# Economic Impacts of Submarine Fiber Optic Cables and Broadband Connectivity in the Democratic Republic of Congo

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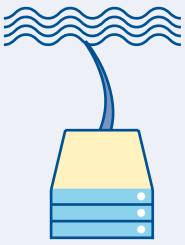
# Economic Impacts of Submarine Fiber Optic Cables and Broadband Connectivity in the DRC

## HOW DO SUBSEA CABLES GENERATE ECONOMIC IMPACT?

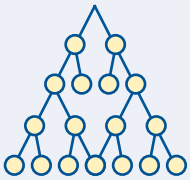
Subsea cables are the global backbone of the Internet, connecting people, businesses, and economies around the world. They connect us to the cloud, deliver streaming video, and increase efficiency and productivity for business. Subsea cables' importance is all the more apparent during the Covid19 pandemic when many of us have switched to working from home, remote learning, and online gaming and entertainment.

We studied the economic impact of subsea cables and broadband connectivity on the DRC. Landing in 2012, the DRC's sole cable led to transformational effects, increasing productivity and efficiency, leading to significant impacts on employment and economic growth.

**Subsea cables arrive**



**Network is built out**



**Internet speed increases**

**Price per data unit decreases**

**Increased data traffic competition**

**Consumers**

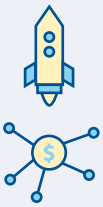
Existing consumers enjoy better speeds, increasing their consumption of digital content, products, and services.

Some consumers decide to subscribe to services for the first time

**Business**

Increased internet speed, quality and reliability makes doing business easier

More businesses use the cloud and e-commerce for the first time



**New firms and startups emerge to serve consumers and businesses**

**Growth in productivity, efficiency, and revenue for firms**

**New business opportunities**

**Economic Impacts**

**8.2%**

**The DRC's subsea cable catalyzed a 8.2% increase in employment in fiber-connected areas by 2014**

**19%**

**The DRC also experienced a 19% increase in GDP per capita by 2017.**

These results imply that for each 1 million people living in an area that is or becomes fiber-connected, 82,000 additional people become employed.*

* We quantified the impact on GDP per capita, however there was no evidence of impacts on the national employment rate. The areas of the DRC that are fiber-connected constitute a relatively small share of the total population (and thus total employment), but account for a relatively large share of the DRC's measured economic output (GDP). experts note that the most significant constraint to connectivity for the DRC is the lack of a national fiber optic backbone to deliver traffic and bandwidth to operators, enterprises, and consumers. Deployments of fiber infrastructure are hampered by the country's huge size, challenging topography, dispersed population, and affordability.

Download the full report at rti.org/subsea-cables-africa

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# 1. Overview

This study explores the economic impact of the international data connectivity delivered by submarine fiber optic cables ("subsea cables") on the Democratic Republic of Congo (DRC). Subsea cables are the global backbone of the internet, connecting people, businesses, and economies around the world (Figure 1).[1,2]

The importance of connectivity to economic growth is well-established—and further underscored by our collective experience during the COVID-19 pandemic—but rigorous studies have not been conducted for many countries.[3,4,5] This study is one in a series our team prepared about how improvements in international data connectivity have generated economic growth for countries in Africa.[6]

We analyze the economic impacts associated with the arrival of the West African Cable System (WACS), the only subsea cable that lands in the DRC. Experts interviewed for this work were unanimous in their assessment of the economic significance of WACS for the DRC. There was a substantial impact on the cost, speed, and quality of connectivity, which in turn had important knock-on effects for the economy.

Our analysis quantified a 19% increase in GDP per capita by the end of 2017 because of the economic activity catalyzed by WACS' connectivity (Table 1). Our findings are consistent with the insights offered by 15 Congolese telecommunications experts.

We also found that people who live in fiber-connected areas were 8.2% more likely to be employed. This means that for each 1 million people living in an area that is or becomes fiber-connected, 82,000 additional people tend to become employed.

Additional cable landings will be beneficial, but experts note that the most significant constraint to connectivity for the DRC is the lack of a national fiber optic backbone to deliver traffic and bandwidth to operators, enterprises, and consumers. Deployments of fiber infrastructure are hampered by the country's huge size, challenging topography, dispersed population, and affordability.

The DRC is at a crossroads in its ability to transform the country's telecommunications infrastructure. The presidency is on the cusp of signing a new law that will facilitate a friendlier environment for the telecommunications industry. If the law comes into force, the DRC may be ripe for new opportunities relevant to broadband expansion. Experts emphasize this would be beneficial for the country's economic development.

This paper reviews our quantitative analysis findings about the economic impact of subsea cables on the DRC and experts' perspectives on the economic development potential of improvements in connectivity.

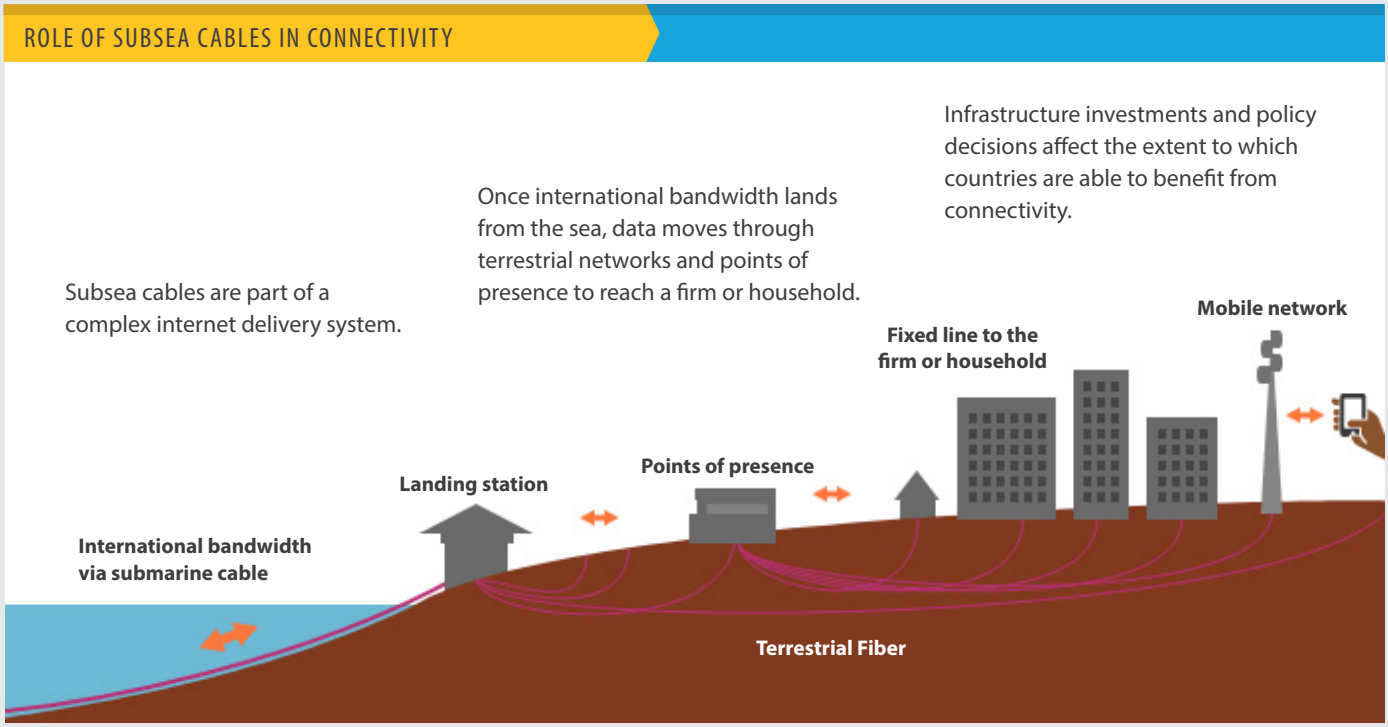
**Table 1. Key Takeaways: The Economic Impact of Subsea Cables on the DRC**

