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Could fibre access improve economic outcomes for low and middle-income households in South Africa?

Theoretical framework, literature review and case study of Kayamandi

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Introduction

Fibre penetration in South Africa's urban areas has deepened in recent years. Some investors are now looking to high-density township areas for the next phase of fibre rollout. Commercial viability is being tested through various models. The developmental impact of ubiquitous and affordable internet access in low-income neighbourhoods is often part of the rationale.

We posit that ubiquitous, unfettered and affordable internet access, e.g. through fibre, could have a positive socioeconomic impact in areas where these networks have not been available. Fast, uncapped internet allows users to access a network without considering supply and cost constraints.

- We screened close to 70 articles to identify how the internet affects people's lives, on balance focussing on developing regions. Research about the impact of fibre access in low- and middle-income countries (LMICs) is scant, partly because of its limited rollout in many of these regions. However, there is much research about the impact of gaining access to the internet more broadly, irrespective of the type of technology used. We did not confine our search to fibre networks and included fixed and mobile broadband, assuming that the results could be transferred and could even be stronger for fibre networks.
- We also provide a case study of the potential impact of low-cost fibre access in a socio-economically disadvantaged community in South Africa. In 2022, PayGoZo – a fibre network provider – commissioned a survey to establish employment and internet usage behaviour as a baseline to compare the impact of fibre network rollout in Kayamandi, Western Cape. The survey was conducted before the network went live. We report the baseline results here.

Internet access in South Africa

The majority of South Africans rely on mobile connections to access the internet. South Africa had a smartphone penetration rate of 108%¹, but fixed broadband connections (like fibre) were equivalent to only 3% of the population in the same year (1.80 million subscriptions) (ICASA, 2022).

The nationwide service MNOs provide is very different from a fixed point of network access like one might have at home. In this manner, mobile and fixed broadband connections are complementary rather than substitutes. It is analogous to bottled water versus municipal supply: consumers want bottled water to take small sips when moving outside their homes but would never use it to fill their bathtubs or wash clothes – large water volumes flowing at high speed are necessary for these tasks.²

¹ The number of smartphone subscriptions (65.31 million) in South Africa is greater than the size of the population.

² We stole this excellent analogy from Rich Henn, CEO of PayGoZo.

One can say that mobile connections are like bottled water with a select use-case, while fibre access is more akin to municipal water supply.

Geography also plays a role: due to high installation costs, fixed broadband traditionally requires a relatively high population density of affluent households for the network to be commercially viable. The cost of providing access to people living in rural areas is, in some instances, prohibitive, where alternative technology like mobile or satellite networks presents a better business case.

There has been fast progress in developing fixed broadband networks (fibre, in particular), but the process is far from complete. In addition, South Africa's mobile network coverage in many areas has download speeds comparable to fixed broadband. This is likely to change as the fibre network expands, but currently, mobile connectivity presents a viable (albeit expensive when measured in Mbps) alternative in many areas. Compared to a selection of BRICS and other countries³, South Africa's fixed broadband download and upload speeds underperform. South Africa performs relatively better regarding mobile broadband download speed, but upload speeds remain comparatively low (ICASA, 2022).

In addition, broadband access in South Africa is expensive. A study by Cable.co.uk compares the average price per Mbps of fixed broadband connections in different countries, ranking South Africa 125th out of 220.⁴ A monthly subscription to fixed broadband is only affordable for wealthier South Africans. Depending on network speed and the Internet Service Provider, most fibre-to-the-home (FTTH) subscriptions are upward of R500 per month. With an average disposable income of R5 555 per person per month (2021), this remains out of reach for most South Africans, even if a network is available.⁵

Will new fibre networks deliver economic benefits if most South Africans already have internet access via mobile broadband? Fibre cables typically allow faster download and upload speeds because the lines can withstand a higher data transfer volume. While a 3G/4G mobile connection is sufficient to search for something online or watch a short video clip, it becomes prohibitive when using it for extended periods, like attending an online class, streaming a full-length film, or working from home. Fibre optic cables are also significantly faster and cheaper than the legacy DSL copper cables that, until recently, accounted for most fixed broadband connections in South Africa. There are an estimated 16.7 million households in South Africa. With roughly 1.4 million fibre connections in 2021, just over 8% of households have fibre access. South Africa still has a long way to go to bridge the digital divide⁶.

