ASSESSMENT OF THE ECONOMIC IMPACT OF TELECOMMUNICATIONS IN COTE D'IVOIRE

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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 additional information at its disposal, research has 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 Cote d'Ivoire economy.

Fueled by intense competition, Cote d'Ivoire boasts a wireless penetration rate of 96.27% well above the West Africa average, ranking third in the region. Although followed by a more recent period of decline, the initial simultaneous growth in the number of fixed lines shows a muted fixed-mobile substitution effect in comparison to many other emerging countries. Meanwhile, the Internet and broadband market remains stalled, likely due to the high costs of international bandwidth and limited access to the country's only international fiber optic submarine. Following the landing of a second cable in 2011 and a reduction in costs, broadband could very well experience huge growth in coming years. Mobile broadband could also address these barriers, although it is too early to predict its economic impact given that the first 3G networks in the country did not launch until March 2012.

The telecommunications sector has directly contributed to the Ivoirian economy, particularly influencing GDP and employment. With a total of US$1.67 billion in revenues, the industry represents 6.9% of the country's GDP, creating 3,250 direct and 62,315[1] indirect jobs. Many positive externalities have also come as a result of increased mobile telephony adoption. According to the econometric models developed for this study, every 1% increase in mobile penetration contributes 0.059% to GDP growth. Ultimately, mobile telephony contributed an annual US$ 347 million to Cote d'Ivoire GDP. This contribution will likely accelerate with the launch of more services that rely on telecommunications to reach consumers.

On the other hand, it is not possible to estimate the economic impact of broadband as of now given the limited deployment of fixed broadband (96,000 existing lines at present) and the recent launch of wireless broadband. However, wireless broadband adoption is expected to accelerate, with a forecast installed base of 4,384,000 subscriptions by the end of 2017, at which point its economic effects will be more clearly established.

To sum up, telecommunications' annual contribution to the 2012 GDP of US$ 24,680 million, telecommunications effects amount to US$ 2,017 million (or 8.17%).

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[1] Authors' estimate based on comparable direct/indirect ratios in peer countries.

Annual contribution to GDP	Amount
Direct effects of telecommunications	US$ 1,670 million
Indirect effects of mobile telephony	US$ 347 million
Indirect effects of broadband	To be determined
Total	US$ 2,017 million

Table 6. Cumulative Economic effects of telecommunications
Source: TAS analysis

While the economic impact of broadband was not estimated due to its limited deployment, it is believed that the country's economy will also benefit from future adoption. Given the observed direct and indirect benefits of the introduction of mobile phone services, Cote d'Ivoire would benefit from policies that foster ICT adoption. Further support of a competitive market will likely encourage a decline in prices and increased operator investment in the sector. However, when supporting competition, it is critical to consider that excessive industry fragmentation is detrimental to sustainability and innovation levels.

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. Along these lines, applications to facilitate remittances across francophone African countries, such as the Orange Money International, remain a key incentive to ICT adoption.

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, foundations, and academics 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 the study of 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 Cote d'Ivoire 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.

Now used by the majority of the Cote d'Ivoire population, mobile voice services reflect a mature market that has demonstrably affected the country's economy. To measure this impact, this study employs a structural model that depends on four equations modelling the market operation between 2005 and 2013 taking into account:

- Endogenous growth from existing capital and labor together with the telecommunications infrastructure metrics
- Demand for telecommunications services depending on the price and adoption patterns
- Supply and competition of telecommunications taking into account the regulatory and infrastructural investments in telecommunications
- Revenues and outputs of the telecommunications market as a proxy for the 'health' and sustainability of the market

In terms of broadband's impact on the economy, this study attempted to use a structural model similar to the one used when assessing the impact of wireless telephony. However, is should be noted that between 2005 and 2013, the Internet and broadband markets showed relatively little activity. 3G just recently launched in March 2012 as a wireless broadband platform and will likely accelerate growth in this sector in the near 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 the Ivorian economy (Section 3) follows and is complemented by an explanation of the key characteristics of the country's telecommunications market (Section 4). Telecommunications' direct and indirect economic contributions to the Cote d'Ivoire economy follow (Section 5), along with a discussion of the study's methodology and findings. The policy 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). 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

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[2] Kelly, Tim, and Michael Minges, eds. *Maximizing Mobile*. Rep. The World Bank, 2012. Web. <http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/IC4D-2012-Report.pdf>.

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 lodging and 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.

The effects of broadband introduction on the economy also 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), as did an examination of Indonesia and Malaysia (Katz, 2012).[3] 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.

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[3] http://www.itu.int/ITU-D/treg/broadband/ITU-BB-Reports_Impact-of-Broadband-on-the-Economy.pdf

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. Lastly, broadband access can also result in a rise in GDP, productivity growth, supply elasticity, and household income. While most studies tend to focus on developed economies, more recent studies offers evidence of these benefits in the case of emerging countries as well. This study will provide additional insights regarding the economic impact of telecommunications on the economy of Cote d'Ivoire.

3. The economy of Cote d'Ivoire

Amongst the world's 20 poorest countries, Cote d'Ivoire experienced a time of economic growth fueled by coffee and cocoa production in the 1960s, but the early 1980s and late 1990s showed a significant decline in growth and subsequent increase in poverty.[4] As a result, the income gap widened, increasing tension within the country that led to an eventual civil war in 2002, which only exacerbated the country's economic instability. The war caused thousands of deaths amongst the Cote d'Ivoire people and displaced hundreds of thousands of others while the rural poverty rate increased from 15% in 1985 to 62% in 2008.[5]

The world's largest producer of cocoa,[6] Cote d'Ivoire suffers from extremely volatile global commodity prices.[7] If fully exploited, the country's natural resources could increase agricultural output while simultaneously offering more labor opportunities.[8] Challenges to efficient natural resource management include weak ties between the companies and other sectors of the economy as well as inadequate transparency relating to the arrangements between the government and the oil companies.[9]

Despite United Nations presence and a peace accord in 2007, Cote d'Ivoire continued to suffer from political conflict. The socio-political turmoil will continue to threaten economic growth and recovery at a time when the government needs to address infrastructure deficiencies and an overall weak business climate. To prevent future unrest, it is imperative that economic growth continues and translates into poverty reduction and improved standards of living. That said, the country has experienced better than projected economic recovery, seeing a 9.8% rise in economic activity in 2012.[10]

	2010	2011	2012	2013	2014	2015
Annual % Change GDP at Market Prices ($2005)	2.4	-4.7	9.8	8.0	8.0	8.1
Current Account Balance / GDP (%)	2.0	-5.6	-3.3	-3.0	-2.9	-3.4

Table 2. Cote d'Ivoire: Economic Growth
Source: World Bank Global Economic Prospects (June 2013)

