improve social inclusion of rural populations and enhance welfare of urban poor.

4. The Telecommunications Industry in Niger

4.1. Telecommunications demand

The telecommunications sector in Niger has grown rapidly over the last 15 years largely due to both the adoption of mobile telephony and an increase in fixed-line subscriptions (See Figure 4).
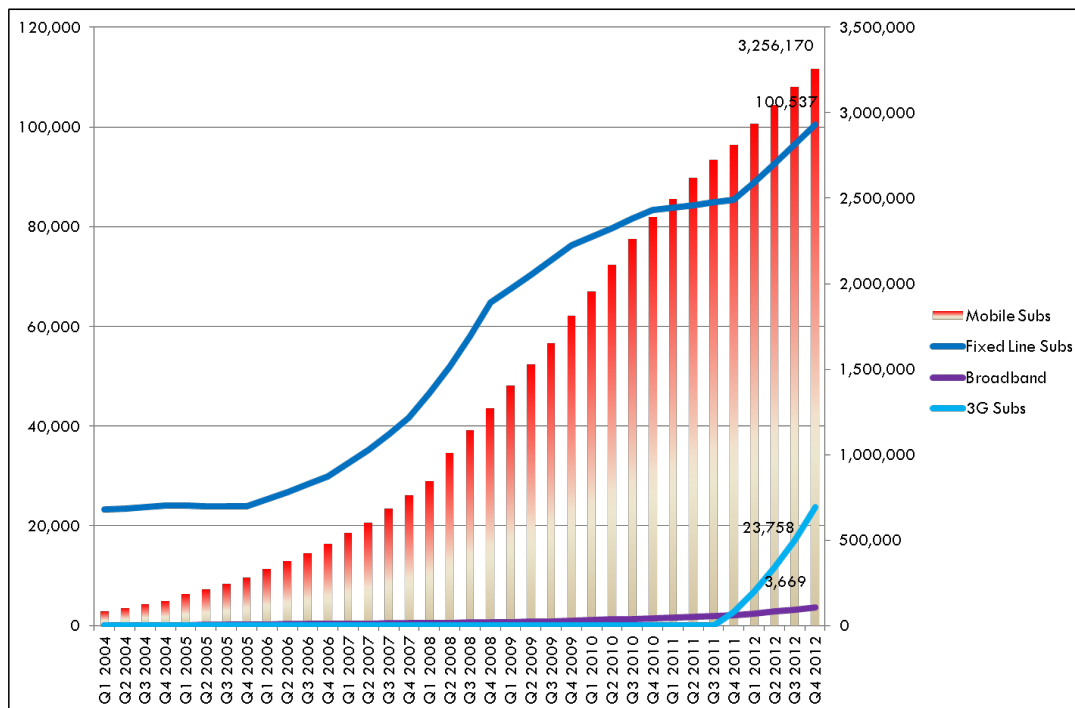

Figure 4: Mobile, Fixed-line, Broadband, and 3G subscribers in Niger
Sources: ITU and Wireless Intelligence

While wireless has experienced a dramatic increase in subscriptions, so too have fixed-lines, which increased more than 400% between 2004 and 2012. Up until 2005, fixed-lines saw very little growth, but early 2006 commenced a notable incline, with the number of fixed-line subscriptions nearly tripling in just three years. This growth has continued through present, and the number of fixed-line subscriptions increased by 13% in 2012.

This phenomenon of simultaneous growth of both technologies indicates an industry context of a market searching for any possibility to meet its needs through either technology. While the growth rate in mobile telephony is higher than fixed, the Nigerien

market does not exhibit the same technology substitution dynamic as seen in other emerging countries.[17]

The number of mobile subscriptions in Niger grew exponentially between 2004 and 2012, reaching 3.3 million mobile subscriptions by year-end 2012, up from just 82,000 in 2004. Despite this growth, however, mobile penetration in the country by the end of 2012 is just 32.42%, well below the West Africa regional average of 71.17%. Of the 15 countries, Niger ranks last (see Figure 5).
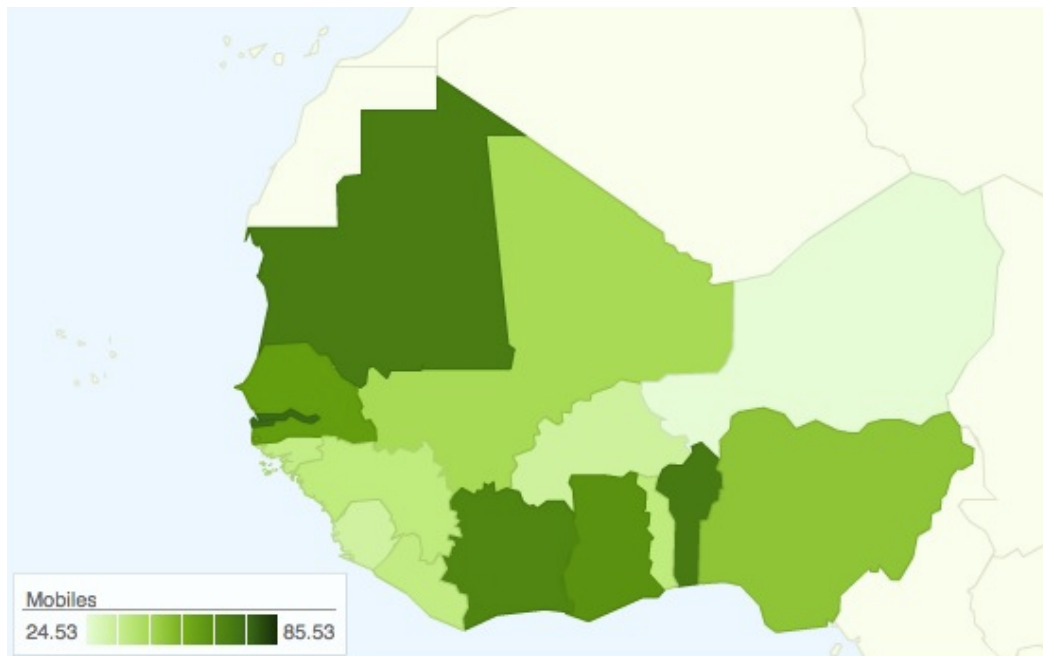