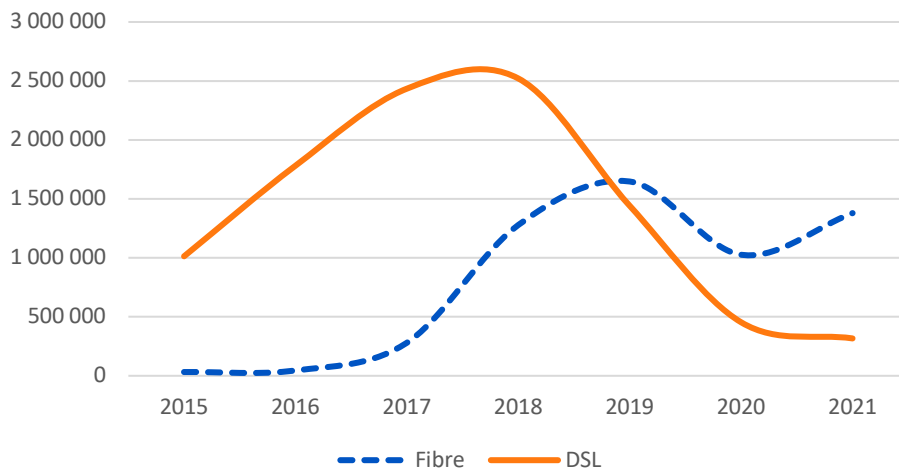
³ The sample includes Brazil, Chile, China, Denmark, Hong Kong, India, Russia, Singapore, South Africa, and Thailand.

⁴ <https://mybroadband.co.za/news/broadband/477891-this-is-how-expensive-broadband-in-south-africa-really-is.html>

⁵ Average disposable income is current income, less taxes on income and wealth (source: Quantec, own calculations).

⁶ The gap between those that have access to the internet and a computer, and those that do not.

Figure 1: Number of DSL and fibre to the home/building connections



Source: (ICASA, 2022)

The growing popularity of content streaming and opportunities to work from home creates demand for fibre among all households. In this context, it is encouraging that there is a growing uptake of fibre networks in South African townships. PayGoZo recently established its first aerial fibre network in Kayamandi, a township in Stellenbosch. They offer packages at R5/day, R30/week, or R100/month. This is substantially cheaper than the median fibre-to-the-home (FTTH) offering. Vuma is also playing in this space. They have established Vuma Key, targeting households that earn less than R5 000 per month, and Vuma Reach, for households that earn between R5 000 and R30 000 per month. They are running pilots in Alexandra (Johannesburg), Khayelitsha (Cape Town), and Kayamandi.

“Our most recent survey shows that more people across South Africa’s township communities realise how this technology can revolutionise how they access their favourite entertainment without interruption and save money by spending less on mobile data” – Lianne Williams, Marketing Director at Vuma.

The high population density of townships makes these fibre connections commercially viable, and with the right business model and technology could be a game changer for South Africa.

Case study: Internet access in an informal housing community in South Africa

To highlight the potential contribution of low-cost fibre to the South African setting, this section provides a case study of fibre roll-out in Kayamandi, a township outside Stellenbosch in the Western Cape. In early 2023, PayGoZo⁷ – an aerial fibre network provider – systematically started setting up an aerial fibre network in the socio-economically disadvantaged community. Prior to rolling out the fibre network, PayGoZo conducted a baseline survey to assess pre-roll-out internet usage and potential socio-economic areas that would benefit from the PayGoZo network. In what follows, we provide the results of the baseline survey as a case study of current internet access in socio-economically disadvantaged areas in South Africa.