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[4] Rural Poverty Project http://www.ruralpovertyportal.org/country/home/tags/cote_divoire
[5] Rural Poverty Project http://www.ruralpovertyportal.org/country/home/tags/cote_divoire
[6] African Economic Outlook http://www.africaneconomicoutlook.org/en/countries/west-africa/cote-divoire/
[7] Rural Poverty Portal http://www.ruralpovertyportal.org/country/home/tags/cote_divoire
[8] African Economic Outlook http://www.africaneconomicoutlook.org/en/countries/west-africa/cote-divoire/
[9] African Economic Outlook http://www.africaneconomicoutlook.org/en/countries/west-africa/cote-divoire/
 IMF http://www.imf.org/external/pubs/ft/scr/2013/cr13171.pdf

Increased political, social, and institutional stability in 2012 combined with a renewed interest in infrastructure upkeep led to an improvement in Cote d'Ivoire's economy. Forecasts for the upcoming years estimate continual GDP growth of approximately 8.0%. This growth will only occur, however, if the government continues its efforts in strengthening the country's social cohesion and business climate and in supporting the emerging private sector.[11]
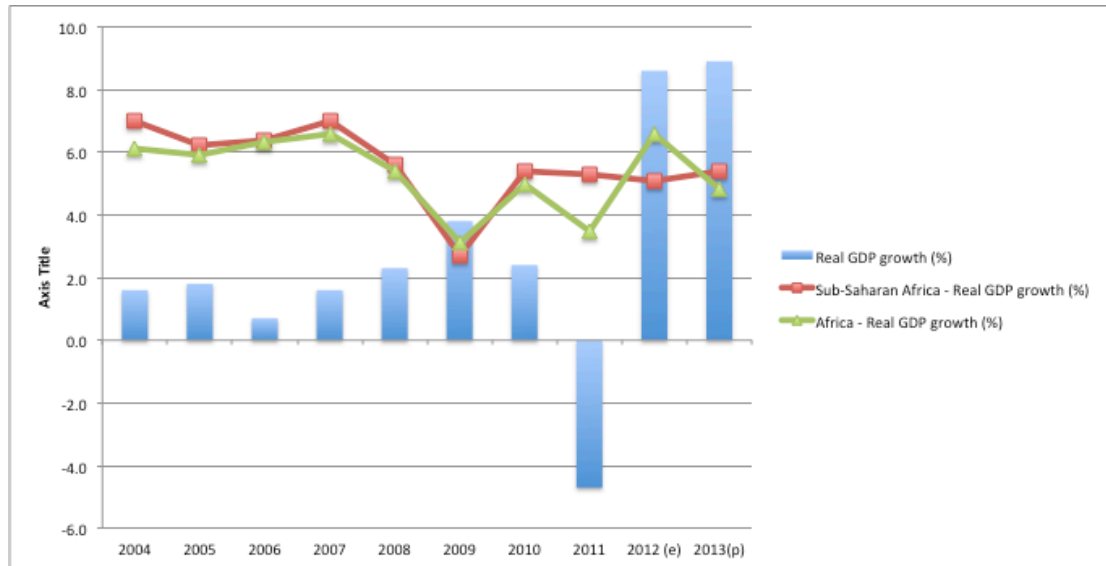

Figure 1. Cote d'Ivoire: Economic growth
Source: African Economic Outlook, IMF Regional Economic Outlook

Spurred by benchmark recommendations set in place by the IMF, the country made progress toward reducing energy sector subsidies and reforming the cocoa industry. In 2008, the latest year available, its gross fixed capital formation equated to 10% of GDP. Meanwhile, the country is behind its recommended schedule for controlling the wage bill, restructuring the public sector, adopting a new electricity code, and auditing domestic arrears.[12]

The African Central Bank Association reported that the May 2013 Ivorian bond issue generated approximately US$ 250 million, US$ 60 million more than the government had expected the issue would raise, reflecting resumed investor confidence. President Ouattara has issued four sovereign bonds in local currency thus far during his tenure, attracting investors from the Western and Central African regions as well as from Canada, France, and Hong Kong.[13]

The political and security turmoil calmed somewhat in early 2013, playing a role in Cote d'Ivoire's economic recovery. After a spike from 1.68% in 2010 to 4.91% in 2011 due to a

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[11] African Economic Outlook http://www.africaneconomicoutlook.org/en/countries/west-africa/cote-divoire/

[12] IMF http://www.imf.org/external/pubs/ft/scr/2013/cr13171.pdf

[13] African Central Bank Association http://www.aacb.org/en/top-news/ivorian-bond-harvests-more-€184-million

crisis-related surge in prices, inflation fell back to 1.3% in 2012[14] and this trend will likely continue.[15]
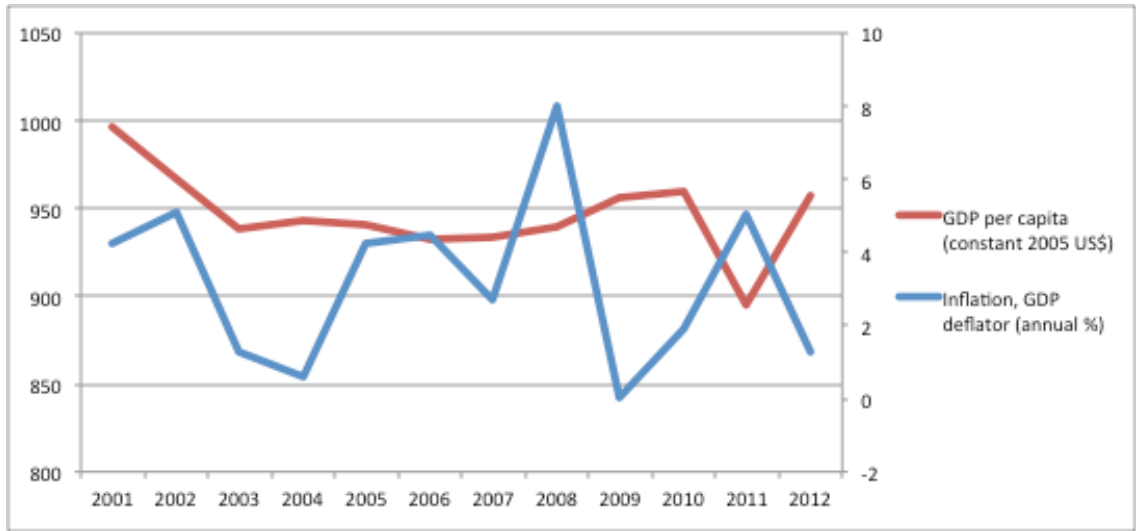

Figure 2. Cote d'Ivoire: GDP Growth and Inflation
Source: World Bank Data

In 2008 (the latest year available), Cote d'Ivoire imports equaled 38.80% of GDP while exports equaled 46.51% and the balance of goods and services equated to 7.71%. The significant increase in investment-related imports coupled with efforts to strengthen the economy resulted in a larger budget deficit in 2012, and the external account recorded a deficit of approximately 2% of GDP in 2012, the country's first deficit in five years. Foreign direct investment − which accounted for 1.43% of GDP in 2012 - helped in part to finance this deficit. The state does not discriminate against foreign investors, but investment lags as a result of capital controls and foreign exchange restrictions. Barriers to trade, including a 7.3% trade-weighted average tariff, further discourage international trade.