Figure 5: Niger belongs to the lower cluster for mobile penetration in West Africa
Source: ITU (2011)

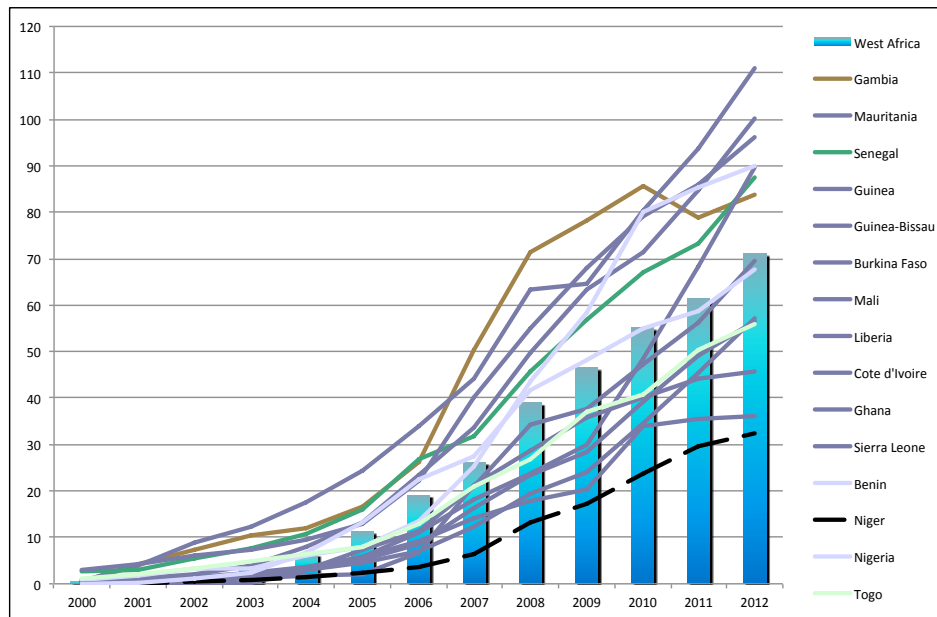[17] See the example of Latin American countries

Figure 6: Mobile penetration in West Africa region
Source: ITU (2013)

The majority (98.99%) of mobile subscribers use prepaid services and only 58,476 have contracts. In terms of technology, 99.8% of the subscribers use second-generation services (GSM) with 42,900 lines connected to 3G networks.

In terms of technology, of the country's 5.79 million mobile subscriptions by the second quarter of 2013, 38,000 – or .66% - are 3G. While this number is small, it is growing rapidly, up from 2,658 at the end of 2011. In terms of fixed-line broadband subscriptions, this number barely surpassed 3,600 in 2012. The deployment of multiple long haul transmission links is expected to meet the growing demand for the services, however, by making Internet and telephony more affordable and accessible.

In September 2012, state-owned fixed-line incumbent Sonitel began laying its 300km fiber-optic cable between Dosso and Konni. Earlier in the year, the government granted the company exclusivity on both international calls and the rollout of fiber-optic infrastructure, a decision later overturned following disputes with Airtel and Orange. In response, the government then awarded Sonitel with a contract to deploy a 900 km fiber-optic backbone from Niamey to Dosso. At the same time, Orange began deploying its own network. Reaching the landing points of submarine cables (such as ACE), would allow Niger, a landlocked country, to reduce prices of broadband services, driving broadband penetration rates.

Later in the year, the Economic and Monetary Union of West Africa in conjunction with Sonitel and Burkina Faso's incumbent operator, Onatel, launched a fiber-optic connection between Burkina Faso and Niger.

Meanwhile, the focus on bringing wireless services to previously underserved rural regions will likely bolster mobile and broadband rates as well. Orange completed the first

phase of its mobile broadband connectivity deployment (with 3G coverage of 11.20% in November 2012, reaching more than 50 off-grid village locations. In the past - as still holds true for many remote areas in the country - backhaul impracticality and the high cost of fuel transportation and infrastructure deployment prevented such rollouts. To address these issues, connectivity at these stations is solar-powered. Services like mobile money could also spur demand for mobile services.