More about PayGoZo: PayGoZo is an aerial fibre network provider. Aerial fibre is cheaper to install than underground fibre and provides the service at a lower cost. The technology is not novel, but PayGoZo’s commercial model is. Like one can access a fibre network from anywhere in your house, PayGoZo

⁷ In other regions, PayGoZo operates as FiberTime™

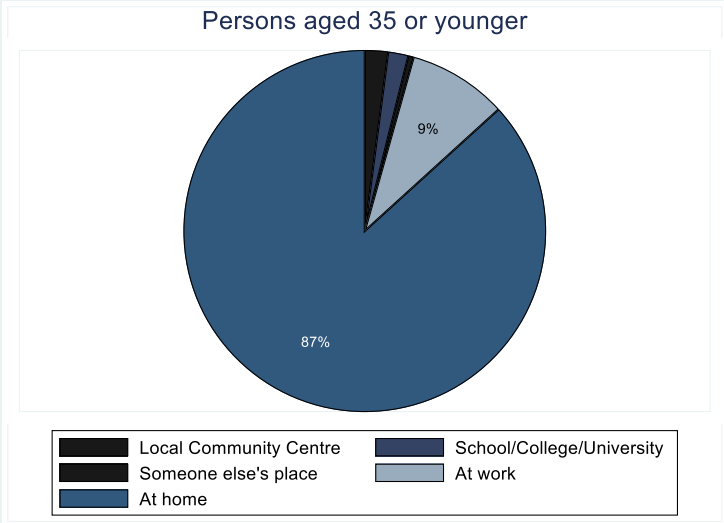
allows users to access its network anywhere within its coverage area in Kayamandi. Users within the network coverage area can sign up with their smartphone, add 'airtime' to their wallet and immediately connect to the network. The PayGoZo model is premised on time-based usage. Bundles are available for a single device at R5 per day, R30 for a week, or R100 for a month (current 2023 prices). The service offers totally uncapped, high-speed internet. It is an affordable alternative to mobile data, which is how most residents of Kayamandi currently access the internet (African Response, 2022).

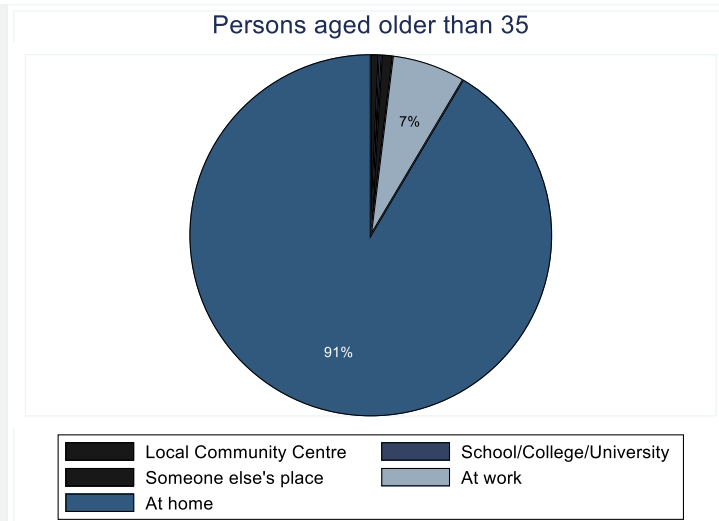
More about the survey: Data was collected using a face-to-face household survey. A stratified multistage random sample was drawn from the Kayamandi population, which allowed the researchers to create a sample representative of that area's population. Given this sampling strategy, weights are included in the analysis.

The final sample consists of 1001 observations. The sampled population consists predominantly of informal/non-brick dwellings (51%), with the remainder made up of formal structures (23%) and backyard structures (26%). Almost the entire sample (99%) consisted of Black African respondents. Among those living in formal dwellings, there are considerably more women (60%) than men (40%). Sixty-seven per cent of this population have completed high school, and 33% have not. The sample looks only slightly different for individuals living in informal dwellings, with women (58%) still exceeding the male sample (42%) and only 55% of the population having completed high school (African Response, 2022).

All respondents to the survey (100%) reported having access to some form of internet. Three-quarters of respondents answered that they access the internet daily, illustrating the high demand for network services. However, there is variation in the places and methods of internet access. Housing structures and a large share of informal backyard dwellings make installing and connecting to a traditional fibre network impractical. Nevertheless, the survey showed that most residents of Kayamandi access the internet from home (Figure 2). Without current large-scale DSL/ fibre networks in Kayamandi, most users use mobile data connections to access the internet. This implies that the PayGoZo network would not necessarily increase the convenience of using the internet, but it could improve network quality and affordability.

Figure 2: “Where do you predominantly access the internet?”