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[14] World Bank Data
[15] IMF http://www.imf.org/external/pubs/ft/scr/2013/cr13171.pdf

Figure 3: Cote d'Ivoire: Foreign Trade and Gross capital Formation; Source: World Bank Data
Note: With the exception of FDI, data for Cote d'Ivoire is not available past 2008

While increasing somewhat over recent years, population growth has stayed relatively stable, increasing from 1.72% in 2008 to 2.00% in 2010 to 2.29% in 2012. Cote d'Ivoire has a very large poor population, the majority of whom are small-scale farmers who suffer from market access difficulties, low education levels, and little access to technology.[16] The economy has suffered as productive land decreases due to population growth and environmental degradation, which will likely threaten future agricultural productivity. This erosion of productive land comes largely from the increase in intensive farming, but the northernmost regions are already experiencing negative effects of climate change that impact soil and livestock.[17]

To encourage public investment, the government has agreed to implement reforms addressing fiscal risks, revenue collection, and public financial management as well as the domestic debt.[18] Cote d'Ivoire saw modest trade improvements prior to the 2011 conflict, but state intervention has continued to limit private-sector development.[19] At the same time, increased industrial production and the "buoyancy of the tertiary sector" point toward increasing private sector confidence[20] Meanwhile, the country's 2011-14 economic and financial program, backed by the IMF, allowed Cote d'Ivoire to complete the Highly Indebted Poor Countries Initiative in June 2012, resulting in a large cut in external debt.[21]

In terms of the Cote d'Ivoire economic conditions, telecommunications infrastructure can play an important role. On the economic side, telecommunications can increase the inter-linkages among Ivoirian enterprises as well as facilitate their exports. Additionally, telecommunications can improve the productivity of small farmers by enhancing their access to inputs while

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[16] Rural Poverty Project http://www.ruralpovertyportal.org/country/home/tags/cote_divoire

[17] Rural Poverty Project http://www.ruralpovertyportal.org/country/home/tags/cote_divoire

[18] IMF http://www.imf.org/external/pubs/ft/scr/2013/cr13171.pdf

[19] Heritage http://www.heritage.org/index/country/cotedivoire

[20] IMF http://www.imf.org/external/pubs/ft/scr/2013/cr13171.pdf

[21] African Economic Outlook http://www.africaneconomicoutlook.org/en/countries/west-africa/cote-divoire/

facilitating market reach. From a social standpoint, both wireless telephony and broadband should improve social inclusion of rural populations and enhance welfare of urban poor.

4. The Telecommunications Industry in Cote d'Ivoire

4.1. Telecommunications demand

The rapid adoption of mobile telephony has led to a boom in Cote d'Ivoire's telecommunications sector (see Figure 4).
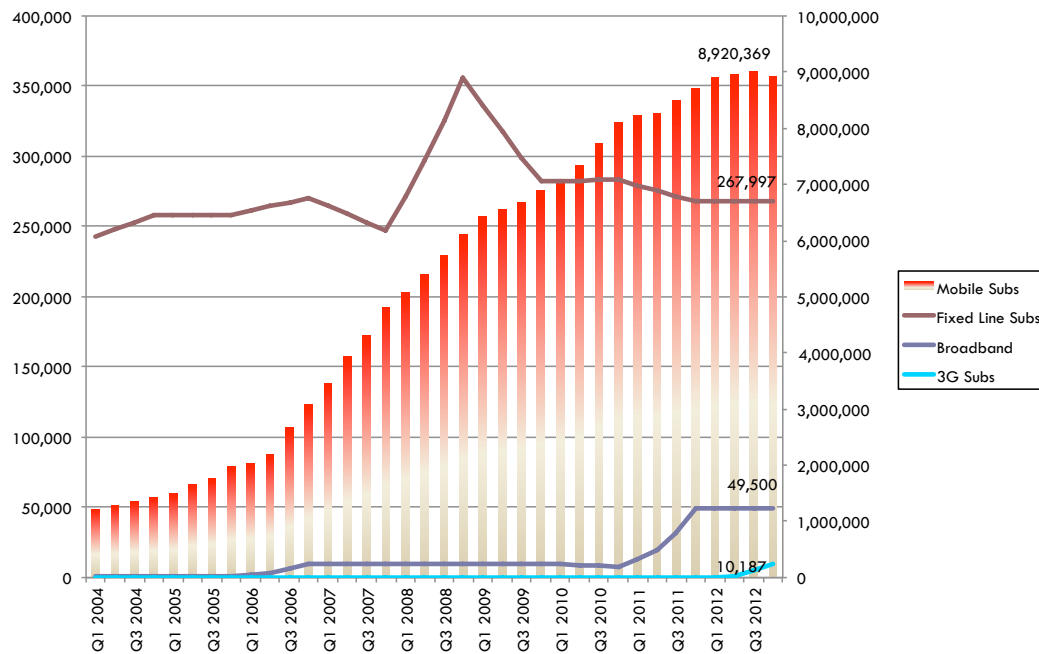

Figure 4. Cote d'Ivoire: Mobile, Fixed-line, Broadband and 3G subscribers,
Sources: ITU and Wireless Intelligence