| INDICATOR | TIME PERIOD | MEAN VALUE |
|---|---|---|
| **Employment** | 2007—2013 | 8.2% increase in likelihood of being employed in fiber-connected areas. For every 1 million people in these areas, an extra 82,000 tend to become employed. |
| **Economic growth** | 2012—2017 | 19% increase in gross domestic product (GDP) per capita |

Source: Authors' estimates.

1 Clark, K. 2019. *Submarine Telecoms Industry Report, 7th Edition*. Submarine Telecoms Forum.
2 Brake, D. 2019. *Submarine Cables: Critical Infrastructure for Global Communications.* Information and Technology Foundation.
3 Hjort, J, Poulsen, J. 2019. The Arrival of Fast Internet and Employment in Africa. *American Economic Review*, 109(3): 1032-1079.
4 Minges, M. 2015. Exploring the Relationship between Broadband and Economic Growth. WDR 2016 Background Paper; World Bank, Washington, DC.
5 Khalil, M., Dongier, P., & Zhen-Wei Qiang, C. 2009. *Information and Communications for Development: Extending Reach and Increasing Impact*. World Bank.
6 Other countries included in this series are Kenya, Mozambique, Nigeria, South Africa, and Tanzania.

**Figure 1.** **Role of Subsea Cables in Internet Connectivity**




# 2. Democratic Republic of Congo Country Profile

The DRC is the largest country in Sub-Saharan Africa and the second largest nation in Africa in terms of land area. It has a widely dispersed population of 86.8 million people, only about 19% of whom are connected to electrical grids,[7] despite the substantial hydropower potential of the Congo River. Complicating infrastructure development and deployment, about three-quarters of the DRC is one of the globe's largest rain forests.

The economy is largely based on export of natural resources. The DRC is the world's leading cobalt exporter, accounting for 37% of global cobalt exports.[8] Copper ore and refined copper are also key exports.

Despite its abundant mineral wealth, the DRC's population experiences vast poverty. About 77% of the population lived below the poverty line in 2012 (see Table 2). Its gross domestic product (GDP)—the most common measure of the value of goods and services produced by a country—was $47.3 billion in 2019, or about $545 per capita (nominal terms).

The informal economy was estimated to be over 30% of the country's official GDP between 2010-2014.[9] Much of the informal activity occurs via unregistered cross-border trading of goods to neighboring markets within Burundi, Rwanda and Uganda.[10] In addition, many people are engaged in subsistence agriculture.

Another way to look at the DRC's GDP is to take into consideration purchasing power parity (PPP). PPP accounts for differing price levels for comparable expenditure categories between countries. By applying PPP one can assess,

7 World Bank. 2019. World Development Indicators. See https://databank.worldbank.org/source/world-development-indicators.
8 Simoes,A. and C. Hidalgo. 2011. The Economic Complexity Observatory: An Analytical Tool for Understanding the Dynamics of Economic Development. Workshops at the Twenty-Fifth AAAI Conference on Artificial Intelligence.
9 International Monetary Fund. 2017. *Regional Economic Outlook: Sub-Saharan Africa – Restarting Growth Engine*. Washington D.C.: International Monetary Fund.
10 World Bank. 2011. *Facilitating cross-border trade between the DRC and neighbors in the Great Lakes region of Africa: improving conditions for poor traders*. Washington D.C.: World Bank.

**Table 2. Key Indicators for the DRC's Population and Economy**

| INDICATOR | | VALUE | YEAR |
|---|---|---|---|
| Population | | 86.8 million people | 2019 |
| Literacy Rate | | 77 % of population aged 15+ | 2016 |
| Primary education completing rate | | 64% of population aged 25+ | 2016 |
| Poverty rate | | 77 % of population below World Bank poverty line of 1.90 USD PPP/day | 2012 |
| GDP, nominal USD | • Total<br>• Per capita | 47.3 billion<br>545 | 2019 |
| GDP, nominal CDF | • Total<br>• Per capita | 78.0 trillion<br>898,386 | 2019 |
| GDP, purchasing power parity | • Total<br>• Per capita | 64.2 billion (2011 USD PPP)<br>789 (2011 USD PPP) | 2017 |
| Unemployment | | 4.2% of labor force | 2018 |

Sources: [a]Penn World Table and [b]The World Bank.

both between countries and over time, real year-on-year changes and economic trends based on actual living standards. Through the lens of PPP, the DRC's economy is the equivalent of $64.2 billion (2011 USD) with a per capita GDP of $789. Later, we will use the PPP method of quantifying the economy to generate our results, enabling impacts to be interpreted directly as improvements in living standards relative to different points in the past.

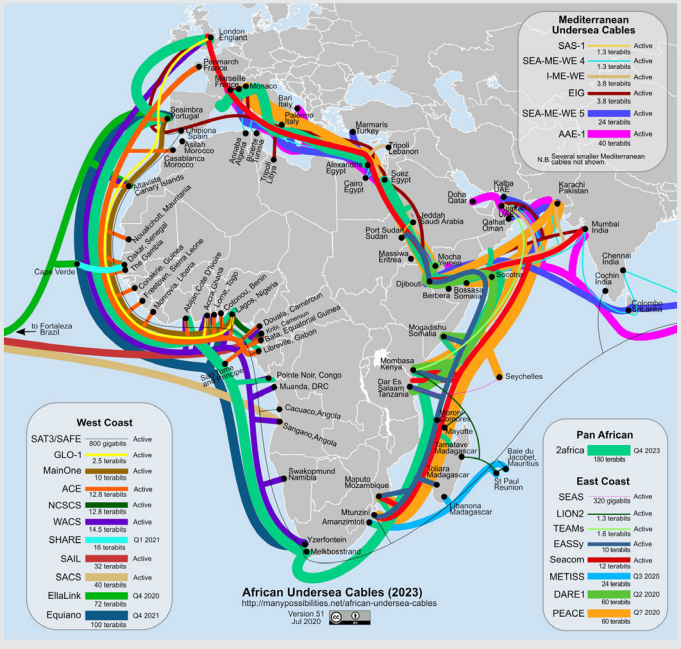
There is only one subsea cable connecting the DRC directly with the rest of the world, the West Africa Cable System (WACS) from 2013. The WACS's landing station is in the coastal city of Muanda. The country also has access to Eastern Africa submarine cables via neighboring Rwanda and Zambia. Google and Facebook have announced plans to land two new cables in the DRC by 2021 and 2023/4, respectively. For reference, Figure 2 shows a map of subsea cables in Africa.