4.2.Telecommunications supply

Niger has four mobile services providers: Airtel, Moov, Orange, and SahelCom. In 2000, the country's telecoms regulator ARM awarded GSM licenses to Celtel (now Airtel Niger), Telecel (now Moov Niger), and SahelCom. Seven years later, the regulator awarded a new "global license" to Orange for fixed, wireless, and Internet services.[18] Despite entering the mobile market last, Orange boasted a 28% market share (1.67 million active customers) in 2013, second only to Airtel. Its mobile network covers 75% of the population. Orange remains the country's second operator in terms of market share (see Table 2).[19]

	2009	2010	2011	2012	2013
Airtel (Bharti)	61.94 %	55.42 %	53.432 %	50.78 %	50.81 %
SahelCom (Sonitel)	7.74 %	7.31 %	7.75 %	8.06 %	8.39 %
Moov (Etisalat)	11.85 %	11.65 %	12.45 %	12.67 %	13.00 %
Orange	18.47 %	25.63 %	26.37 %	28.48%	27.79 %

Table 2: Subscriber market shares in Niger mobile market
Source: GSMA Intelligence

Despite the relatively low penetration rates, the growth in services throughout the sector fuelled a dramatic increase in total service revenues. Over the course of 15 years, revenues grew from US$ .017 billion in 1996 to US$ .317 billion in 2011 (see Figure 7). This increase is largely due to the adoption of mobile services.

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[18] TeleGeography
[19] Orange
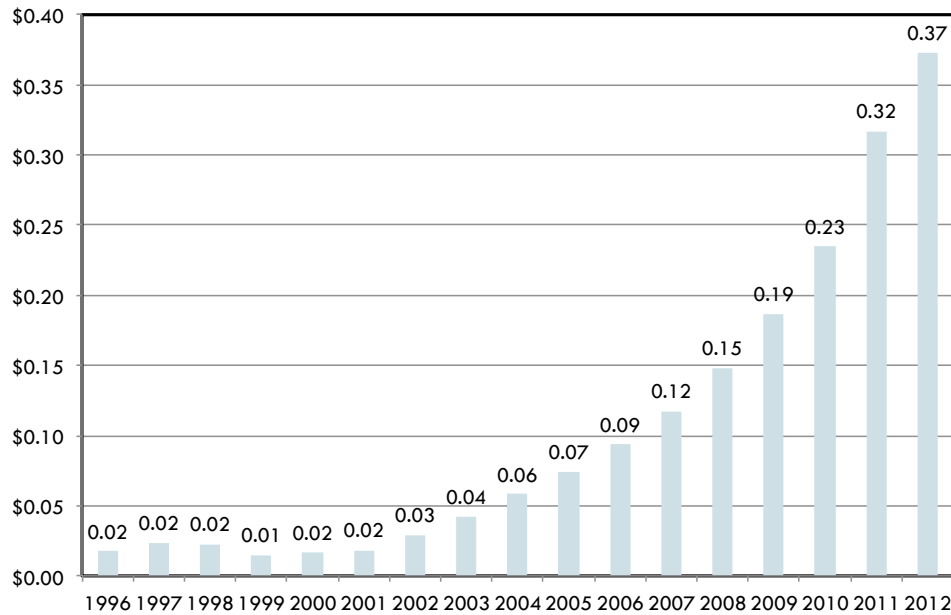
Figure 7: Telecommunications Service Revenues 1996-2011 (in USD Billions)
Source: ITU

In July 2011, the communications ministry encouraged operators to apply for Niger's first 3G licenses. Since 2000, growth in the telecommunications sector has outperformed the country's Real GDP growth (see Figure 8).

Figure 8: Annual change in real GDP and Telecom Market Revenues
Source: ITU (2013); World Bank

During this time frame, both prepaid and blended ARPU (Average Revenue Per User) stayed relatively flat.
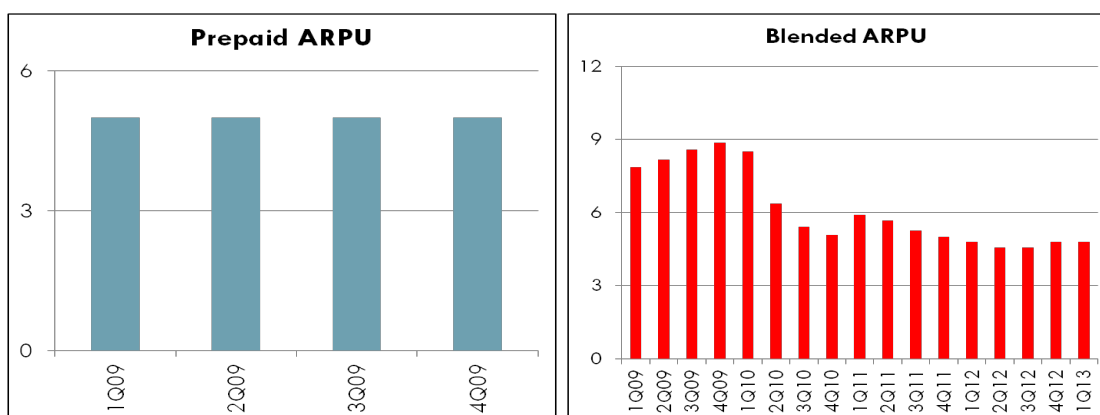
Figure 9: Evolution of ARPU (ARPU Prepaid and Blended of Orange Niger)
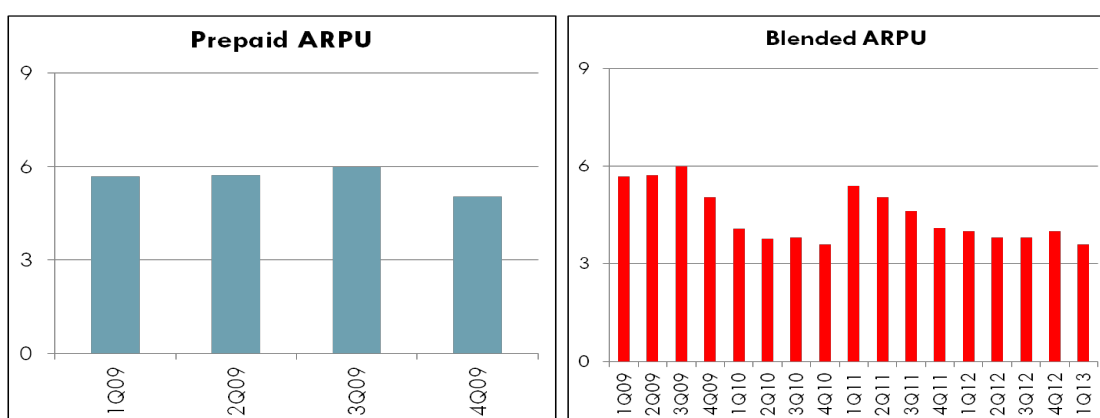
Figure 10: Evolution of ARPU (ARPU Prepaid and Blended of Telecel Niger)