At the end of 2012, the number of mobile subscribers in Cote d'Ivoire reached nearly 8.9 million, which equated to a penetration rate of 96.27%. When compared to other Western African countries, Cote d'Ivoire ranked third among West African countries, behind just Ghana (100.28%) and Mauritania (111.06%) and well above the regional average penetration rate of 71.17%.
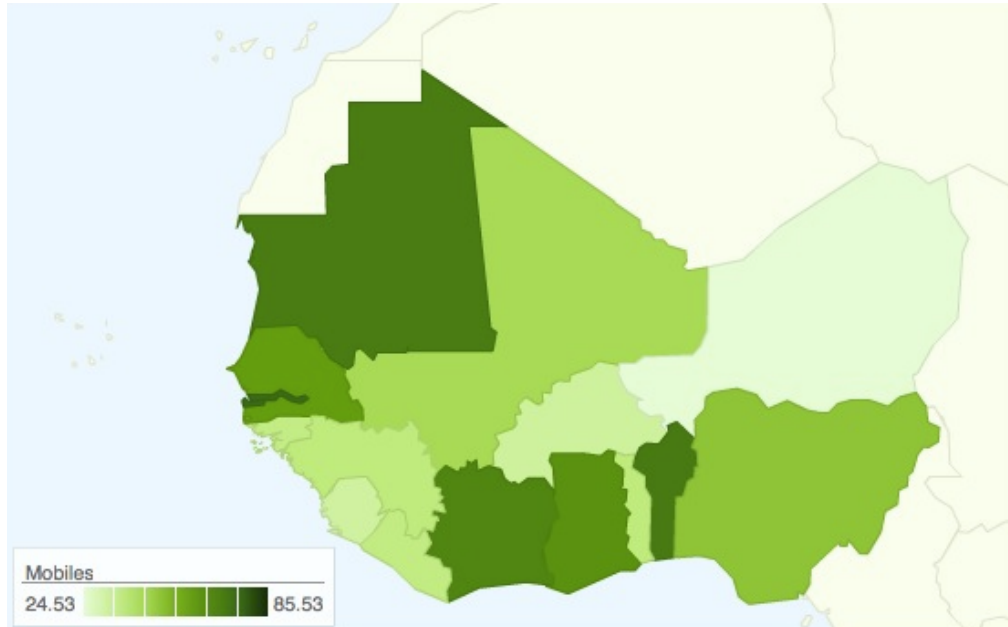
Figure 5: Cote D'Ivoire belongs to the leading cluster for mobile penetration in West Africa
Source: ITU (2011)

The majority (92.4%) of Ivoirian mobile subscribers use prepaid services and only 1,452,000 have contracts. In terms of technology, 99.8% of the subscribers use second-generation services (GSM) with 42,900 lines connected to 3G networks.
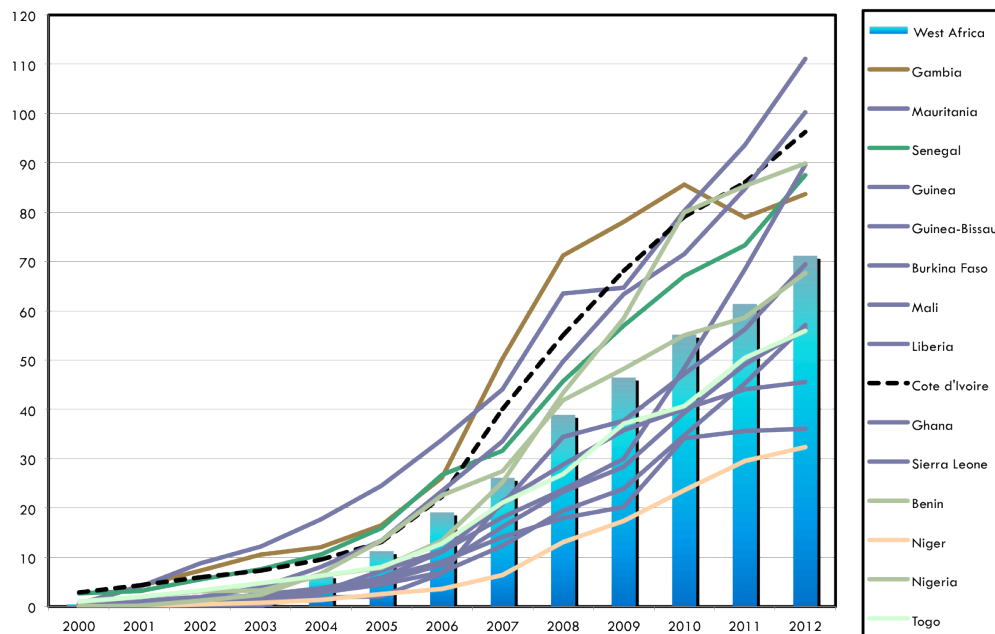

Figure 6: Mobile penetration in West Africa region
Source: ITU (2013)

Even with the introduction of mobile telephony services and the subsequent surge in wireless subscriptions, fixed-line services also experienced a period of growth. The number of

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subscriptions grew by 44% in 2008, from 247,573 at the end of 2007 to 356,502 at the end of 2008. After this spike, however, the number fell substantially, down 21% to 282,070 subscriptions by the end of the year. Since this decline, the number of fixed subscriptions has continued to fall, ending 2012 at 267,997. While the demand for fixed line services has declined slightly at the same time demand for mobile services has increased dramatically, the substitution effect is still much lower than the phenomenon observed in many other emerging countries[22].

Broadband penetration has yet to experience a notable increase. That said, the number of subscriptions increased from 71,000 at the start of 2011 to 96,200 at the end of 2012. The high costs of international bandwidth and limited access to the country's only international fiber optic submarine cable have stalled growth of the Internet and broadband market.[23] The landing of a second cable at the end of 2011 coupled with a reduction in prices of broadband services could lead to accelerated growth in the near future. The country already has a national backbone network of more than 20,000 km of fiber optic cable, which could accelerate the development of a healthy broadband market.

While a surge in 3G subscriptions has driven the growth of an emerging broadband market in many countries, 3G services have not yet taken off in Cote d'Ivoire. The first 3G license was not awarded until March 2012 and the country ended the year with 10,200 3G subscriptions.

4.2. Telecommunications supply

Cote d'Ivoire's above average mobile penetration rates are partly a result of the country's highly competitive mobile sector. While MTN and Orange lead the market,[24] the country is home to a total of six mobile operators, including Moov-Atlantic (Etisalat), KoZ (Comium Group), and Oricel Green Network (LAP Green). In April 2012, Mobile Cafe launched its network, as the first wholly-domestically owned GSM provider.[25]

	2009	2010	2011	2012	2013
MTN	35.19 %	33.96 %	35.88 %	33.49 %	34.37 %
Orange	30.36 %	34.89 %	33.49 %	34.25 %	32.84 %
Moov	19.03 %	18.02 %	19.27 %	22.07 %	22.16 %
KoZ	8.93 %	8.72 %	9.14 %	8.00 %	7.30 %
Green	6.48 %	4.42 %	2.22 %	1.95 %	2.73 %
Mobile Café	---	---	---	0.24 %	0.51 %

Table 3: Subscriber market shares in Cote d'Ivoire mobile market
Source: GSMA Intelligence

The resulting successive auction of multiple wireless licenses has increased the industry's competitive intensity beyond a sustainable point. As a result of the launch of six wireless

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[22] See the example of Latin American countries
[23] Source: Yahoo Finance http://finance.yahoo.com/news/research-markets-cote-divoire-ivory-153300886.html
[24] Source: Yahoo Finance http://finance.yahoo.com/news/research-markets-cote-divoire-ivory-153300886.html
[25] Source: Oxford Business Group

companies, the Herfindahl Hirschman Index has declined from 5,010 in the 4Q2004 to 2,826 in 3Q2013. This has resulted in a potential exit of one of the operators –KoZ (Comium Group) - which is constrained by limited access to capital. However, if a new entrant acquires KoZ,[26] the level of competitive intensity will not decline.[27]