**Table 3. Subsea Cable Landing in the DRC**

| CABLE | DESIGN CAPACITY (TBPS) | LOCAL LANDING STATION(S) | READY FOR SERVICE YEAR |
|---|---|---|---|
| West African Cable System (WACS) | 14.5 | Muanda | 2012 |
| Equiano | 100 | Muanda | 2021 |
| 2Africa (announced) | 180 | Muanda | 2023 |

Note: Some data sets show ACE as having landed in Muanda. However, we confirmed with DRC officials that it has not in fact landed.

**Figure 2. Subsea Cables in Africa**




Source: Song, S. 2020. African Undersea Cables (2023). See https//www.manypossibilities.net.

# 3. Analysis Approach

We analyzed the economic impacts of subsea cables by pairing rigorous economic analysis approaches with interviews with Congolese experts in internet connectivity. In so doing, not only were we able to understand what the impacts have been of past improvements in connectivity, but also the implications of—and barriers and facilitators to—improvements in connectivity going forward. This section offers a high-level description of our approaches.[11]

Note that because terrestrial fiber and wireless networks connect users to subsea cables' landing stations, we include them in the analysis. However, we emphasize that the impacts quantified are for the international connectivity associated with subsea cables and not domestic connectivity. While the recently commissioned national internet exchange in Kinshasa is gradually bringing data resources on shore nevertheless, a substantial amount of the cloud services and data resources accessed domestically are stored abroad.

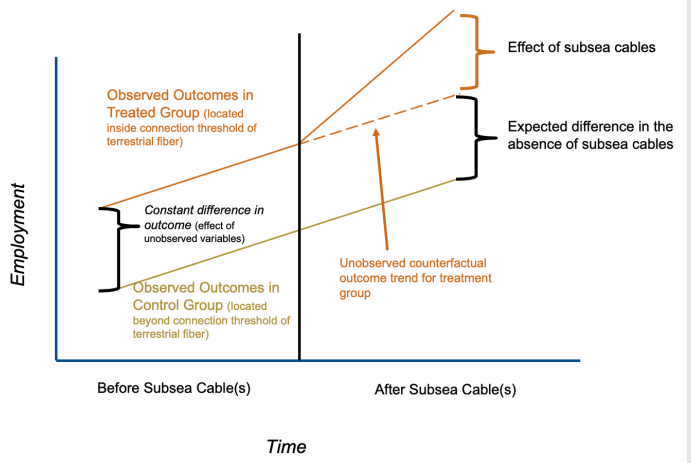
## 3.1 ECONOMETRIC ANALYSES

We employed two complementary econometric methods to quantify the impacts of subsea cable landings: difference-in-differences (DID) and synthetic control (SC). Of all available econometric methods and strategies, these two methods offer the most robust, reliable, and accurate way to estimate causal effects in the context of subsea cables. Each one of these methods derives from cutting-edge statistical techniques[12,13,14] and have been used to investigate research questions similar to those posed by our analysis.[15,16,17]

### 3.1.1 Difference-in-Differences (DID)

DID estimates the causal impact of subsea cables on employment outcomes. DID consists of identifying the impacts associated with a specific intervention or treatment over some period of time. In this analysis, international data connectivity via subsea cables is the intervention. The impact ("treatment effect") is identified by comparing the difference in outcomes before and after the intervention for the group exposed to the intervention ("the treatment group") to the same difference for the unexposed ("the control group"). In our approach, assignment to the treatment group is based on close proximity to terrestrial fiber in the base period.[18] Being located near terrestrial fiber is a key factor that would enable individuals to access the benefits of subsea cables. Because DID estimation is based on the differences in the changes that occurred between the two groups pre- and post-subsea cables, the technique inherently controls for many time-invariant factors such as age and gender. See Figure 3.

**Figure 3. Difference in Differences Technique for Analysis of the Impact of Subsea Cables**




The data we used for our analysis of employment comes from the United States Agency for International Development's (USAID) Demographic and Health Surveys (DHS),[19] which asks individuals about their employment status and type of occupation. The DHS data are geocoded, which enabled greater precision in our econometric approach.

Using the DHS data, we were able to compare changes in employment outcomes (before and after subsea cables) for individuals located within a few hundred meters of the

11 A detailed technical addendum accompanies this report.
12 Athey, S., Imbens, G. W. 2017. The State of Applied Econometrics: Causality and Policy Evaluation. Journal of Economic Perspectives, 31(2): 3-32.
13 Baum-Snow, N, Ferreira, F. 2017. Causal Inference in Urban and Regional Economics. National Bureau of Economic Research (NBER) Working Paper Series. Working Paper 20535.
14 Imbens, G. W., & Wooldridge, J. M. 2009. Recent developments in the econometrics of program evaluation. Journal of Economic Literature, 47(1), 5-86.
15 Hjort, J, Poulsen, J. 2019. The Arrival of Fast Internet and Employment in Africa. American Economic Review, 109(3): 1032-1079.
16 Abadie, A., Diamond, A., Hainmueller, J. 2010. Synthetic control methods for comparative case studies: Estimating the effect of California's tobacco control program. Journal of the American Statistical Association, 105.490 (2010): 493-505.
17 Roller, L.H., Waverman, L. 2001. Telecommunications infrastructure and economic development: A simultaneous approach. American Economic Review, 91.4: 909-923.
18 We use the baseline terrestrial fiber to assign treatment to avoid upward biasing the estimates. Note that the expansion of terrestrial fiber between baseline and endline only makes the estimates more conservative.
19 U.S. Agency for International Development. Demographic and Health Surveys. See https://dhsprogram.com/Data/.