5. The economic impact of telecommunications in Niger

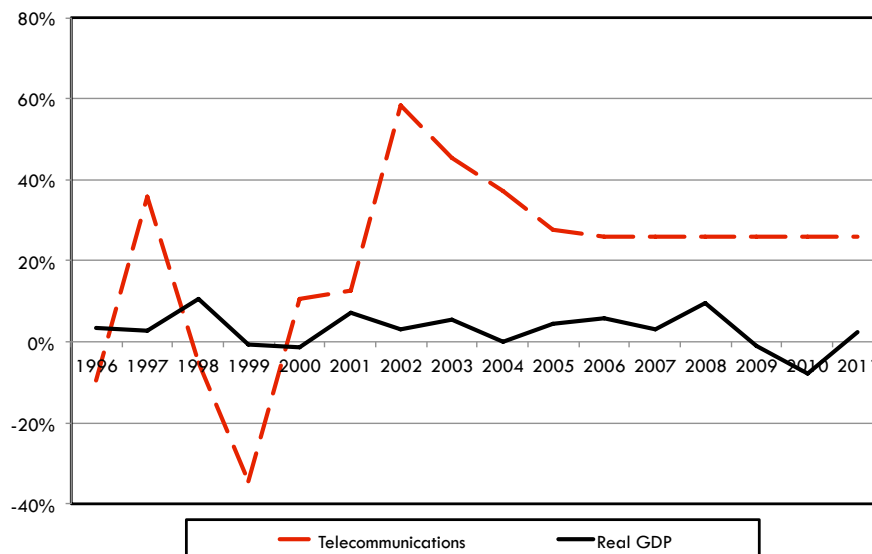The impact of telecommunications on the Nigerien economy needs to be assessed first in terms of the sector's direct impact, as measured by its contribution to GDP, and then in terms of the employment opportunities generated by its operators and their local suppliers. On the other hand, as a general purpose technology, telecommunications also has an indirect impact on the economy that results in positive externalities as reviewed in chapter 2. This chapter will assess the direct and indirect contributions that telecommunications has made to economic development in Niger.

5.1. Direct economic contribution

The total revenues of Niger's telecommunications industry in 2012 totalled US$ 373 million, or 5.7% of the country's GDP (see Figure 11).

Figure 11: Telecommunications Sector Revenues (as percentage of GDP)
Source: ITU; IMF

Beyond its contribution to overall GDP, the value-added of the telecommunications sector is estimated US$ 230 million in 2012[20].

In addition to its direct monetary contribution to the economy, the industry also fuelled job creation. In 2011, the telecommunicat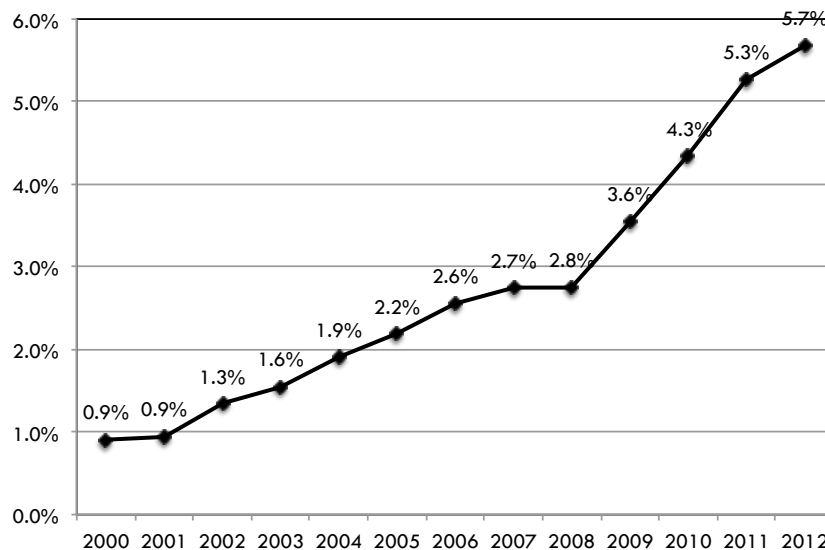ions sector accounted for 759 estimated direct jobs (i.e. employment within the telecom sector) and 13,910 indirect jobs. Combined, these jobs equated to 0.15% of Niger's total employment.

