

The economic impact of Telecommunications in the Republic of Guinea¹

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Abstract

The purpose of this paper is to analyze the economic impact of telecommunications in the Republic of Guinea. The empirical analysis conducted suggests that the sector generates a significant direct and indirect economic impact, contributing to 6.02% of the country's 2019 GDP. From a direct effect standpoint, the Guinean telecommunications companies have generated in 2019 US\$ 581 million in revenues, which represent 5.04% of the country's GDP. On the other hand, the sector generates approximately 1,413 direct jobs and 1.03% of total salaries in the Guinean workforce. Beyond the direct effects, the telecommunications industry has indirectly contributed US\$ 113 million on average per year to the whole economy since 2010 (0.98% of the 2019 GDP). This contribution is driven by mobile services (voice and data), but does not consider fixed broadband, which has no impact, due to the limited number of subscribers. Sectors mostly impacted by telecommunications were found to be business services (43.04% of the indirect economic impact), financial services (15.81%), trade (12.28%), other services (mainly entertainment, 9.42%), the electricity, gas and water sector (9.25%), and manufacturing industries (5.98%). Given the economic importance of telecommunications, public policies and regulatory frameworks need to be defined to maximize investment in network deployment, particularly in mobile broadband.

JEL classification: L96, O33, O47

Keywords: Telecommunications, ICTs, Economic Growth

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¹ The following study was funded by the General Secretariat of Orange. The views expressed in the report are those of the authors and do not necessarily reflect the opinions of Orange.

1. Introduction

The purpose of this paper is to analyze the economic impact of the telecommunications sector in the Republic of Guinea. Driven by wireless technology, telecommunications services have expanded in recent years in the country and are now being used by most of the population (the country reached 53.6% mobile unique subscribers' penetration in 2019²), reflecting a fairly developed market expected to generate a positive impact on the economy. To measure the sector contribution, this study compiled statistics of its direct effect from National Accounts, constructed a structural model to calculate the indirect impact, and built an input/output table to determine the industries mostly benefitting from telecommunications.

To provide a context for its approach, the study first reviews the research literature conducted to assess the economic impact of telecommunications, introducing the recent empirical work (chapter 2). Chapter 3 provides a descriptive analysis of the country's economy and the recent evolution trends of the telecommunications sector. Telecommunications' direct and indirect economic contributions to Guinea's economy follow (chapter 4), along with a discussion of the study's methodology and findings. Finally, conclusions and policy implications are derived these findings (chapter 5).

2. Research Review

In the past decades, several studies have been conducted to assess the economic impact of telecommunications, confirming positive effects on GDP growth and, in some cases, on employment and productivity (Hardy, 1980; Karner and Onyeji, 2007; Jensen, 2007; Katz et al., 2008; Katz, 2011; Katz et al., 2009; Katz et al., 2012, Arvin and Pradhan, 2014).

While most single country research tends to focus on advanced economies, more recent studies, propelled by data availability, have been able to offer evidence of these benefits in the case of emerging countries as well. Mobile telephony, particularly, has acquired a growing role in several low-income countries, by addressing the lack of traditional fixed-line services and generating significant economic effects. As mobile networks become a permanent fixture of the digital infrastructure, so, too, does their effect on the market and the economy.

Multiple micro-economic studies from emerging countries show that enhanced communication results in more efficient markets, ultimately improving 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, input prices in the grain market fell, resulting in increased profits for farmers and, ultimately, consumer welfare improvements (Aker, 2008). Along those lines, rural Ugandan banana

² Source: GSMA Intelligence

farmers producing perishable crops benefitted as the costs of crop marketing decreased because of enhanced mobile coverage (Muto, 2008).

Mobile networks can also address lack of access to traditional services. In Kenya and Tanzania, the launch of mobile financial services and micropayments reduced both the cost of banking services and the transactional burdens, leading to a reduction of the countries' "unbanked" population. Similarly, the introduction of mobile Health applications in countries such as Ghana and Cape Verde resulted in more accessible, affordable, and higher quality healthcare services in developing countries (Kelly and Minges, 2012).

In some instances, the introduction of mobile networks can result in the creation of employment. When a region of South Africa benefitted from enhanced wireless network, employment significantly increased (Klonner and Nolen, 2010); in Malawi, female labor participation increased as a result of a similar effect (Batziillis et al., 2010). On a related note, the mobile applications that assist with the job search and application process were identified as being 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.