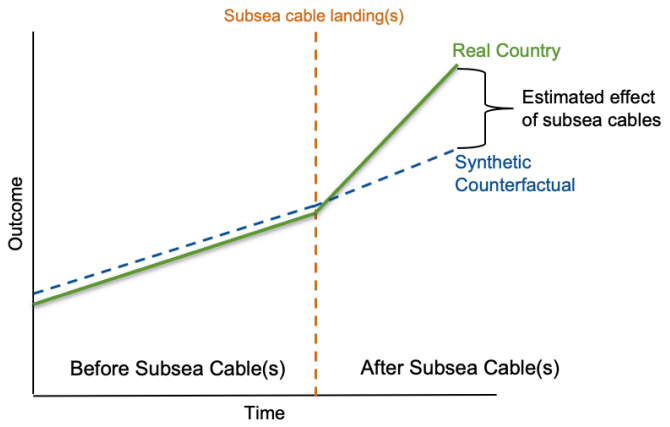
terrestrial fiber to the same changes for individuals located just beyond this distance but still located within a few kilometers of the fiber. Excluding individuals located farther than a few kilometers from terrestrial fiber and focusing on changes between groups located just on either side of a narrow margin produces a control group with high comparability to the treatment group. The resulting groups are similar in terms of both demographic and geographic characteristics, and they would arguably be subject to the same shocks (i.e. there would not be an event that affected a majority of one group but not the other) with the exception of subsea cables. Essentially, the only aspect differentiating individuals in the treatment group from members of the control group is that individuals in the treatment group may have much greater potential to access (or benefit from) high-speed internet after subsea cables arrive. Applying DID in this way enables us to tease out the effect of subsea cables from various potential confounding factors such as distance to other infrastructure and arguably any other shocks that may affect employment status, in addition to time invariant characteristics (which are inherently controlled for in DID).[20]

### 3.1.2 Synthetic Control (SC)

SC estimates the impact of subsea cables on aggregate economic outcomes (including employment) by comparing the DRC's actual outcomes after subsea cable arrivals to a synthetic counterfactual. A synthetic counterfactual, in essence, is an alternative version of the DRC that did not experience the subsea cable landing but for which all other prevailing macroeconomic trends continued. The counterfactual is a weighted combination of similar countries which did not receive subsea cable landings during the time period of interest.

We use a weighted combination of multiple countries because the resulting counterfactual is more similar to the DRC across a variety of important and relevant dimensions, such as GDP per capita, sectoral labor composition, and urban population share, than any single comparison country alone. The construction of the counterfactual uses a completely computationally-driven matching technique that optimizes the fit of the counterfactual based on the countries' actual data. Importantly, the estimated counterfactual can be tested for its robustness and reliability, which helps quantify confidence in each set of results. See also Figure 4.

**Figure 4. Synthetic Control Technique for Analysis of the Impact of Subsea Cables**




The country-level data we used for SC analysis come from the Penn World Table (PWT)[21] and the World Bank's World Development Indicators (WDI)[22]. These sources provide relevant national statistics from officially recognized sources, which are then standardized using well-documented methodology. Importantly, the detailed methodology and data quality control measures used to standardize the data enable comparison across countries and over time, and thus for our application of SC to match on a variety of important macroeconomic characteristics and outcomes.

The estimated effects using DID and SC provide complementary insights due to their similarities and differences across different dimensions, as described in Table 4. By applying two econometric methods, as well as qualitative interviews, our research sheds insight into various aspects of economic impact caused by subsea cable landings.

20 Many things affect employment status, but factors that would bias the DID estimates are events that occurred between the baseline and endline surveys that differentially affected the outcomes of the two groups. Based on the method of treatment assignment, it is highly unlikely that an event systematically affecting employment outcomes for one group but not the other occurred between the two periods, besides the addition of subsea cables.

21 Feenstra, R. C., Inklaar, R., Timmer, M. 2015. The Next Generation of the Penn World Table. American Economic Review, 105(10), 3150-3182.

22 World Bank Group. 2019 World Development Indicators. See https://databank.worldbank.org/source/world-development-indicators.

**Table 4.** **Similarities and Differences of Econometric Analysis Strategies**

| IMPACT DIMENSION | | DIFFERENCE IN DIFFERENCES | SYNTHETIC CONTROL |
|---|---|---|---|
| **Treatment** | Subsea cables (explicitly) | ● | ● |
| **Temporality** | Discrete point-in-time impacts | ● | ● |
| **Outcome** | Employment | ● | ● |
| | Economic growth | ● | ● |
| **Space** | Spatially-specific impacts (specific to fiber-connected areas) | ● | |
| | Spatially-inspecific impacts (at the country-level) | | ● |
| **Data aggregation** | Microdata geocoded to identify individuals/firms in fiber-connected/unconnected areas within countries | ● | |
| | Macrodata on countries (national statistics) | | ● |

### 3.2 THEMATIC ANALYSIS OF INTERVIEWS WITH KEY STAKEHOLDERS

We interviewed 15 Congolese broadband connectivity experts with telecommunications firms, consultancies, and government agencies. Interview topics included current connectivity trends and challenges (e.g., network expansion, latency, affordability), public-sector priorities driving network expansion, role of subsea cables in the broader landscape of connectivity and internet quality, role of connectivity in economic development, and future trends and issues. So that interviewees could be open and candid, we advised that participation could be confidential, that we would not attribute responses to individuals, and that only the synthesized remarks of all interviewees would be presented in our reports.

# 4. Economic Impacts of Subsea Cable Landings

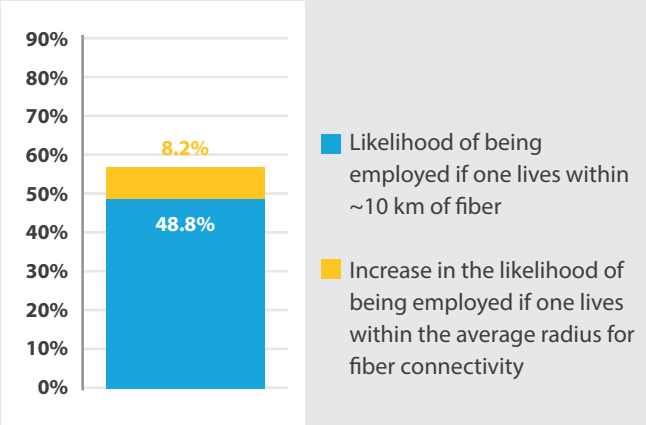
We quantified impacts on both GDP per capita and employment. We note that the impacts of subsea cables accrue in areas that are also most represented in the DRC's economic statistics. These areas are also more likely to be connected by fiber.

### 4.1 IMPACTS TO DATE

The arrival of WACS caused significant increases in employment in areas connected to the terrestrial fiber, like Kinshasa. Across the DRC, on average, data connectivity from subsea cables increased the likelihood of being employed by 8.2% in areas connected to fiber, as seen in Figure 4. These results imply that for each 1 million people living in an area that is or becomes fiber-connected, 82,000 additional people become employed.