In March 2012, L'Agence des Telecommunications de Cote d'Ivoire (ATCI) awarded the country's first 3G license to MTN Cote d'Ivoire for US$ 11.9 million.[28] Additional licenses were allocated to Moov and Orange, which was the first operator to launch 3G services.[29]

Total service revenues have grown more than nine-fold over the course of the past 15 years, up from US$ 180 million billion in 1996 to US$ 1.67 billion in 2012. Despite revenue growth of more than 25% in 2008 alone, since this point, total service revenues have remained relatively flat, growing just 4% over the course of the last 3 years.
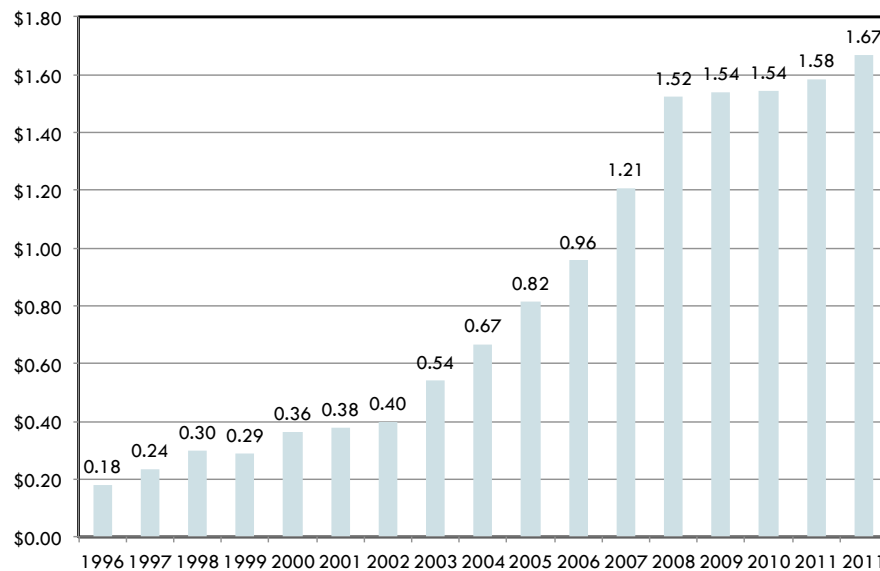

Figure 7: Cote d'Ivoire. Telecommunications Service Revenues 1996 – 2011 (in US$ billions)
Source: ITU (2013)

As a result of this slow down, revenue growth of the telecommunications sector dipped below growth of Real GDP, but has since regained momentum (see Figure 8).

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[26] Potential buyers include the Viettel group, Globacom, and Millicom.
[27] Another wireless license held by Warid Telecom and Huawei is up for sale as well.
[28] TeleGeography
[29] Source: http://www.oxfordbusinessgroup.com/economic_updates/côte-d'ivoire-evolution-dans-le-secteur-de-la-téléphonie-mobile
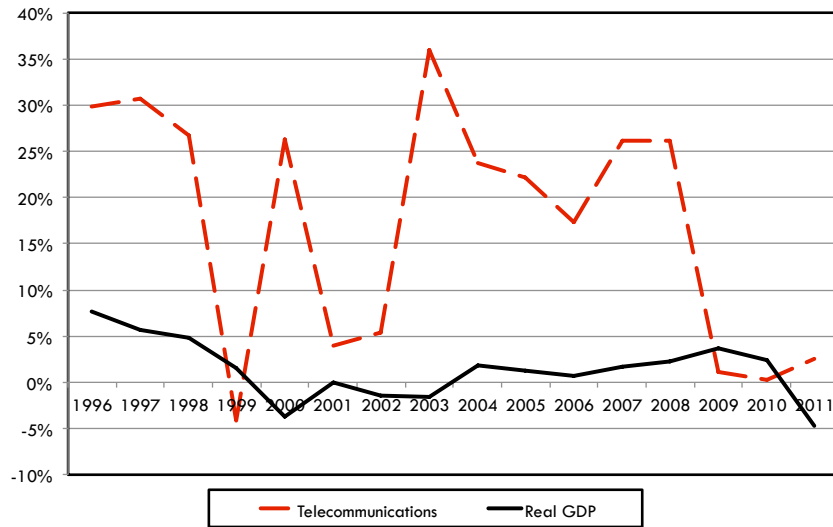
Figure 8: Annual change in real GDP and Telecom Market 1996-2011
Sources: ITU (2013); World Bank

The change in telecommunications sector revenue reflects the dramatic growth of mobile telephony. At the same time, with so much competition in the market, prepaid ARPU increased slightly during 2009, but blended ARPU has fallen through present.
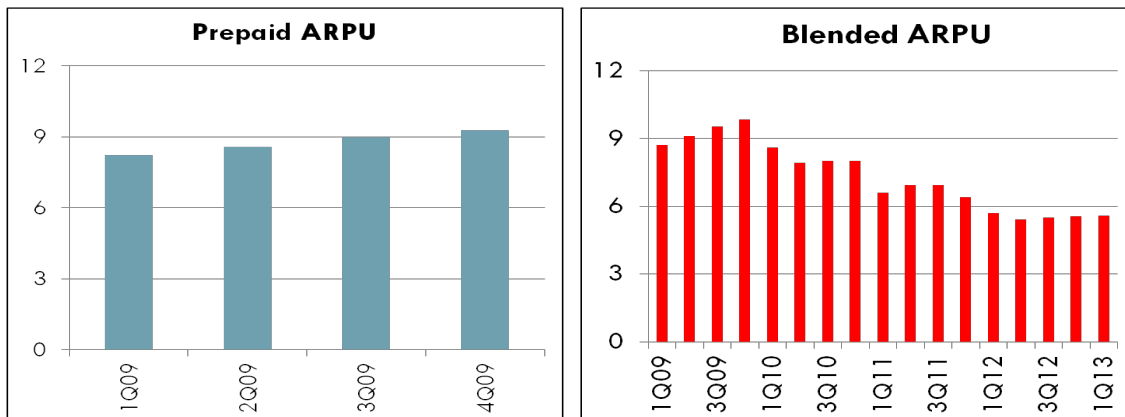