5.2. Indirect economic contribution

As shown in the literature reviewed above, beyond the direct economic contribution, telecommunications can also contribute indirectly to economic growth. This section assesses the positive externalities of telecommunications for Niger. As anticipated in the introduction, given the different penetration rates exhibited by mobile telephony and broadband, the analysis of economic impact of both technologies will be conducted through two different econometric models.

5.2.1 Data Availability

Regional and country-level statistical studies of ICT's impact in emerging economies tend to suffer from lack of microdata as institutions and technical committees do not always collect information in a relatively frequent and consistent manner. This situation introduces a degree of complexity in the data mining phase. This study relied on several databases for information: GSMA Intelligence, International Telecommunications Union,

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[20] Calculated by looking at the ratio of Transportation, and Communications to GDP, as provided by the African Central Bank.

Informa, and Pyramid Research as well as data from the local regulator – Autorité de Régulation Multisectorielle du Niger (ARM).

In addition, data also came from in-country operators. The operators provide telecommunications' costs which, in the case of mobile telephony, were disagregated in pre- and post-paid ARPUs. Other macroeconomic metrics (GDP, fixed capital formation, education, labor force etc) are available from the World Bank and IMF. Local operators also make available market performance metrics (capex, revenues, etc.). A description of data sources is included in Appendix A.

5.2.2 Mobile telephony economic impact

To measure the indirect economic impact of mobile telephony on the GDP, a structural model consisting of four equations was constructed: an aggregate production function modeling the economy and, subsequently, three functions: demand, supply, and output. The last three functions model the wireless market operation and, controlling for the reverse effects, the actual impact of the infrastructures is estimated. In the production function, GDP is linked to the fixed stock of capital, labor, and the mobile infrastructure proxied by mobile penetration. The demand function links mobile penetration to the average consumption propensity of individuals proxied by GDP per capita, the cost of a basic mobile service, and the competition in the mobile market, measured by the HHI (Herfindahl Hirshman) index. The supply function links the aggregate mobile revenue to mobile price levels proxied by ARPU (Average Revenue per User), the industry concentration index of the mobile market (HHI), and GDP per capita. The infrastructure equation links annual change in mobile penetration to mobile revenues, used as a proxy of the capital invested in a country during one year.

The econometric specification of the model is as follows:

Aggregate Production function:
$$GDP_{it} = a_1 K_{it} + a_2 L_{it} + a_3 Mob\_Pen_{it} + \varepsilon_{1it} \qquad (1)$$

Demand function:
$$Mob\_Pen_{it} = b_1 MobPr_{it} + b_2 GDPC_{it} + b_3 HHI_{it} + \varepsilon_{2it} \qquad (2)$$

Supply function:
$$Mob\_Rev_{it} = c_1 MobPr_{it} + c_2 GDPC_{it} + c_3 HHI_{it} + \varepsilon_{3it} \qquad (3)$$

Output function:
$$\Delta Mob\_Pen_{it} = d_1 Mob\_Rev_{it} + \varepsilon_{4it} \qquad (4)$$

The model yields a coefficient of impact for mobile telephony that is not statistically significant (see Table 3).

Variables	Mobile Model
Growth (GDP$_{it}$)	
Labor force (L$_{it}$)	-0.45219***
Fixed Capital Stock (K$_{it}$)	0.333***
Mob Penetration (Mob_Pen$_{it}$)	0.017
Constant	13.081***-
Demand (Mob_Pen$_{it}$)	
GDPC (GDPC$_{it}$)	1.427
Mob. Price (MobPr$_{it}$)	0.804***
Market Concentration (HHI$_{it}$)	-0.0012***
Constant	-7.663
Supply (Mob_Rev$_{it}$)	
Mob Price (MobPr$_{it}$)	1.871***
GDPC (GDPC$_{it}$)	1.814*
Market Concentration (HHI$_{it}$)	-0.0012***
Constant	-6.256
Output (ΔMob_Pen$_{it}$)	
Mob Revenue (Mob_Rev$_{it}$)	0.005
Constant	-5.124***
Year Effects	YES
Quarter Effects	YES
Operator Effects	YES
R^2	
Growth	0.99
Demand	0.74
Supply	0.86
Output	0.01

Table 3. Results of Mobile Telephony Structural Model
Source: Telecom Advisory Services analysis

According to the structural model, the only variables that appear to be statistically significant in explaining dynamics of the telecommunications sector are the following:

- Low levels of skills and education hamper wireless telephony adoption (coefficient: -.45219)
- Competition has already significant positive effects on adoption (coefficient: -.0012) and investments (coefficient: -.0012)

The lack of statistical significance of the impact of wireless telephony on GDP growth is due to the limited adoption of the technology between 2005 and 2013 (average wireless penetration: 20.55%). This is confirmed by running a simple Cobb-Douglas production function, which includes mobile telephony as one of its terms (see Table 4).

```
. reg  lgdp  lfcapital  llabedu  lmobpen y_1-y_11 op_1-op_4 qt_1-qt_4
note: y_1 omitted because of collinearity
note: op_4 omitted because of collinearity
note: qt_3 omitted because of collinearity
```