In particular, 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) found initial increasing returns to economic growth as a result of the "return to scale effect" when it comes to mobile telecommunications' effects on the economy. In other words, wireless telecommunications' economic impact is maximized once the infrastructure reaches a critical mass point. 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. A similar effect was identified by Katz and Callorda (2018).

Like mobile voice services, broadband can also affect economic growth, at several levels. First, the deployment of broadband technology across business enterprises improves productivity by facilitating the adoption of more efficient business processes (e.g., marketing, inventory optimization, and streamlining of supply chains). Second, extensive deployment of broadband accelerates innovation by introducing new consumer applications and services (e.g., new forms of commerce and financial intermediation). Third, broadband leads to a more efficient functional deployment of enterprises by maximizing their reach to labor pools, access to raw materials, and consumers (e.g., outsourcing of services, virtual call centers). In recent years, the explosive growth of mobile broadband allowed for the study of its specific economic contribution. For instance, Katz and Koutroumpis (2013) estimated that, in the case of Senegal, a structured

model like the one used in this study indicated that every 1% increase in mobile broadband penetration yielded 0.022% growth in GDP.

In sum, multiple studies conclude that mobile networks and broadband access have positive economic effects. This study will provide additional insights regarding the economic impact of telecommunications on the economy of Guinea.

3. Descriptive analysis

Country overview

Guinea has been classified as a “low-income” country by the World Bank, although its economy showed an impressive growth in recent years, at around 10% in 2016 and 2017, before slowing to 6.2% and 5.6% in 2018 and 2019, respectively. According to the International Monetary Fund estimates, the economic growth is projected to decelerate in 2020 to 2.9%, mainly due to the COVID-19 worldwide crisis, before recovering to a 7.6% growth rate in 2021³.

With a total population of 12.4 million -64% of which live in rural areas-, the country reports a low unemployment rate of 3.6%.⁴ Growth in recent years was driven by foreign direct investment (FDI) in the mining sector. According to the 2020 Index of Economic Freedom, the country will register \$482.7 million in Foreign Direct Inflow (FDI) this year.⁵ The mining industry grew at an annual rate of roughly 50% in 2016 and 2017, far above the performance of non-mining sectors, with investment in infrastructure and the expansion of the primary and tertiary sectors remaining strong.⁶ The current account balance as a percent of GDP has proven volatile in recent years, possibly because of variations in mineral prices.

The country’s economy largely depends on agriculture and the mining sectors. Guinea is richly endowed with minerals such as bauxite, iron, diamond, gold deposits, and uranium. Particularly, the country has the world largest bauxite reserves -estimated at a quarter of the world's proven reserves-, and only lies behind China and Australia in the extraction quantities of that mineral in 2017.

Since 2007, Guinea’s economic growth appears to be tracking that of the Sub-Saharan African region, although some volatility driven by the 2009 recession or the recent growth since 2017 may have been driven by mineral international prices (see Figure 1).

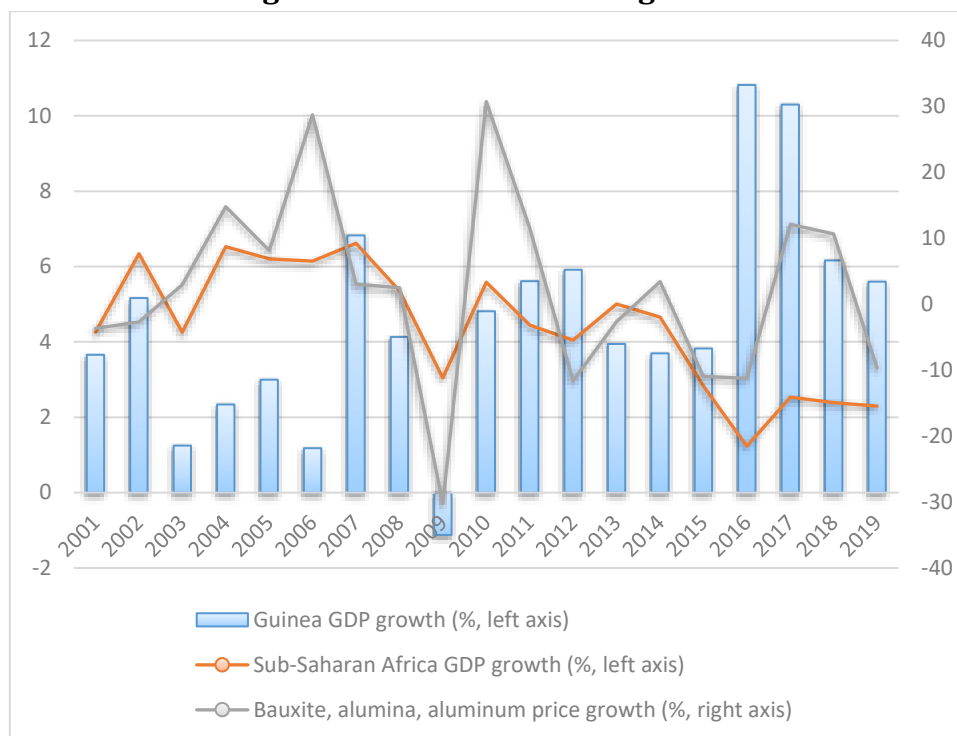
³ Source: International Monetary Fund, World Economic Outlook Database, April 2020