Figure 9: Evolution of ARPU (Left: Atlantique Prepaid ARPU; Right: Atlantique Mali Blended ARPU)
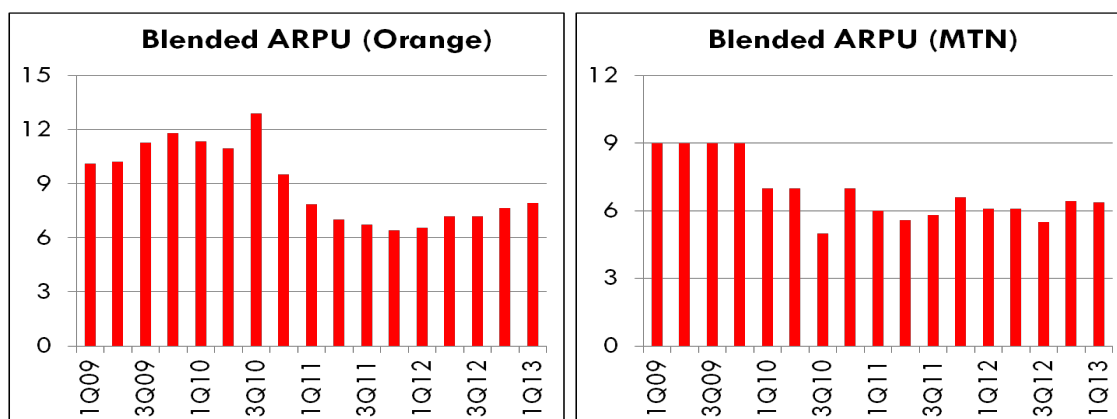Source: INFORMA

Figure 10: Evolution of ARPU (Left: MTN Blended ARPU; Right: Orange Cote d'Ivoire Blended ARPU)
Source: INFORMA

5. The economic impact of telecommunications in Cote d'Ivoire

The impact of telecommunications on the economy of Cote d'Ivoire first needs to be assessed in terms of the sector's direct impact, resulting from its contribution to the GDP as well as the employment generated by its operators and their local suppliers. On the other hand, as a general purpose technology, telecommunications' positive externalities also impact the economy, as reviewed in chapter 2. This chapter will assess the direct and indirect contributions that telecommunications has made thus to economic development in Cote d'Ivoire.

5.1. Direct economic contribution

Cote d'Ivoire's telecommunications industry total revenues in 2012 totalled US$ 1.67 billion[30], or 6.9% of the country's GDP[31].

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[30] Source: ATCI
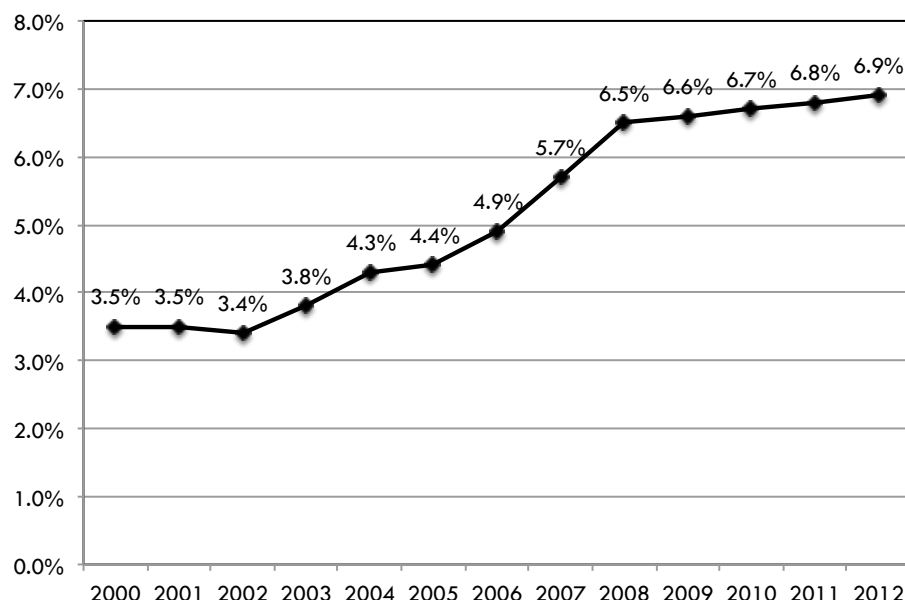[31] Sources: ATCI; World Bank.

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

Beyond its contribution to overall GDP, the value-added of the telecommunications sector in 2012 is estimated to be US$ 503 million.[32]

In addition to its direct monetary contribution to the economy, the industry also fuelled job creation. In 2012, the telecommunications sector accounted for 3,250 direct jobs[33] (i.e. employment within the telecom sector) and an estimated 62,315 indirect jobs. Combined, these jobs equated to 0.5% of Cote d'Ivoire's total employment.

5.2. Indirect economic contribution

As shown in the literature reviewed above, beyond its direct economic contribution, telecommunications can have a positive effect on economic growth. This section assesses the positive externalities of telecommunications in Cote d'Ivoire. As anticipated in the introduction, given the differing mobile telephony versus broadband penetration rates, the analysis of economic impact of both technologies will be conducted through two separate econometric models.

5.2.1 Data Availability

Regional and country-level statistical studies of ICT's impact on emerging economies usually suffer from a lack of data as the 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 including the

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[32] Calculated by looking at the ratio of Transportation, and Communications to GDP, as provided by the African Central Bank.
[33] Source: ATCI

local regulator – Agence des telecommunications de Cote d'Ivoire (ATCI) – as well as GSMA Intelligence, International Telecommunications Union, Informa, and Pyramid Research.

In-country operators compiled additional data. The operators provided telecommunications' costs and, in the case of mobile telephony, they 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. Market performance metrics (capex, revenues, etc.) are also available from local operators. 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 Hirschman) 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:

<u>Aggregate Production function:</u>
$$GDP_{it} = a_1 K_{it} + a_2 L_{it} + a_3 Mob\_Pen_{it} + \varepsilon_{1it} \qquad (1)$$
<u>Demand function:</u>
$$Mob\_Pen_{it} = b_1 MobPr_{it} + b_2 GDPC_{it} + b_3 HHI_{it} + \varepsilon_{2it} \qquad (2)$$
<u>Supply function:</u>
$$Mob\_Rev_{it} = c_1 MobPr_{it} + c_2 GDPC_{it} + c_3 HHI_{it} + \varepsilon_{3it} \qquad (3)$$
<u>Output function:</u>
$$\Delta Mob\_Pen_{it} = d_1 Mob\_Rev_{it} + \varepsilon_{4it} \qquad (4)$$

These models found that mobile telephony has significantly affected the economy of Cote d'Ivoire during the last 7 years (2005-2012). The annualized average contribution to the Gross Domestic Product is equal to an estimated 0.059 % of GDP growth for every 1% increase of mobile penetration (see Table 4).