Source	SS	df	MS			
Model	10.7052588	19	.563434672			
Residual	.081729987	118	.000692627			
Total	10.7869887	137	.078737144			

Number of obs =   138
F(19,   118) = 813.47
Prob > F   = 0.0000
R-squared   = 0.9924
Adj R-squared = 0.9912
Root MSE   = .02632

lgdp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
lfcapital	.3274061	.0516393	6.34	0.000	.2251462	.4296659
llabedu	-.7919483	.5061219	-1.56	0.120	-1.794208	.2103108
lmobpen	.0267323	.0531315	0.50	0.616	-.0784826	.1319471
y_1	(omitted)					
y_2	.0758016	.0397565	1.91	0.059	-.0029271	.1545303
y_3	.1499083	.0722532	2.07	0.040	.0068273	.2929893
y_4	.1859559	.0970649	1.92	0.058	-.0062591	.3781709
y_5	.2779696	.1216994	2.28	0.024	.0369717	.5189674
y_6	.4424051	.148133	2.99	0.003	.1490615	.7357487
y_7	.5373089	.1689551	3.18	0.002	.2027317	.8718861
y_8	.4625666	.186003	2.49	0.014	.0942301	.8309032
y_9	.5627932	.2022524	2.78	0.006	.1622783	.963308
y_10	.6848334	.2140624	3.20	0.002	.2609316	1.108735
y_11	.73337	.2215664	3.31	0.001	.2946082	1.172132
op_1	-.0006432	.007449	-0.09	0.931	-.0153943	.0141079
op_2	-.0006432	.007449	-0.09	0.931	-.0153943	.0141079
op_3	-.0006432	.007449	-0.09	0.931	-.0153943	.0141079
op_4	(omitted)					
qt_1	.006018	.0128135	0.47	0.639	-.0193562	.0313923
qt_2	.0028639	.0085943	0.33	0.740	-.0141551	.0198829
qt_3	(omitted)					
qt_4	.08819	.0156704	5.63	0.000	.0571583	.1192217
_cons	19.13442	7.754633	2.47	0.015	3.778139	34.49071

Table 4. Results of Cobb- Douglas Function with wireless telephony
Source: Telecom Advisory Services analysis

Furthermore, looking at the results in light of the exponential growth impact curve of Gruber and Koutroumpis (2011), Niger exhibits an unusually low coefficient of economic impact (0.017), well   below the function estimated by Gruber and Koutroumpis' exponential model based on a sample of 150 countries, and significantly below its peers of the Francophone zone (see Figure 12).
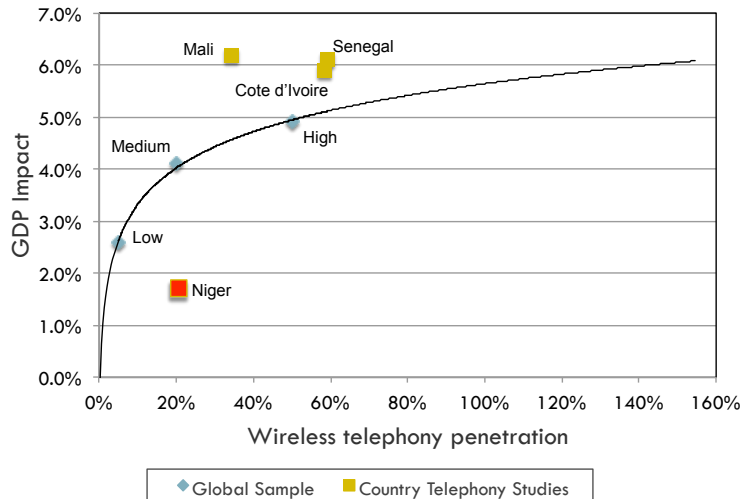
Figure 12: Wireless Telephony Impact: Country Model Results Versus Global Sample Estimates
Note: Estimate based on fitted line of previous studies (median mobile penetration: 58.27 %)
Source: Telecom Advisory Services analysis

That said, when considering the forecast of wireless telephony penetration in Niger for the next four years, we hypothesize that the economic impact model specified on future data would yield significant results (see Figure 13).
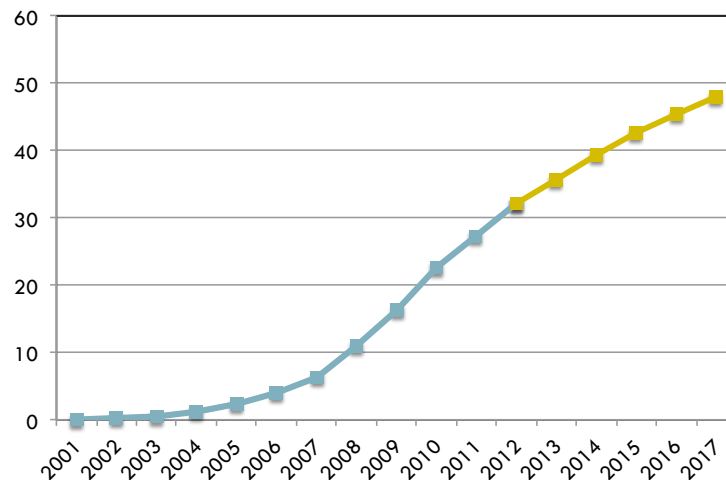
Figure 13: Wireless Telephony Penetration (2001-17)
Source: GSMA Intelligence

In four years, wireless telephony in Niger will reach 48%. Based on the results of studies conducted for other countries in the Francophone zone, the indirect economic effect of the technology will then emerge.