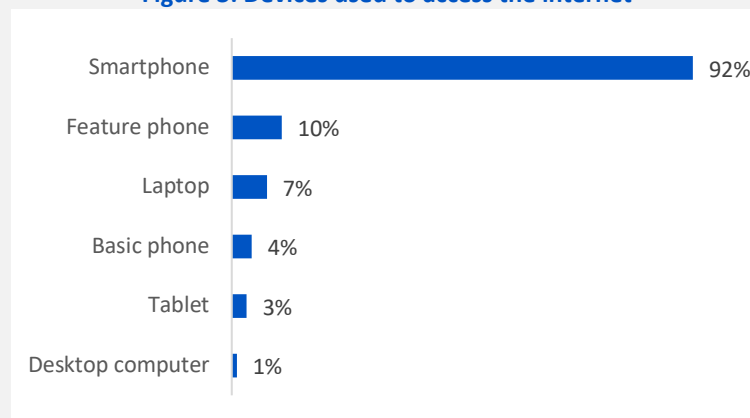




Source: African Response 2022

Internet access is subject to also having access to a device to connect to a network. When asked which devices respondents have access to, 92% reported having access to a smartphone. Only 7% of respondents reported having access to a laptop and 3% to a tablet, primarily limited to people living in formal structures. Laptop access, in particular, was associated with people in formal employment.

Figure 3: Devices used to access the internet

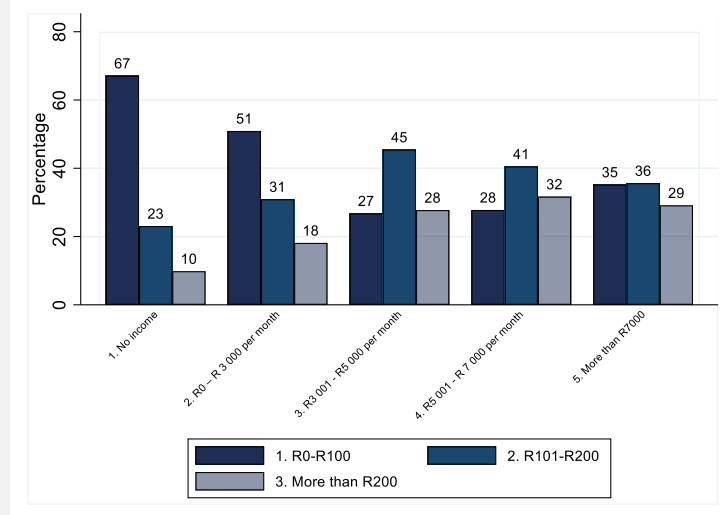


Source: African Response 2022

The survey in Kayamandi showed that respondents, on average, spend R153 per month on data and use about 2GB of data. A third of people using the internet in Kayamandi spend between R100-R200 per month to get access. A further 25% spend more than R200 monthly. Based on these expenditure patterns, PayGoZo’s offer of uncapped, high-speed access at R100 per month could be an attractive alternative. Presumably, the costs savings as well as the additional utility of uncapped access will increase consumer welfare.

Average monthly internet spending is positively associated with a household’s monthly income. Among households with no income, 67% report spending between R0 and R100 monthly on the internet. This percentage drops to 35% for households earning more than R7 000 monthly. Among the wealthiest households, 29% report spending more than R200 per month on internet costs, while this spending pattern is only present among 10% of no-income households.

Figure 4: Average monthly internet spend on data per household income group (% of respondents)



Source: African Response 2022

Cost and convenience are the most significant drivers of data purchasing behaviour (African Response, 2022). Data that runs out too quickly and is too expensive were reported as the biggest challenges. Since fibre networks are typically uncapped, it could be a superior product offering to capped mobile in South African townships. The PayGoZo network is one of several trying to breach the township model. It does not necessarily increase access to the internet since internet penetration through mobile connections is already very high, but affordable fibre networks in townships could give consumers the benefits of full broadband internet, which typically is much faster, more stable and uncapped.