⁴ Source: UN Human Development Indicators

⁵ Source: Heritage Foundation.

⁶ Source: World Bank - Guinea overview

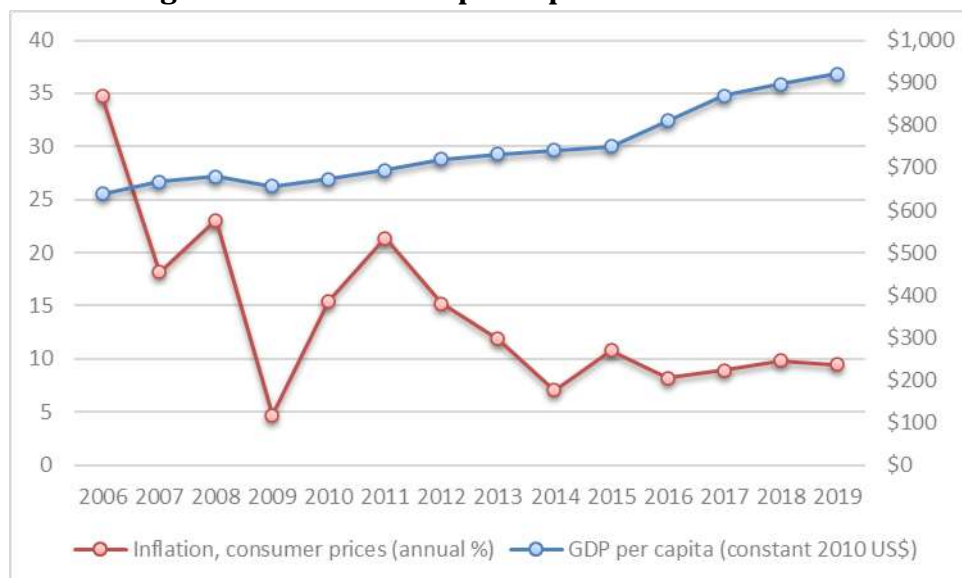
Figure 1. Guinea: economic growth



Source: own elaboration from World Bank and Federal Reserve St. Louis data

Real GDP per capita exhibited continuous growth since 2009, while inflation declined rapidly from 20% levels in 2011, although remained at a stable 10% level in recent years (Figure 2).

Figure 2. Guinea: GDP per capita and Inflation



Source: own elaboration from World Bank Development Indicators

The fiscal balance improved from -2.1% of GDP in 2017 to -1.1% in 2018, although the budget deficit is essentially financed by external resources, due to the fall in domestic funding. Debt remains at a moderate level, with a public debt-to-GDP ratio falling from 39.6% in 2017 to 37.6% in 2018.⁷ According to the World Bank, the main threats to the future economic growth in the country are the slow pace of infrastructure development and eventual decrease in commodity prices.

Despite the reported low unemployment rate, the country faces big social challenges. According to the United Nations, the population in “multidimensional poverty”⁸ accounts for 62%. Life expectancy at birth is 61.2 years, while literacy rate is only 32%.⁹ In 2019, Guinea was ranked in 175 out of 189 countries in the UN Human Development Index placing it in the “low human development” category.