23 Feenstra, R. C., Inklaar, R., Timmer, M. 2015. The Next Generation of the Penn World Table. *American Economic Review*, 105(10), 3150-3182.
25 World Bank Group. 2019 World Development Indicators. See https://databank.worldbank.org/source/world-development-indicators.

**Figure 5. Effect of Subsea Cables on Employment Among Working Age Individuals in Areas Within 500 Meters of Terrestrial Fiber**




Source: Authors' estimates.

Turning to impacts on the national economy, we quantified the economic impact on GDP per capita catalyzed by WACS, however there was no evidence of impacts on the national employment rate. This is probably due to difficulties for data traffic to branch out from Muanda and Kinshasa to the rest of the country.

**Figure 6. Impact of Subsea Cables on GDP per Capita**

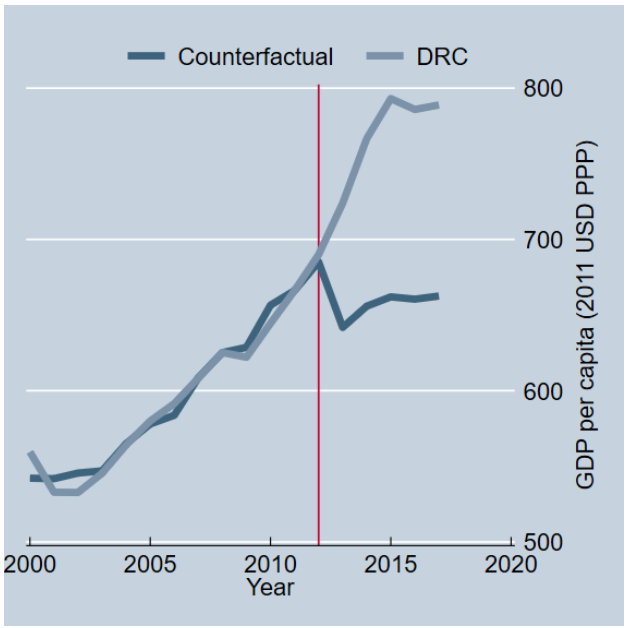



Figure 6 shows how the DRC's GDP levels would have been less if the subsea cable had not arrived (the counterfactual).

In 2017, 5 years after the subsea cables arrived, the DRC's actual GDP per capita was $126 greater (19% greater) than it otherwise would have been. In other words, without these subsea cables, we estimate that the DRC's GDP per capita in 2017 would have been $663 rather than the actual $789, as shown in Table 5. (Recall from Section 2 that all results are presented at PPP so we can compare changes in living standards over time.) The impact was greatest within the first year of arrival, with additional impacts in subsequent years smaller but still positive.[23]

The areas of the DRC that are fiber-connected constitute a relatively small share of the total population (and thus total employment), but account for a relatively large share of the DRC's measured economic output (GDP).

The terrestrial fiber network prioritizes key economic centers. Evidence for this comes from the limited terrestrial fiber in the DRC that runs from the coast to Kinshasa. Highly populated areas along the border with Burundi, Rwanda, and Uganda, which account for a large share of DRC's informal economy remained un- or under-connected. Because national GDP data largely reflect connected areas, it is not surprising that significant GDP impacts were quantified at the national level whereas employment impacts were not.[24]

Overall, the findings suggest that WACS caused employment impacts and GDP impacts (and increases in labor productivity) but these impacts are mostly concentrated in areas connected to the terrestrial fiber.

**Table 5. GDP per Capita, Actual v. Counterfactual**

| | | 2012 | 2017 |
|---|---|---|---|
| 2011 USD PPP | Actual | 690 | 789 |
| | Counterfactual | — | 663 |
| | Difference | — | 126 |
| 2011 Congolese franc | Actual | 368,856 | 421,740 |
| | Counterfactual | — | 354,208 |
| | Difference | — | 67,531 |

23 All U.S. dollar values are in 2011 USD PPP. All Congolese franc values are in 2011 CDF.

24 International Monetary Fund. 2017. *Regional Economic Outlook: Sub-Saharan Africa – Restarting Growth Engine*. Washington, DC: International Monetary Fund.