Variables	Mobile Model
Growth (GDP$_{it}$)	
Labor force (L$_{it}$)	0.375***
Fixed Capital Stock (K$_{it}$)	0.135***
Mob Penetration (Mob_Pen$_{it}$)	0.059*
Constant	-
Demand (Mob_Pen$_{it}$)	
GDPC (GDPC$_{it}$)	-1.441
Mob. Price (MobPr$_{it}$)	-1.132**
Market Concentration (HHI$_{it}$)	-0.252
Constant	25.210**
Supply (Mob_Rev$_{it}$)	
Mob Price (MobPr$_{it}$)	-0.07456***
GDPC (GDPC$_{it}$)	1.016***
Market Concentration (HHI$_{it}$)	-0.189***
Constant	13.091
Output (ΔMob_Pen$_{it}$)	
Mob Revenue (Mob_Rev$_{it}$)	0.477*
Constant	2.360
Year Effects	YES
Quarter Effects	YES
Operator Effects	YES
R^2	
Growth	0.99
Demand	0.37
Supply	0.88
Output	0.03

Table 4. Results of Mobile Telephony Model
Source: TAS analysis

The model results confirm the economic spillover of wireless telephony in Cote d'Ivoire. In addition, the structural model yields other interesting findings:

- Wireless prices affect both the demand (coefficient: -1.132) and supply of services (coefficient: -.07456)
- Competition has positively affected investments (coefficient: -.18853)
- Incomes seem to affect critically operator revenues (coefficient: 1.0159) while not deterring adoption of services (coefficient: -1.441)

The actual contribution of mobile technology was calculated by multiplying the compound annual growth rate of wireless penetration between 2005 and 2013 (formula 5) by the coefficient of economic impact derived from the econometric model presented in Table 4 (Formula 6):

CAGR = (Wireless penetration 2Q2013 (92.45%)-Wireless penetration 4Q2005 (12.91%)) ^ (1/7.5)-1   (5)

The CAGR for wireless telephony in the Cote d'Ivoire for the period 2005-2013 is 30.01%.

Impact of wireless on GDP (2005-2013)= CAGR (30.01%)*Coefficient of Impact (0.059)   (6)

According to the formula, the annual contribution on GDP from mobile telephony amounts to 1.77% of GDP. Based on the difference between 2005 GDP of US$ 16,363 million and 2012 GDP of US$ 24,680, the indirect annual contribution of wireless telephony to the GDP of Cote d'Ivoire amounts to US$ 347.72 million (see calculations in Appendix B).

Furthermore, looking at the results in light of the exponential growth impact curve of Gruber and Koutroumpis (2011), with a median mobile penetration of approximately 58.27% in the sample period, Cote d'Ivoire had a coefficient of 0.059, indicating an acceleration of impact (see Figure 12).
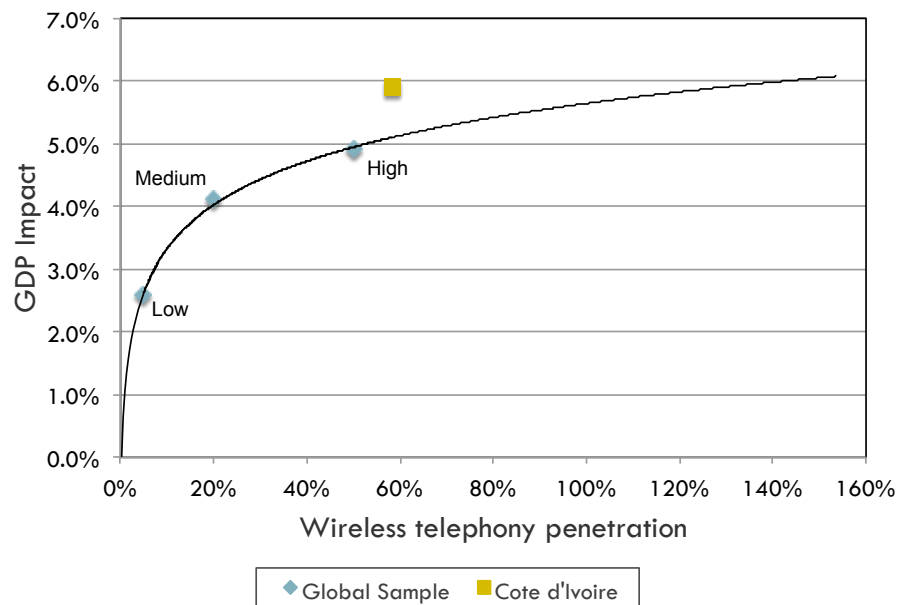

Figure 12: Wireless Telephony Impact: Country Model Results Versus Global Sample Estimates
Note: Estimate based on fitted line of previous studies (median mobile penetration: 58.27 %)
Source: TAS analysis

The reason that the new coefficient is higher than the coefficient estimated by Gruber and Koutroumpis' model (2011) could be partially due to the vast heterogeneity experienced in their global sample. The curve represents the "average case" and each country can perform differently depending on its individual macroeconomic and institutional conditions. However, another potential explanation - about which we remain cautious - is that the economic contribution of mobile telephony is accelerating due to the launch of new services that rely on telecommunications to reach consumers. We consider, in particular, financial services like mobile money that rely on text messaging.

5.2.3 Broadband economic impact

To analyze mobile broadband's impact on the Cote d'Ivoire economy, we utilized a model similar to the mobile telephony structural model. The model also consists of four equations: an aggregate production function modeling the operation of the economy and subsequently three demand, supply and output functions. The latter functions model the mobile broadband market operation and estimate the economic impact of mobile broadband while controlling for the reverse effects. The demand function links mobile broadband penetration to the average consumption propensity of individuals proxied by GDP per capita, the cost of a basic mobile broadband service (price of a monthly subscription), the percent of individuals that fulfill secondary education, and the percent of the population residing in densely populated urban areas. The supply function links the aggregate mobile broadband revenue to the relevant price levels and the GDP per capita. The infrastructure equation links annual change in mobile broadband penetration to the market 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:
$$GDP_{it} = a_1 K_{it} + a_2 L_{it} + a_3 BB\_Pen_{it} + \varepsilon_{1it} \tag{6}$$
Demand function:
$$BB\_Pen_{it} = b_1 BBPr_{it} + b_2 GDPC_{it} + b_3 Edu_{it} + b_4 Urb_{it} + \varepsilon_{2it} \tag{7}$$
Supply function:
$$BB\_Rev_{it} = c_1 BBPr_{it} + c_2 GDPC_{it} + c_3 HHI_{it} + \varepsilon_{3it} \tag{8}$$
Output function:
$$\Delta BB\_Pen_{it} = d_1 BB\_Rev_{it} + \varepsilon_{4it} \tag{9}$$

However, the model could not be run due to the limited number of observations. In order to generate statistically significant results for this type of estimation, 45 observations are required at a minimum. Even by collecting quarterly data, the launch of mobile broadband in march 2012 can generate only five observations.