The telecommunications sector

The 2019 Annual Report of the Post and Telecommunications Regulatory Authority (ARPT, 2019) of Guinea highlights the recent advances of the telecommunications industry in the country. Wireless subscriptions reached 12,910,000 by the end of 2019. That figure represents a mobile penetration in the country of 105.1%, a four percent increase with respect to the prior year. Those penetration figures are considerably above the regional average of the Sub-Sahara African countries (82.4% by 2018)¹⁰. On the other hand, as stated above, the penetration level in terms of mobile unique subscribers reached 53.6%. In addition, by the end of 2019 there were 4,815,000 internet subscriptions, which represents a penetration of 39%¹¹ (18.9% in terms of mobile broadband unique subscribers¹²). Figure 3 depicts the recent evolution in terms of subscriptions for the different telecommunications services since 2011.

As indicated in Figure 3, the Guinean telecommunications environment is essentially based on wireless technology. The International Telecommunications Union (ITU) reported zero fixed telephone subscriptions in 2018, while on the other hand, fixed broadband has only reached 1,213 subscriptions at the end of the same period, which corresponds to only 0.07% of Guinean households. Thus, the analysis of the economic impact of telecommunications must focus exclusively on wireless networks.

⁷ Source: World Bank - Guinea overview

⁸ Concept introduced by the United Nations to measure how people experience poverty in multiple and simultaneous ways: health, education, and standard of living.

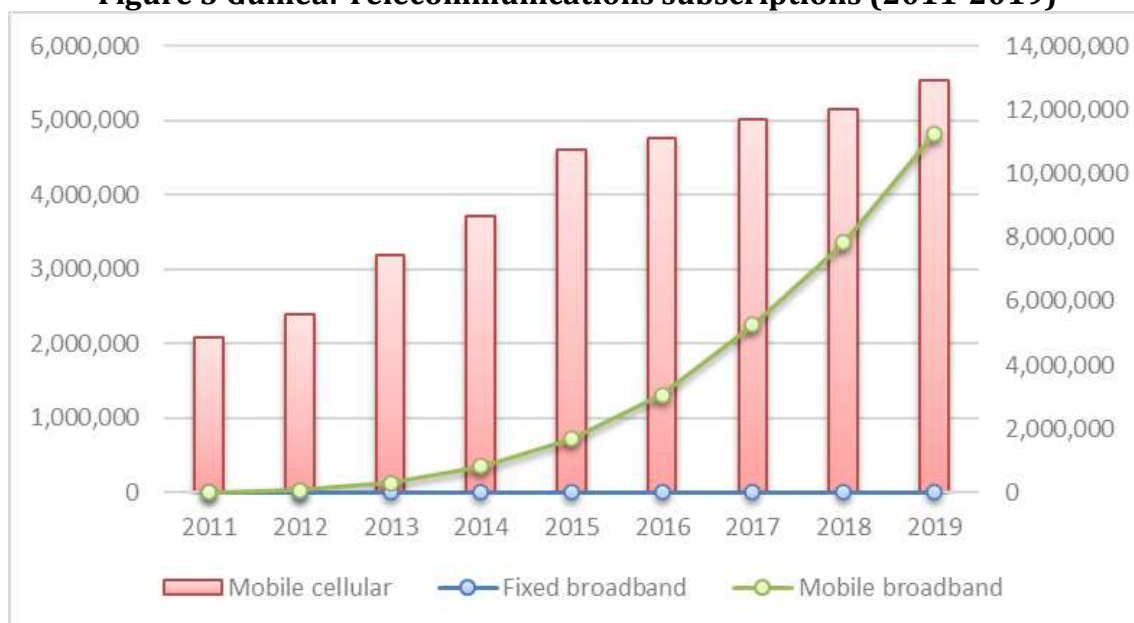
⁹ Source: UN Human Development Indicators

¹⁰ Source: World Bank World Development Indicators

¹¹ Source: ARPT (2019)

¹² Source: GSMA Intelligence

Figure 3 Guinea: Telecommunications subscriptions (2011-2019)



Sources: own elaboration from GSMA Intelligence and World Bank World Development Indicators

In 2019, the telecommunications industry of Guinea reached revenues of US\$ 581 million, representing 5.04% of the country's GDP¹³, thereby providing evidence of the relevance of this sector for the country's economy. The importance of the sector can also be validated when looking at the number of jobs it generates. In 2019, the sector employed 1,413 direct workers¹⁴, which represents 0.03% of the formal labor force¹⁵. In addition, according to the input/output matrix developed for this study, the telecommunications sector represents 1.03% of total salaries in the country.