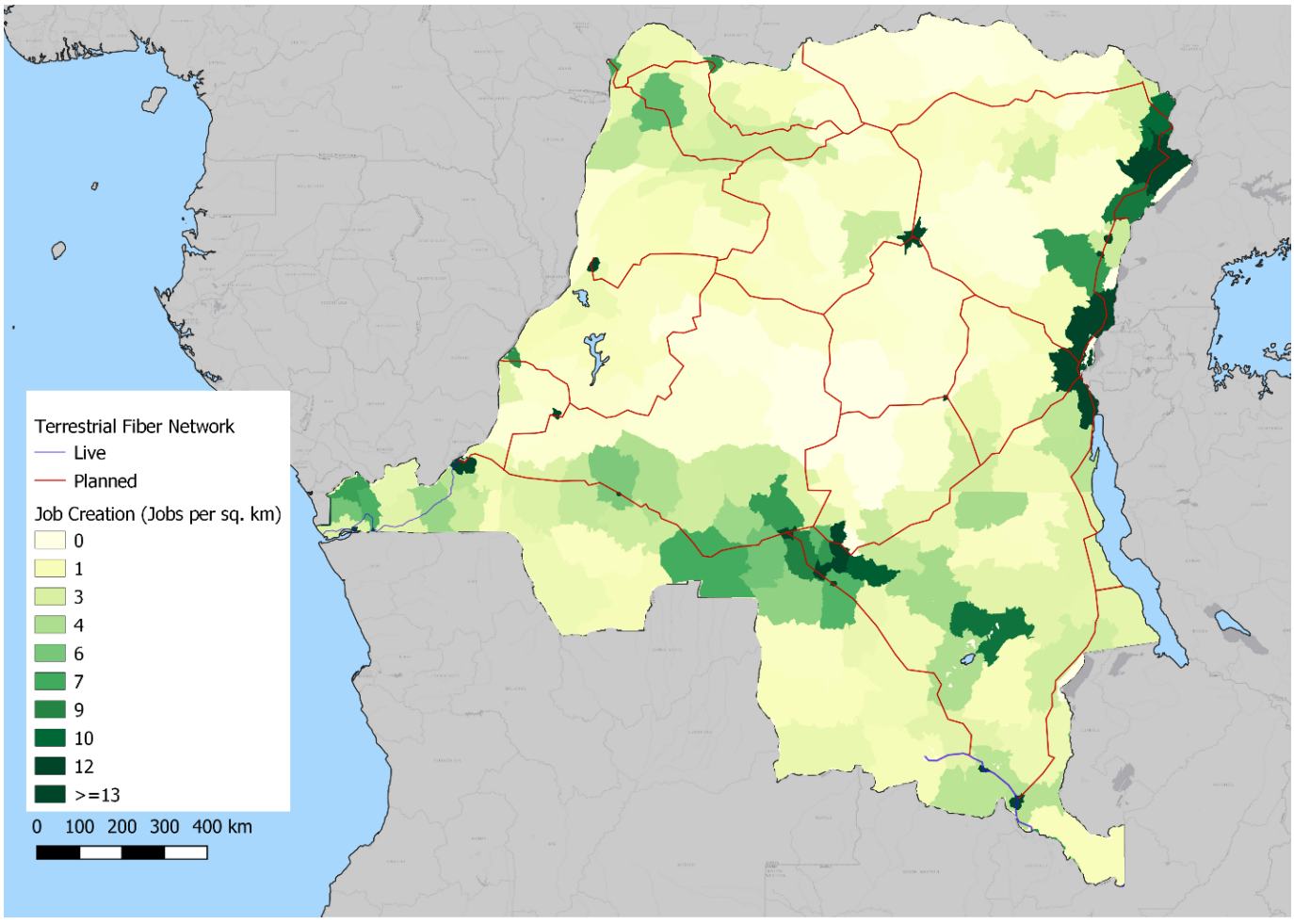
## 4.2 FORWARD-LOOKING IMPLICATIONS OF ECONOMETRIC ANALYSES

The positive effects identified on employment in fiber-connected areas offer the best estimate of the likely impacts for areas that will be connected to fiber in the future. To estimate potential job creation, we must assume that the causal effects already estimated for fiber-connected areas holds, on average, for areas that are still unconnected.

Figure 7 depicts the estimated actual and potential job creation for all of the DRC, calculated by applying the effect on employment (i.e. the increase in the likelihood of being employed) to population density (per square kilometer). For connected areas, the map shows the actual estimated job creation. For unconnected areas, the map shows potential job creation if these areas were connected (assuming the average causal effect holds). The key implication is that connecting the most densely populated areas that are currently unconnected could increase long term employment.

Numerous factors influence whether the estimated effects will hold in areas that are connected in the future, including improvements to the subsea cable technology, education levels of people living in newly connected areas, and the composition of those local economies. Obviously, the farther into the future one forecasts, the greater uncertainty there is around the magnitude of the impacts, owing to the potential for a large degree of change from current conditions. Nonetheless, even if the effect of connecting new areas turned out to be smaller than for the connected areas included in this study, the potential development gains would be socially and economically meaningful.

**Figure 7.** **Actual and Potential Job Creation as a Result of Subsea Cables and Expanded Terrestrial Fiber**



# 5. Stakeholder Perspectives on Connectivity

Congolese experts concurred with our economic impact results. With greater network expansion, there is potential for the DRC to experience greater employment and further productivity gains especially in densely populated areas. However, network expansion is difficult because of an overall lack of infrastructure, affordability, and the country's vast area and challenging topography.

## 5.1 TELECOMMUNICATIONS MARKET AND NETWORK EXPANSION

The DRC has access to additional cables via neighboring Rwanda and Zambia to the coast, but all traffic goes to Muanda where WACS lands. There is no national fiber backbone, which has resulted in a near complete dependency by operators on microwave radio back haul and satellite links to move traffic from Kinshasa to other parts of the country. Certainly, this impacts latency, cost, and network availability.

As such, the DRC has one of the lowest internet usage rates in the world with only 9% of the population using the internet in 2017 (Table 6). Not surprisingly, there is minimal update of fixed broadband subscriptions (0.01 per 100 inhabitants).

The DRC telecom sector is dominated by four mobile network operators (Vodacom, Airtel, Orange, and Africell) and eight major ISPs (Microcom, Raga, Afrinet, Orioncom, Standard Telecom, DHI Telecom, GBS, and Liquid Telecom) who carry voice and data traffic to serve consumers and enterprises. All MNOs have national coverage except Africell whose sites are concentrated in Kinshasa and major cities.

The national regulator reported that mobile penetration as of January 2020 is just over 40%, an indication of the ineffectiveness of mobile networks in reaching larger segments of the population. Indeed, mobile operators are reporting a decline in mobile penetration levels because population growth is faster than network penetration or subscriber uptake. Network coverage typically follows the prosperity of towns and/or population density.

### 5.1.1 Wired and Wireless Broadband Market

The DRC does not have a national backbone for supporting widespread broadband usage. The national telecom infrastructure is poorly developed and so much of the primary technology used in this sector is outdated. Apart from the sparse national radio and satellite infrastructure, providers are constructing network infrastructure, but many still rely on satellite technology, especially to reach remote locations.

Most of the country's fixed broadband infrastructure is concentrated around the major cities of Kinshasa, Kisangani, and Lubumbashi.[25] According to Ecofin Agency, the state-backed Congolese Society of Post and Telecommunication (SCPT) completed the second phase of the national fiber optic project in 2017, connecting Kinshasa and Kasumbalesa. This phase of the project was deployed by China International Telecommunication Construction Corporation (CITCC) and financed in partnership with China Eximbank.[26]

**Table 5. Key ICT Indicators**

| INDICATOR | VALUES | YEAR |
|---|---|---|
| Electrification | 19% of population with access to electricity | 2017 |
| Internet users | 9% of population | 2017 |
| Fixed broadband subscribers | 0.01 subscriptions per 100 inhabitants | 2018 |
| Fixed Broadband Speed | 0.51 megabits per second | 2014 |
| Fixed Broadband Monthly Subscription Charge | 361.70 2011 USD PPP | 2014 |
| Mobile Cellular Subscribers | 43 subscriptions per 100 inhabitants | 2018 |
| Mobile Download Speed | 12 megabits per second | 2020 |
| Mobile Broadband Prepaid Subscription Charge | <0.01 2011 USD PPP per 500 megabits | 2017 |

Source: International Telecommunication Union and Ookla Speedtest.

25 World Bank. 2010. Public-Private Partnership in Telecommunications Infrastructure Projects: Case of the Democratic Republic of Congo. Washington D.C.: World Bank.
26 Ecofin. 2017. DR Congo: Second phase of national fiber optic backbone completed. Geneva: Agence Ecofin.

There are roughly 43 mobile subscriptions per 100 inhabitants. The GSMA estimates that nearly all of these are prepaid and include broadband access.[27]

### 5.1.2 Wired and Wireless Broadband Market

Mobile wireless networks cover about 40% of the population and a large share of that coverage includes 3G.[28] Airtel, Orange, and Vodacom provide 4G service. 4G LTE services are now accessible to customers in Kinshasa[29] and other major towns, according to interviewees.