In order to anticipate the potential economic impact of wireless telephony in Niger, the researchers integrated all country observations within a single model, which yields the following results (see table 5).

	Variables	Four-Countries
Growth (GDP)	Labour force (L)	-0.383***
	Fixed Capital Stock (K)	0.891***
	Mob Penetration (Mob_Pen)	0.028***
	Constant	9.887***
Demand (Mob_Pen)	GDPC (GDPC)	-0.656
	Mob. Price (MobPr)	-0.468*
	Market Concentration (HHI)	0.0017***
	Constant	10.380
Supply (Mob_Rev)	ARPU (ARPUit)	0.099***
	GDPC (GDPCit)	1.423***
	Market Concentration (HHI)	-0.0002***
	Constant	9.688***
Output (ΔMob_Penit)	Mob Revenue (Mob_Rev)	0.551
	Constant	1.174
Controls	Year Effects	YES
	Quarter Effects	YES
	Operator Effects	YES
R2	Growth	99.99%
	Demand	61.29%
	Supply	93.55%
	Output	7.77%

Table 5. Francophone West Africa: Four-country integrated model results
Source: Telecom Advisory Services analysis

According to the four-countries model, an increase of one percent in wireless penetration could trigger 0.028 percent contribution to each of the countries GDP growth rate. The model is specified with a high degree of controls (country, year, quarter, and operator) and still yields statistically significant coefficients (to the 0.1%).

By relying on the four-country coefficient, the actual contribution of wireless technology to Niger's GDP was estimated. For this purpose, the compound annual growth rate of wireless penetration between 2009 and 2013 (formula 5) was multiplied by the coefficient of economic impact derived from the econometric model presented in Table 5 (Formula 6):

CAGR = (Wireless penetration 2Q2013 -Wireless penetration 4Q2009) ^ (1/4)-1   (5)

Impact of wireless on GDP (2009-2013)= CAGR*Coefficient of Impact   (6)

Following this, the annual impact of wireless on a country's GDP was divided by the CAGR of GDP (formula 7) and multiplied by the incremental GDP between 2009 and 2012 (formula 8).

% impact of wireless to GDP growth = Annual impact of wireless on GDP / CAGR GDP (2009-2012)   (7)

Impact of Wireless on Incremental GDP = Incremental GDP (2012-2009) * % impact of wireless to GDP growth (8)

By dividing the total impact of wireless on incremental GDP growth between 2012 and 2005 by the number of years, the annual impact was estimated for each country (see table 6).

Item	Component	Niger
1	Annual contribution of wireless telephony to GDP growth (for every 10% increase in wireless penetration)	0.28
2	Wireless telephony penetration 2Q2013	32.74%
3	Wireless telephony penetration 4Q2009	12.33%
4	CAGR Wireless telephony penetration	27.65%
5	Annual impact of wireless on GDP	0.77%
6	CAGR GDP per capita (2009-2012)	7.72%
7	Percent contribution of wireless telephony to GDP growth	10.03%
8	Incremental GDP (2012-2009) ('000'000)	US$ 1,314 mm
9	Total Impact of Wireless Telephony on Incremental GDP growth	US$ 10 mm
10	Annualized impact	US$ 2.5 mm

Table 6. Niger: Annual Wireless Impact on GDP
Source: Telecom Advisory Services analysis

In sum, the indirect annual contribution of wireless telephony to the GDP in Niger was US$ 2.5 million.

5.2.3 Broadband economic impact

Examining the economic impact of broadband led to a similar conclusion. The future development of mobile broadband in Niger allows us to anticipate that this technology will yield an important economic contribution in the years to come (see Figure 14).
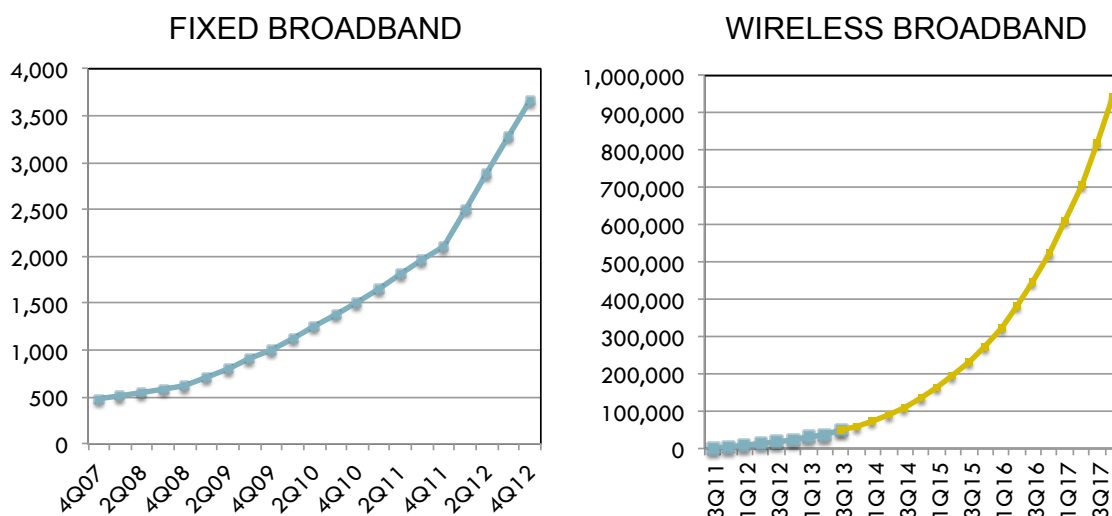
Figure 14: Fixed and Wireless Broadband Hitorical and Forecast
Sources: ITU; GSMA Intelligence