4. Results of the empirical estimates

The contribution of telecommunication services to economic growth is driven by the sector internal dynamics (such as the investments linked to the deployment of networks and services) and the positive externalities derived from private and enterprise use of services (*spill-over effects*). By allowing a more efficient functioning of the economy, telecommunications networks and services contribute to overall value creation.

As stated above, the direct effect of the sector in the economy can be approximated by its weight in the country's GDP (the industry gross revenues in 2019 where US\$ 581 million¹⁶, which represent a 5.04% GDP). On the other hand, the analysis of *spill-over* effects (also called indirect) of mobile telecommunications on the economy is measured through a structural econometric model, composed of an aggregated production

¹³ Source: ARPT (revenue) and IMF (GDP 2019 estimate)

¹⁴ Source: ARPT (2019)

¹⁵ According to the International Labour Organization, there were 4.3 million people employed in Guinea in 2019

¹⁶ Source: ARPT

function, a demand function, a supply function, and an infrastructure function; defined as follows:

- Aggregate production function: $GDP_{it}=a_1K_{it}+a_2Labor_{it}+a_3Mob_Pen_{it}+ a_4Shock_{it}+\epsilon_{1it}$
- Demand function: $Mob_Pen_{it}=b_1Rural_{it}+b_2GDPpc_{it}+b_3Mob_Price_{it}+ b_4HHI_{it}+\epsilon_{2it}$
- Supply function: $Revenue_{it}=c_1MobPr_{it}+c_2GDPpc_{it}+c_3HHI_{it}+\epsilon_{3it}$
- Infrastructure function: $\Delta Mob_Pen_{it}=d_1Revenue_{it}+\epsilon_{4it}$

The production function models the impact on GDP from mobile penetration (measured in terms of unique subscribers), with gross capital formation, labor and a “shock” control variable to capture economic cycle variations affecting the country. In this case, the control variable is proxied by the world price of three minerals (bauxite, alumina, and aluminum), underlining the importance of this factor for the country’s economy. The definition and source for the variables used is provided in Table 1.

Table 1. Variables Description and Source

Item	Variable	Source	Description
1	GDP	World Bank World Development Indicators and International Monetary Fund	Series 2000-2018 from World Bank. Data extrapolated to 2019 with IMF forecasted growth rate. Data converted to quarterly frequency by assuming constant CAGR within each year.
2	K (Gross Fixed Capital Formation)	World Bank World Development Indicators	Built with data of GFCF as percentage of GDP till 2018. Extrapolated to 2019 assuming same CAGR from the period covered by the sample.
3	Labor	Penn World Tables	Data till 2018. Extrapolated to 2019 assuming same CAGR from the period covered by the sample. Data converted to quarterly frequency.
4	Mobile unique subscribers'	GSMA Intelligence	Total mobile unique subscribers'
6	Mobile Broadband unique subscribers'	GSMA Intelligence	Total mobile broadband unique subscribers'
8	Minerals price	Federal Reserve Bank St. Louis	Index price for bauxite, alumina, and aluminum
9	Population	World Bank World Development Indicators	Data till 2018. Extrapolated to 2019 assuming same CAGR from the period covered by the sample. Data converted to quarterly frequency.
10	Rural population	World Bank World Development Indicators	Data till 2018. Extrapolated to 2019 assuming same CAGR from the period covered by the sample. Data converted to quarterly frequency.
11	GDP per capita	World Bank World Development Indicators and International Monetary Fund	(1)/(9)
12	ARPU (to proxy mobile price)	GSMA Intelligence	Average revenue per connection
13	HHI Mobile	GSMA Intelligence	Industrial concentration index for overall mobile services
14	HHI 3G	GSMA Intelligence	Built with 3G market share data from GSMA Intelligence
15	Revenue	GSMA Intelligence	(4)*(12)
16	Mobile Broadband Price	Christoph & Allison and ITU	Price of a mobile 1GB plan. Data converted to quarterly frequency and extrapolated to missing periods.

Results for the econometric estimations of the structural model are provided in Table 2.