The national carrier, the Société Congolaise des Postes et Télécommunications (SCPT), has developed a 3,000 km fiber link from Muanda in the west and connects over 600 km to the Kinshasa-Kasumbalesa link in the east. However, construction of both links is substandard and there are frequent outages. Inadequate maintenance fixes are common, which hinders quality. The overall span of the cable is abysmal for a country as big as DRC. Thus, it is not uncommon for there to be no internet availability across all networks, sometimes lasting hours at a time.

As a state-owned carrier, SCPT serves operators and enterprises along its fiber routes but does not offer retail mobile or retail voice. The carrier also owns and operates metro fiber rings in Kinshasa, Lubumbashi, and Goma. The biggest challenge users face with the SCPT cable system is lack of stability and responsiveness. The Muanda link is particularly unreliable and often subject to downtime. The follow-on link to Kasumbalesa also has throughput issues from end to end. There is also a fiber link between Kinshasa and Brazzaville in the Republic of Congo. It was completed in 2018 to provide redundancy for operators in DRC through an alternate connection to WACS and is minimally used.

Fiber infrastructure construction is protected by the government and there is very little difficulty building fiber physically as long as right-of-way is secured. As of this writing, private operators are not permitted to develop national fiber backbone networks, although Vodacom, Airtel, Orange, Liquid Telecom, and Standard Telecom each have developed limited fiber infrastructure in their respective networks with rings primarily in Kinshasa, Lubumbashi, and Bakongo.

Despite the relative ease with which physical construction can be done, telecom infrastructure projects typically suffer delays, which increases roll-out costs. Importation of equipment is laborious and slow. Furthermore, operators complain about the quality of local manpower and the difficulty of finding appropriate hires for their network rollouts. One interviewee told us that requisite talent is in limited supply.

The cumulative effect of the underdevelopment of the national fiber network is that the country has one of the lowest internet penetration rates on the continent. Prices are relatively high, demand is unmet, available user speeds are slow, and data services are uneven. However, there is some optimism among stakeholders that the current situation is set to change due to pending high priority action by the new government on three fronts.

First, the country's parliament passed a new telecommunications law in September 2018 to replace that from 2002. Due to be promulgated by the President soon, it is anticipated that the new law will remove constraints for the private sector to participate in the development of the national fiber backbone. (In the meantime, ministry decrees have sufficed.) The law is also expected to stimulate a new wave of investment and economic growth by establishing full competition on an open-market basis, technology-neutral regulations, and the establishment of a new, semi-autonomous regulator to enforce a more competitive and friendly environment for developing high speed broadband services. These efforts are expected to lead to lower costs for operators and consumers, better service offerings, and overall improvement in the quality and reliability of communications in the country.

Second, the national government has set up a fiber company, the Société Congolaise de Fibre Optique (SOCOF), through a $92 million World Bank grant for the development of the Central Africa Backbone 5 (CAB5). CAB5 is designed to duplicate the Kinshasa to Muanda link and create new fiber routes from Lubumbashi to Kalami in the south and Lubumbashi to Kisangani in the east to connect the three biggest economic hubs of Kinshasa, Lubumbashi, and Goma. The SOCOF fiber network would also connect the country to the Congo Brazzaville/Angola landing station of WACS, ensure redundancy to the SCPT fiber from Muanda, and give operators choice of access with respect to future subsea cables.

28 International Telecommunication Union. 2017. ICT Development Index 2017.
29 ITNA. 2018. Vodacom to launch first 4G operator in DRC. Johannesburg: IT News Africa.

Part of the conditions for setting up the project required that the government promulgate a new telecommunications law to enable SOCOF to designate an operator under a public-private partnership to commercially operate and manage the new fiber infrastructure on behalf of the government. The new law is required to trigger the release of the grant, which will then unlock opportunities by opening up the utilization of the country's fiber assets to the private sector. They would also be able to deploy new fiber infrastructure of their own within the country. There is also a possibility that construction of a new Muanda link would go forward ahead of the execution of the new law as funds were released mid-2019 for field works to commence during the first quarter of 2020.

Third, the market anticipates landings in Muanda of new OTT-led submarine cables, 2Africa by Facebook and Equiano by Google, as well as the possibility of a third private Kinshasa–Muanda spur. In March 2020, the regulator, Autorité de Régulation de la Poste et des Télécommunications du Congo (ARPTC), licensed Liquid Telecom to develop a new landing station in Muanda in preparation for the arrival of Equiano. The new landings and private spur would be required to interconnect to the SCPT cable as a licensing condition. When these new subsea cables land, DRC would likely enter a new phase of growth and investment security that has the potential to yield a more reliable communications network and improved digital services, especially if the planned regulated interoperability of subsea cables is achieved.

As stated above, the biggest headache facing broadband networks in DRC is the absence of a reliable national fiber network through which operators can move traffic across the country. The need for high quality national fiber with extended coverage and high-speed is quite strong. Operators eagerly anticipate the development of the SOCOF fiber for choice and redundancy, and the signing of the new telecoms law to secure regulatory protection for their own expansion plans. These developments will lead to significant expansion of the country's overall network infrastructure.

In terms of private fiber deployments, Liquid Telecom is presently developing the Kasumbalesa–Kinshasa route and has a metro ring in Lubumbashi and Goma. The operator links these metros with East African submarine cables through Zambia and is also working to build a metro link in Kwolize.

Furthermore, Société Nationale d'Electricité (SNEL), the national electricity company, owns 3,000km of unlit dark fiber mounted on high-voltage electricity transmission towers between the Inga Dams and Katanga. Vodacom, Airtel and Liquid all use SNEL in parts of their respective networks. In December 2019, the regulator granted licenses to six operators, Microcom, Vodacom, Airtel, Orange, Africell, and Liquid to develop metro rings in Kinshasa and regional backbone networks in the West province. These fiber rollouts will enable new connections and improved service delivery in both the enterprise and retail market segments.

## 5.2 AFFORDABILITY

Internet access is unaffordable for most Congolese. Infrastructure development, maintenance, and operating costs are high. The telecommunications sector is the second highest revenue earner for the government after the mining sector. With relatively high taxes, up to 4.5% of operator revenues, operators transfer these costs to customers, resulting in high prices. Furthermore, costs of data services are high because, unlike voice, they are unregulated and dominated by the monopoly enjoyed by SCPT on subsea cable access.

Prices have dropped significantly over the past 5 years due to SCPT fiber development, increased competition, and increased access to satellites systems for wholesale traffic including 0ther Three Billion (03B), Eutelsat, and Intelsat satellites. Presently, 1Mbps rates are now in the US$800 to $1,000 range, down from US$2,000 to $3,000 5 years ago. Costs vary between regions, with Lubumbashi and Goma less expensive because of their proximity to East African cables. Retail prices have also fallen.

Device costs represent a barrier to access, and although newer, lower-cost ones are coming to market, there is some discussion that the government will tax devices. This has the potential of further impeding uptake.