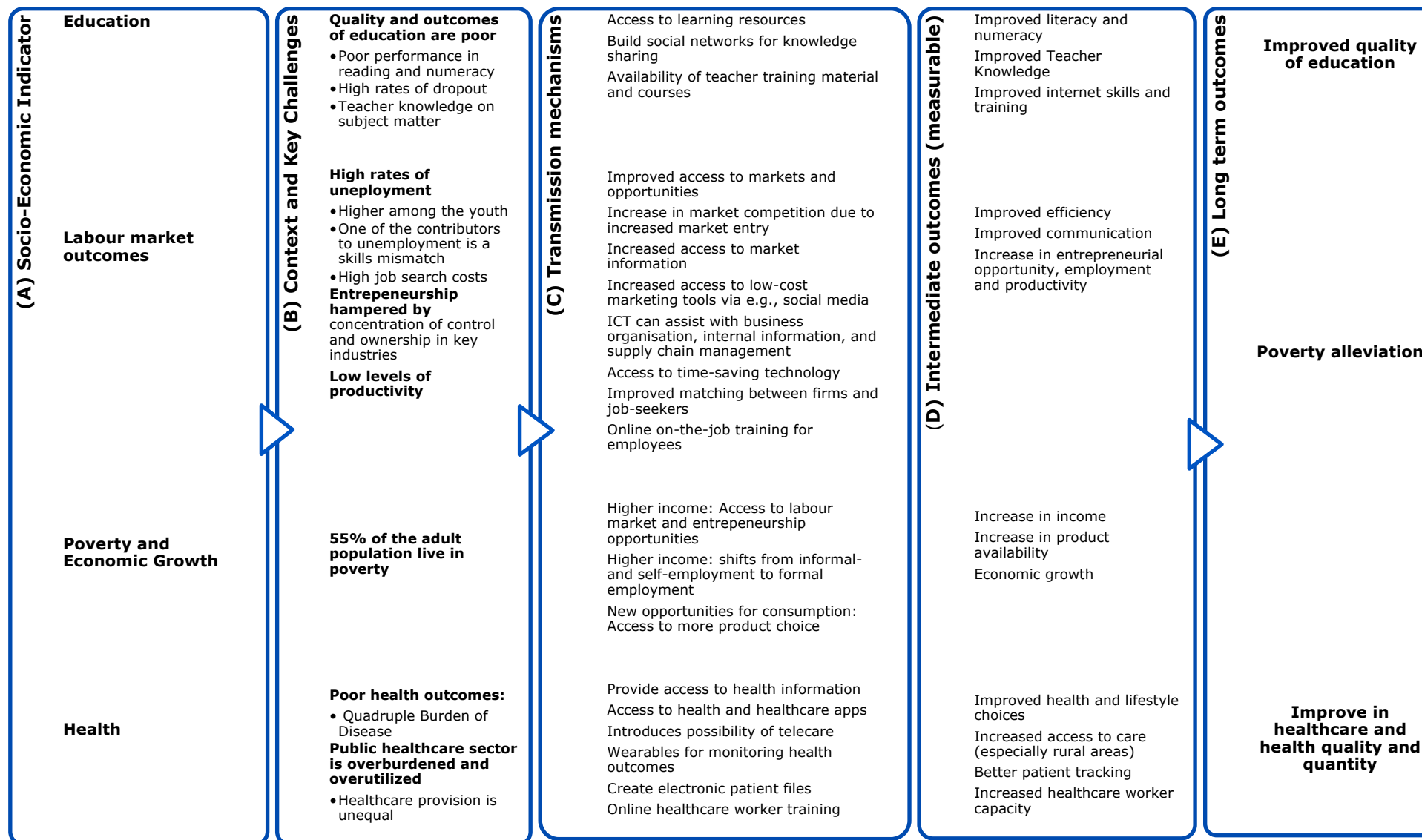
Ideally, one wants to quantify the effects of having access to an affordable, uncapped, high-speed fibre network. Most of the existing literature tests the impact of internet *access* rather than the impact of *fast, uncapped* internet. The field of study is still emerging. The following section outlines the various pathways and transmission mechanisms through which the internet can impact socioeconomic outcomes, presented in a theoretical framework. We use this to posit the impact of affordable fibre networks in townships.

Theoretical framework

Using the available literature, we provide a theoretical framework to explain how access to the internet (faster, more reliable, and cheaper) can improve people's lives. It shows the transmission mechanisms and potential causal socio-economic impact(s) of improved internet access.