Table 2. Econometric impact of mobile telecommunications

	[I]	[II]
Aggregate production function		
	Log(GDP)	Log(GDP)
Log(Mobile unique subscriber penetration)	0.180* [0.108]	
Log(Mobile BB unique subscriber penetration)		0.174* [0.101]
Log(Gross Fixed Capital Formation)	-0.024 [0.045]	0.000 [0.046]
Labor	0.000*** [0.000]	0.000*** [0.000]
Log(Mineral price)	0.248** [0.126]	0.437*** [0.147]
Demand function		
	Log(Mobile unique subscriber penetration)	Log(Mobile BB unique subscriber penetration)
Log(Mobile penetration)		1.030*** [0.007]
Log(Rural Population)	-0.974 [0.923]	-13.557*** [0.137]
Log(GDP per capita)	-0.214 [0.166]	0.051*** [0.007]
Log(Mobile ARPU)	-0.592*** [0.077]	
Log(Mobile BB price)		-0.011*** [0.002]
HHI Mobile	0.000*** [0.000]	
HHI 3G		-0.000*** [0.000]
Supply function		
	Log(Mobile Revenue)	Log(Mobile BB Revenue)
Log(GDP per capita)	-0.266 [0.261]	3.377*** [0.985]
Log(Mobile ARPU)	-0.128 [0.120]	
Log(Mobile BB price)		-0.406*** [0.111]
HHI Mobile	0.001*** [0.000]	
HHI 3G		-0.001*** [0.000]
Infrastructure function		
	Mobile unique subscriber adoption growth	Mobile BB unique subscriber adoption growth
Log(Mobile Revenue)	-0.011*** [0.002]	
Log(Mobile BB Revenue)		0.000 [0.000]
Observations	40	33
Quarter Fixed Effects	Yes	Yes
Years	2010-2019	2011-2019
R-Squared first equation	0.90	0.88

Note: ***, **, * significant at 1%, 5% and 10%, respectively.

Source: prepared by the authors

Column [I] reports the estimates for mobile services for the period 2010-2019, while

column [II] provides the results for the specific case of mobile broadband from 2011 to 2019¹⁷. According to the econometric model, a 10% increase in unique mobile subscriber penetration yields 1.80% of GDP growth (column [I] of Table 2). The estimation of the contribution of mobile broadband to GDP growth is reported in the column [II] of Table 2, indicating that an increase of 10% of mobile Internet penetration in Guinea yielded a GDP increase of 1.74%. This result is consistent with that reported in column [I] based on the overall impact of mobile telecommunications, which includes the effects from mobile broadband.

Based on the coefficient reported in column [I] of Table 2, mobile telecommunications have contributed annually an average of US\$ 113 million to Guinea economic growth per year between 2010 and 2019 (see Table 3 for full estimation calculus).

Table 3. Mobile telecommunications contribution to Guinea's economic growth 2010-2019¹⁸

Item	Factor	Value	Source and / or estimation formula
1	Annual contribution of unique mobile subscriber's penetration to GDP growth (for a 10% increase in additional penetration). Includes mobile broadband	1.80%	Coefficient resulting from structural model
2	Unique mobile subscribers' penetration, 4Q 2019	53.55%	GSMA Intelligence
3	Unique mobile subscribers' penetration, 4Q 2010	28.36%	GSMA Intelligence
4	Compound Annual Growth Rate (CAGR) of mobile unique subscribers' penetration	7.32%	$(\text{Unique mobile subscribers' penetration } 2019/2010)^{(1/9 \text{ years})-1}$
5	Annual impact of mobile telecommunications on GDP	1.32%	$(\text{Annual impact}/10) * (\text{CAGR Unique mobile subscribers' penetration})$
6	CAGR GDP (2010-2019)	5.58%	$(\text{GDP } 2019/\text{GDP } 2010)^{(1/9 \text{ years})-1}$
7	Percent contribution of mobile telecommunications to GDP growth	23.61%	$\text{Annual impact of mobile telecommunications on GDP} / \text{CAGR GDP (2019-2010)}$
8	Incremental GDP growth (2019/2010)	US\$ 4,318 M	$\text{GDP } 2019 - \text{GDP } 2010$
9	Total impact of mobile telecommunications on incremental GDP growth	US\$ 1,020 M	$\text{Incremental GDP (2019/2010)} * \% \text{ contribution of mobile telecommunications to GDP growth}$
10	Annual impact of mobile telecommunications on GDP	US\$ 113 M	$\text{Total impact} / 9 \text{ years}$

Source: prepared by the authors

¹⁷ As indicated above, we will not perform an analysis of fixed broadband impact due to its penetration level being marginal in Guinea.