Competition is robust. Disruptive practices have been commonly employed by new entrants such as Tigo (now Orange) and Africell in the form of significant pricing reductions or massive usage promos on voice or data offerings. However, the reaction of dominant operators, Vodacom and Airtel, to these tactics tends to be swift and forceful.

To avoid price wars and quality degradation, the regulator established a price floor for voice calls, although data service is not regulated at present. As a result, providers such as Africell that target low income segments are able to continually lower prices for data offerings. Africell became a market disruptor when it started unlimited daily browsing of US$1, the impact of which has been considerable as more consumers seek out the cheaper offering.

The DRC is characterized by huge social and economic divides between urban and rural areas, with disparities across different strata of the population. For this reason, there is not much 3G or 4G penetration outside of the main urban areas. The internet (particularly broadband) tends then to be somewhat restricted to the "big boss" instead of the masses due to availability and pricing constraints. Presently, operators tend to serve rural and remote areas—where infrastructure is poor and many people experience poverty—with ultra-low-cost radio sites. This allows operators to serve a community at the lowest possible operational costs to sustain commercial viability.

Consumers of telecom services are said to be quite demanding. One key industry informant describes three categories of mobile users:

- Very poor customers who are seeking low level services such as voice calls at cheap prices. Most have up to 3 SIM cards which they use to chase new low-cost promotions, though one SIM would be primary. They are very price sensitive and are always looking for the best deal. Quality is not much of a consideration.
- The next category is mid-tier customers who are mainly students and young people. They are also price sensitive, as they continually track the best offers, but want the cheapest price plus quality of service. They want the best in value-added services, data bundles, and product offerings. They are intelligent, demanding, and savvy about network quality.
- The final group are high value customers. These are less price conscious and are loyal to their preferred network. They have always-on data and hardly ever buy bundles. They are business users and always want high-quality service. It is this category that most operators target, despite not being the most numerous. Operators generally build robust infrastructure in the locations where high-value customers work and live.

One ISP has seen heavy reliance by people on voice networks rather than data. The ISP attributes this to cultural practices and low literacy levels that make it is easier for people to call than type into a device. According to one operator, many smartphones are not switched on to data because consumers cannot setup network data settings without assistance. Though data is expanding, operators are really not incentivized to develop their data networks. They are not prioritizing the replacement of their microwave transmission hubs with fiber except when there is congestion, demand for adequate bandwidth to support audio or video conferencing, and a good projected return on investment. This is resulting in the low take-up of data-for-voice substitutions.

In recent times, internet speeds are gradually increasing with 4G deployments. The user experience is improving, though not up to what is expected. There is huge demand for high speed internet at the main population centers of Kinshasa, Lubumbashi, Goma, Bukavu, and Kisangani, among others. However, intercity traffic often relies on radio and satellite links.

## 5.3 PUBLIC POLICY PRIORITIES

While there are positive signals for the DRC telecom industry, the consensus from our interviews is that the biggest challenge facing the sector generally has been the rule of law. The market is plagued by free-for-all actions of market players. For example, licensee rights may be either ignored or trampled upon. This leaves the industry motivated to maximize a return on investment that improves their individual bottom lines with little regard for other players and the market landscape. Historically, political interference by the national government is rife. The state has been more interested in control and revenues than in the market development of the sector.

This dynamic is likely to change. The new government, which was installed January 2019, has expressed its eagerness to create an enabling environment for private participation in the telecommunications sector. In fact, the new telecommunications law (passed September 2018) is expected to reduce barriers for private sector development of the national fiber backbone and to encourage greater competition and better regulation. This should promote a more friendly business environment for developing high-speed broadband services. Although the law has not yet been signed because of some parliamentary considerations, the government has issued ministry decrees that have allowed aspects of it to move forward.

The new government has adopted digitization as a major pillar of development. The country also needs to avoid duplication of infrastructure through the consolidation of public sector communications assets across all government agencies, the standardization of fiber deployments, and the promotion of interoperable private networks.

The government is considering a regulation to mandate that 25% of the fiber capacity of private operators be used to connect government ministries, departments and agencies (MDAs) under the Plan National du Numérique.[30] The Plan outlines the government's goals to digitally transform the DRC and lays out four strategic pillars: Infrastructure, Content, Applied Use, and Governance–Regulation.

In addition, the government is in the process of announcing its national broadband plans which will encompass e-government, cybersecurity, postal transformation and the development of a new national fiber backbone. The government's plan is to develop a national backbone network consisting of 50,000 km of fiber, microwave and satellite links, and open up cities with fiber rings so as to ensure that every locality has broadband connectivity. It would cost $500-750 million and would be coordinated by a soon-to-be-formed state enterprise that would be established under a PPP arrangement with a 30:70 equity ratio. The government considers fiber as very important for economic development.

Another public sector priority is the regulation of the communications sector. The government plans to establish a new regulator with a new vision and mandate with broader powers to coordinate ICT, telecoms, broadcasting and postal services.

# 6. Conclusions

Our findings that subsea cables have had an 8.2% impact on job creation in areas with broadband infrastructure and a 19% impact on GDP per capita indicate that greater connectivity can transform living conditions across the country.

So far, the arrival of WACS has benefited connected areas. However, these benefits, if not eventually experienced more widely, may result in disproportionate economic opportunities and outcomes across geographic lines. Even if future broadband infrastructure results in only a fraction of the impact we identified for currently unconnected areas, the economic impacts would still help mitigate the widening opportunity gaps and contribute to the DRC economy as a whole.

To help realize this potential, it will be critical for the DRC to develop strategies and establish a policy environment that enables the fiber network to be built across the country. This is essential so that all Conoglese have the opportunity to leverage either now or in the future the connectivity to the Internet subsea cables provide. This is all the more important because the government is planning to anchor DRC's economic transformation on digitization with applications extending into e-government services such as social security, personal taxes, digital identities, and access to services. It is encouraging that Parliament recently passed laws making it easier for the terrestrial fiber network to develop and that the President is sending strong signals about passing new laws to build on this momentum. With more effective regulation coupled with measures to ensure affordability we can expect more economic growth and employment.

Whether the magnitude of employment and GDP effect is likely to hold in areas that become connected in the future depends on many socio-economic factors such as the skills of the local labor force and the structure of the local economies (including types of economic activities located there). Thus, if conditions are ripe for the arrival of broadband infrastructure, it would be reasonable to expect economically significant impacts in the newly connected areas that are similar in magnitude to the impacts estimated for the currently connected areas. However, if conditions in other places are not as primed to leverage broadband infrastructure, then the effects would likely be economically less significant.

28 Democratic Republic of Congo. 2019. Plan National du Numérique. Available at https://www.numerique.cd/pnn/.

# Economic Impacts of Fiber Optic Subsea Cables and Broadband Connectivity in the Democratic Republic of Congo

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