That said, mobile broadband has been successfully deployed across the country by at least three operators, which have introduced offers targeted for different market segments.

Plan type	Orange	MTN	MOOV
Daily, 50 Mb cap	1,500 (*)	1,500 (***)	2,500 (****)
Monthly, 5 Gb cap	10000	19,000	20,000
Monthly, 10 Gb cap	15,000	39,000 (**)	39,000

Table 5. Cote d'Ivoire: Wireless Broadband Pricing (in FCFA) (3Q2013)
Source: Operators

(*) 350 Mb

(**) 50 Gb

(***) 250 Mb

(****) 350 Mb, weekly

Therefore, given the foreseeable future development of mobile broadband in Cote d'Ivoire, we anticipate that this technology will yield an important economic contribution in the years to come.

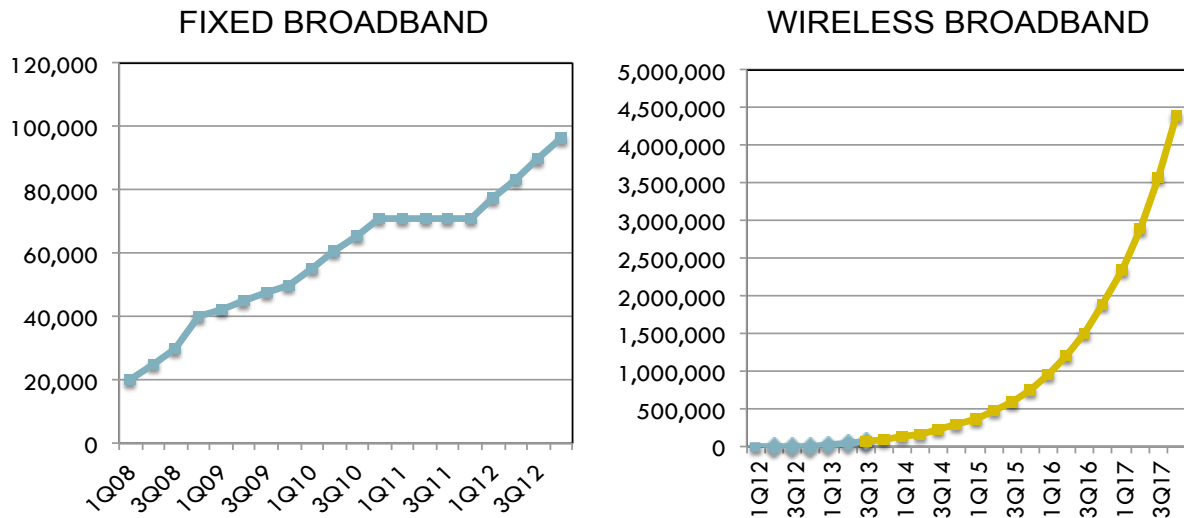FIXED BROADBAND   WIRELESS BROADBAND

Figure 13: Fixed and Wireless Broadband Historical and Forecast
Sources: Informa; GSMA Intelligence

As of the end of 2012, fixed broadband lines had reached 96,000, while wireless broadband connections amounted to 10,187. However, by 2017, wireless broadband connections are forecast to reach 4,384,000. It is estimated that by mid-2015, when broadband connections exceed 600,000, economic effects will be detected.

6. Policy Implications to facilitate telecommunication adoption and welfare

Wireless telecommunications have significantly impacted the economy of Cote d'Ivoire. The direct and - particularly - the indirect effects point to the positive externalities associated with the technology. Adoption of wireless telephony has been directly linked to the decline in prices driven by competitive intensity. Furthermore, competition has positively affected investment by operators, although excessive competition threatens the sustainability of the telecommunications sector.

On the other hand, wireless broadband services have not yet taken off in Cote d'Ivoire, as the first 3G license was not awarded until March 2012 and, as of 3Q2013, there were only 22,000 subscriptions. If the example of other countries in the francophone zone serves as a guide (witness the case of Senegal), an acceleration of wireless broadband adoption is expected to develop, with a forecasted installed base of 800,000 subscriptions by the end of 2017.

Government policies need to focus on generating the conditions necessary to foster the adoption of wireless adoption. This means, first and foremost, the creation of certainty regarding the regulatory framework in order to stimulate capital expenditures to further deploy the 3G networks. In addition, the government must promote the local development of applications, services, and content that will stimulate technology adoption.

7. Conclusion

In sum, this study finds the overarching consensus – that ICT adoption encourages economic growth – to hold true for Cote d'Ivoire, where it has impacted economic growth and employment and allowed the country to benefit from many of its positive externalities. In terms of its annual contribution to the 2012 GDP of US$ 24,680 million, telecommunications effects amount to US$ 2,017 million (or 8.17%).

Annual contribution to GDP	Amount
Direct effects of telecommunications	US$ 1,670 million
Indirect effects of mobile telephony	US$ 347 million
Indirect effects of broadband	To be determined
Total	US$ 2,017 million

Table 6. Cumulative Economic effects of telecommunications
Source: TAS analysis

While broadband's limited deployment prevented estimations of its economic impact, based on future penetration, the country's economy will likely benefit from future adoption. Given the positive relationship between ICT and economic growth, the country must encourage policies that foster adoption while also increasing regulatory stability and promoting local content and services development.

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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 "MTN"	GSMA Intelligence

APPENDIX B: Calculation of Wireless Telephony Indirect Contribution to GDP in Cote d'Ivoire

Item	Component	Value	Source or Formula
1	Annual contribution of wireless telephony to GDP growth (for every 10% increase in wireless penetration)	0.59	Coefficient of model in table 7
2	Wireless telephony penetration 2Q2013	92.45 %	GSMA Intelligence
3	Wireless telephony penetration 4Q2005	12.91 %	GSMA Intelligence
4	CAGR Wireless telephony penetration	30.01 %	(Wireless telephony penetration 2Q2013/ Wireless telephony penetration 4Q2005)^(1/7.5 years)-1
5	Annual impact of wireless on GDP	1.77 %	(Annual contribution/10) * CAGR Wireless telephony penetration
6	CAGR GDP per capita (2005-2012)	6.05 %	(GDP 2012/ GDP 2005)^(1/7years)-1
7	Percent contribution of wireless telephony to GDP growth	29.27 %	Annual impact of wireless on GDP / CAGR GDP per capita (2005-2012)
8	Incremental GDP (2012-2005)	US$ 8,316 mm	GDP 2012 – GDP 2005
9	Total Impact of Wireless Telephony on Incremental GDP growth	US$ 2,434 mm	Incremental GDP (2012-2005) * Percent contribution of wireless telephony to GDP growth
10	Annualized impact	US$ 347.7 mm	Total impact/7