At the end of 2012, fixed broadband lines reached 3,700, while wireless broadband connections totalled 23,750. However, by 2017, wireless broadband connections are forecast to reach 942,000. Economic effects will appear by mid-2015, when broadband will exceed an estimated 600,000 connections.

The observed reduction in prices will foster adoption, which is expected to continue with increased market competition (see Table 7).

	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Orange	NA	20 036	15 412	8 827	5 296	3 707
Airtel	NA	NA	NA	NA	5 296	3 707
Moov	NA	NA	NA	NA	4 766	3 336

Table 7. Prices of Mobile Broadband Offerings (in Franc CFA)
Source: Informa

Two operators – Moov and Airtel – plan to launch mobile broadband services in 2014, which will require Orange to respond with a reduction in prices.

6. Conclusion

The Nigerien telecommunications sector has already generated significant direct economic effects and increased adoption will result in future indirect effects. While competition has led to a decline in wireless telephony pricing, the same effect will likely materialize in the case of wireless broadband. Based on the experience of other countries in the francophone zone (witness the case of Senegal), an acceleration of wireless telephony and wireless broadband adoption is expected to develop in Niger, resulting in associated indirect economic effects.

It is imperative that government policies generate the conditions necessary to foster wireless adoption. First and foremost, they must create a high level of regulatory certainty in order to stimulate the capital expenditures that will lead to further deployment of 3G networks. Additionally, to stimulate technology adoption, the government should promote the local development of applications, services, and content.

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APPENDIX A: Data Sources

Data	Sources
Fixed Line subscribers	ITU
Mobile subscribers	ITU
Mobile unique subscribers	GSMA Intelligence
Internet subscribers	ITU
Fixed broadband subscriptions	ITU
GDP	World Bank
Total Wireless Service Revenues	GSMA Intelligence
Total Fixed Service Revenues	Pyramid Intelligence
HHI	GSMA Intelligence
GDP per capita	World Bank
Population	GSMA Intelligence
Total MTN Connections	GSMA Intelligence
MTN Market Share	GSMA Intelligence
Total Wireless Connections	GSMA Intelligence
Mobile-cellular prepaid – price of a three-minute local call (peak, on-net), in USD	ITU
Price of a three-minute local call to a fixed-telephone line (peak rate), in USD	ITU
Fixed (wired)-broadband monthly subscription charge, in USD	ITU
Gross fixed capital formation (current US$)	World Bank
Gross fixed capital formation (constant 2005 US$)	World Bank
Gross fixed capital formation (% of GDP)	World Bank
Gross capital formation (current US$)	World Bank
Gross capital formation (constant 2005 US$)	World Bank
Gross capital formation (% of GDP)	World Bank
Labor force, total	World Bank
School enrollment, tertiary (% gross)	World Bank
Total Mobile Connections/Population	GSMA Intelligence
100 - "Rural population (% of total population)"	World Bank
Total Mobile Connections Q2 2013	GSMA Intelligence
Internet Service Revenue (US$m)	Pyramid Research
Blended ARPU Total	GSMA Intelligence
Blended ARPU Total	WCIS
ARPU Postpaid	WCIS
ARPU Prepaid	WCIS
ARPU, by subscriber	GSMA Intelligence
Operator ARPU Per Month Postpaid in USD	INFORMA
Operator ARPU Per Month Postpaid in USD	INFORMA
Operator ARPU Per Month Prepaid in USD	INFORMA
Operator ARPU Per Month Prepaid in USD	INFORMA
Operator ARPU Per Month Blended in USD	INFORMA
Operator ARPU Per Month Blended in USD	INFORMA
Operator Total Revenue less Mobile Revenue	INFORMA
Operator Total Revenue less Mobile Revenue	INFORMA
Operator Total Revenue less Mobile Revenue	INFORMA
Operator CAPEX in Millions USD	INFORMA
Operator CAPEX in Millions USD	INFORMA
Operator CAPEX in Millions USD	INFORMA
Operator CAPEX in Millions USD	INFORMA
Operator CAPEX in Millions USD	INFORMA
Revenue Total	GSMA Intelligence
CAPEX Total	GSMA Intelligence
DSL Internet subscriptions	ITU

Percentage of the population covered by a mobile-cellular network	ITU
Network coverage, by population	GSMA Intelligence
Active mobile-broadband subscriptions	ITU
Mobile Broadband	GSMA Intelligence
Mobile broadband at least 1 GB of CAP (US$)	Google Data
Mobile Broadband "Orange"	GSMA Intelligence