¹⁸ This impact coefficient includes mobile broadband as well.

As indicated in Table 3, the indirect impact from wireless telecommunications (including voice and data) to the Guinean economy amounts to US\$ 113 million. This amount was allocated by industry sector by relying on an input/output matrix developed for Guinea. The I/O matrix was developed from the Global Trade Analysis Project Database (GTAP) calculated for the year 2011. According to Guinea's input/output matrix, this amount would have a downstream impact in the following sectors (see Table 4).

Table 4. Sector impact on Guinea's GDP increase in telecommunications output

Sector	Percentage of the impact	Sector weight on GDP (*)	Amount (US\$ million)	Amount (% GDP)
Agriculture, mining, and food processing	1.52 %	49.83%	US\$ 1.72	0.01%
Textiles and apparel	0.32 %	1.74%	US\$ 0.36	0.00%
Wood, paper, petroleum, rubber and plastic products	4.17 %	2.78%	US\$ 4.71	0.04%
Metal products	0.94 %	2.38%	US\$ 1.06	0.01%
Machinery and equipment	0.56 %	1.36%	US\$ 0.63	0.00%
Electricity, gas and water	9.25 %	2.30%	US\$ 10.45	0.09%
Construction	0.01 %	4.84%	US\$ 0.01	0.00%
Trade	12.28 %	14.66%	US\$ 13.88	0.12%
Transportation	2.70 %	7.50%	US\$ 3.05	0.03%
Financial services	15.81 %	2.29%	US\$ 17.86	0.16%
Business services	43.04 %	2.93%	US\$ 48.64	0.42%
Other services	9.42 %	7.39%	US\$ 10.64	0.09%
Total	100%	100%	US\$ 113	0.98%

(*) Excluding communication sector

Source: prepared by the authors; Global Trade Analysis Project Database (GTAP)

As the data on Table 4 indicates, the most important downstream effects of telecommunications on the Guinean GDP are concentrated in the business services sector (43.04% of the downstream effect). In addition, significant downstream effects can be detected in financial services (15.81%), trade (12.28%), other services (mainly entertainment) sector (9.42%), and in the electricity, gas and water distribution sector (9.25%). Finally, an important *spill-over* effect is also detected in manufacturing industries (5.98% in the aggregate).

5. Conclusions

In summary, mobile telecommunications represent 6.02% of the Republic of Guinea 2019 GDP, broken down in direct and indirect effects as depicted in Table 5.

Table 5. Direct and indirect contribution of mobile telecommunications to Guinea's economic growth

Indicator	Million US\$ (2019)	As % of GDP
Gross revenues of mobile telecommunications operators (2019)	US\$ 581	5.04%
Indirect contribution (spill-over) of mobile telecommunications	US\$ 113	0.98%
Total impact of mobile telecommunications on Guinea's 2019 GDP	US\$ 694	6.02%

Source: prepared by the authors

These estimates are consistent with those registered in an input/output matrix developed for Guinea as shown above. According to Table 5, the indirect to direct multiplier is 1.19, while the multiplier for the telecommunications sector according to the input/output matrix is 1.17.

The strong contribution of telecommunications to the Guinean economy is a function of two factors: (i) the dynamism in terms of the sector growth, which in turn triggers a significant number of local suppliers, distributions agents, and providers of various services; and (ii) the positive externalities or *spill-over* effects, by which telecommunications networks and services result in a more efficient functioning of the economy. This drives productivity gains, innovation incentives, and better integration of isolated regions of the country, among other positive effects.

Given the economic importance of telecommunications, public policies and regulatory frameworks need to be defined to maximize investment in network deployment, particularly in mobile broadband. Particularly, as it is becoming clearer in the current worldwide context, telecommunications also contributes to mitigate the disruption from emergencies such as the COVID-19 pandemic, by keeping the economy up and running by allowing, for example, citizens to telecommute. Therefore, public authorities should provide a flexible framework to allow the operators to react quickly to accommodate the increases of network traffic in such situations.

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