We identify four socio-economic indicators (A, in the diagram) on which access to reliable and affordable internet may impact: education, labour market outcomes, poverty, and health.

The theoretical framework identifies the context and key challenges (B) for these socio-economic indicators in South Africa. The model then describes the mechanisms (C) through which improved internet access could address these challenges and how these would affect intermediate (D) and long-term outcomes (E).



ACCESS TO QUALITY EDUCATION

South Africa spends an above-average proportion of its national budget on education. Upper-middle-income countries, on average, spend the equivalent of around 4% of their GDP on education. In South Africa, expenditure on education equated to 6.1% of GDP in 2021 (World Bank, 2021).

South Africa's educational quality and outcomes remain poor, despite high public spending and almost universal access to primary school education. The 2016 Progress in International Reading Literacy Study (PIRLS) – which evaluates the reading skills of fourth-grade pupils – found that out of 50 countries⁸, South Africa had the lowest marks. Only 18% of Grade 4's in South Africa can read for meaning in any language. Even more concerning is that this is the same level as in 2011.⁹ Similarly, the 2019 Trends in International Mathematics and Science Study (TIMSS) – which tests mathematics and science in both the fourth and eighth grades – found South Africa had the fifth lowest achievement out of a selection of 64 global countries (Barth *et al.*, 2017). South Africa also has a high dropout rate among students. In 2022, only 66.1% of the learners enrolled for the first grade in 2010 completed the National Senior Certificate (NSC) within 12 years (Motshekga, 2022).

Several factors contribute to South Africa's poor educational performance. South Africa has a shortage of appropriately trained teachers (Legotlo, 2014), whose jobs are made even more difficult by an insufficient and unequal distribution of resources (Taylor, 2019). Additionally, many teachers are poorly motivated to provide quality education, caused by low salaries, poor working environments, heavy workloads, frequent curriculum changes, overfull classrooms, etc. (Legotlo, 2014). In addition, teachers are often poorly trained and do not have the necessary skills or knowledge (Venkat and Spaul, 2015). All these factors contribute to South Africa's poor educational outcomes.

Potential impact: Access to learning resources

Information and Communications Technology (ICT) can allow learners to access online and distance learning, subject to an internet connection and an electronic device. There are numerous ways through which this can advance education outcomes. The internet allows students to access additional learning material not found in the classroom. They can use this to learn new skills and benefit from sharing knowledge within their social network. Online sources are often more cost-effective than printed material, making them more accessible and improving literacy outcomes (Guerriero, 2015). ICT can also enable more efficient and effective teaching, especially when teachers are ill-prepared and do not have access to the necessary teaching resources (Asongu and Odhiambo, 2019a). The internet access cost and speed likely play an important role in this context. For instance, incorporating online video material into the learning environment only becomes possible if internet access is fast and affordable.

Potential impact: Better educational outcomes

Increased internet penetration has been found to improve the quality of primary education, especially in SSA countries where poor-quality education is pervasive (Asongu and Odhiambo,

⁸ Argentina, Australia, Austria, Azerbaijan, Bahrain, Belgium (Flemish), Belgium (French), Bulgaria, Canada, Chile, Chinese Taipei, Czech Republic, Denmark, England, Finland, France, Georgia, Germany, Hong Kong SAR, Hungary, Ireland, Iran, Israel, Italy, Kazakhstan, Kuwait, Latvia, Lithuania, Macao SAR, Malta, Morocco, Netherlands, New Zealand, Northern Ireland, Norway, Oman, Poland, Portugal, Qatar, Russian Federation, Saudi Arabia, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Trinidad and Tobago, United Arab Emirates, and United States.

⁹ <https://www.businesslive.co.za/fm/features/2023-02-16-south-africa-is-losing-the-literacy-battle/>

2019b)¹⁰. Tchamyou *et al.* (2019) studied 48 African countries to test the relationship between internet penetration and primary and secondary education outcomes. They find that it ultimately leads to a decrease in income inequality. They also find that the interaction between fixed broadband and primary education positively affects economic growth.

Not all studies, however, find a statistically significant relationship between internet use and educational outcomes (Galperin and Fernanda Viacens, 2017). Okyere (2020) finds that internet use in Nairobi (Kenya) does not improve school attendance but improves internet skills and training. Similarly, Malamud *et al.* (2019) studied the impact of internet use on various child educational outcomes in Peru. They show that internet use does not significantly impact reading and math attainments. Faber *et al.* (2015) used primary and secondary school test scores in England to determine the effect of upgrades to high-speed broadband on educational outcomes. In this case, even substantial increases in internet speed did not affect academic achievements and had no significant impact on learning productivity. The results from Faber *et al.* (2015), however, are not necessarily comparable to South Africa as the education environment in England looks starkly different.

Empirical studies are not unanimous about the impact of the internet on education. This is likely due to country-specific contexts and the network speeds on which these studies were based. The studies mentioned earlier by Asongu and Odhiambo (2019) and Tchamyou *et al.* (2019) find a positive relationship between internet penetration and educational outcomes for a cross-section of countries in Sub-Saharan Africa, encouraging us that this might also be the case for South Africa.

IMPROVED LABOUR MARKET OUTCOMES

South Africa has unsustainably high levels of unemployment. Poor educational outcomes also feed through into unemployment. South Africa suffers from one of the highest unemployment rates in the world. More than 3 out of 10 persons aged 15-64 want to work but cannot find a job. If people who have become discouraged and are no longer seeking work are included, this increases to just over 4 out of 10 persons. Unemployment among the youth is a particular concern, with 6 out of 10 persons aged 15-24 not in employment, education or training. At such high levels, unemployment becomes a severe social and economic problem. It aggravates inequality and creates a myriad of fiscal challenges.

One of the key reasons for South Africa's unemployment crisis is a skills mismatch within the labour market: there is a demand for highly skilled individuals, but many people that form part of the labour force do not have the skills to match the need. The problem of unemployment is multi-faceted but closely linked to the poor quality of education. As discussed above, there is evidence that internet access can lead to better educational outcomes. If this is the case, it may help to bridge the skills mismatch in South Africa's labour market.

We consider three other avenues through which internet access could improve labour market outcomes: lowering job search costs, higher employment, entrepreneurship, and productivity.

Potential impact: Lowering job search costs

High job-search costs are one of the factors that can contribute to a person not being able to find a job. Job search behaviour is often classified as being either formal (e.g., applying for jobs on LinkedIn or with employment agencies), word-of-mouth (using social networks) or place-to-place (where job

¹⁰ Measured as above median poor-quality education among countries in this study.

seekers go directly and physically to potential employers, such as factories to ask for work). The method of job search behaviour adopted will often depend on the skill level of the position. For instance, place-to-place job searching is used more frequently by lower-skilled job seekers, which increases the transport cost component of the job search, as opposed to finding a position online. In addition, potential employers looking for skilled employees will often take on job search costs themselves due to the value of employing someone with a specific skill set. This is often different for lower-skilled positions. These factors increase job search costs among lower-skilled, socio-economically disadvantaged individuals. Social networks currently present one of the lower-cost search strategies. As a result, it still plays a vital role in job seekers accessing job opportunities in South Africa, especially among the youth. A recent survey of South African youth consisting of 2 200 respondents showed that the youth spend, on average, approximately R1300 per month searching for work. This comprises mainly transport costs (R478) and internet costs (R465).

A slightly older study of 1 986 young and unemployed individuals in South Africa found similar results. It found that the youth spend on average R938 per month looking for work, mainly transport (R558) and internet, application, agent and bribery costs (R380). Job search costs were found to be a major barrier to market entry. Spatial inequality remnant from the apartheid era – where the economically disadvantaged are situated far from economic hubs – perpetuates and drives these costs.

Lower job search costs are one mechanism that might benefit township communities that previously did not have access to fibre. We use the data from the survey conducted in Kayamandi (Box 1) to establish a baseline for job search behaviour and costs, against which one could compare changes once the PayGoZo network has been established. The findings illustrate the potential value of low-cost fibre through various avenues:

- The internet is the most popular avenue to search for work in Kayamandi, especially among the youth. The internet is most often used to search and apply for job advertisements.
- In 2022, jobseekers in Kayamandi spent between R440 to R840 per month searching for a job.
 - Decreasing data costs would benefit the unemployed youth, who spend more than older cohorts on data for job searching.
 - There is indicative evidence that poorer households have smaller budgets at their disposal to look for work.

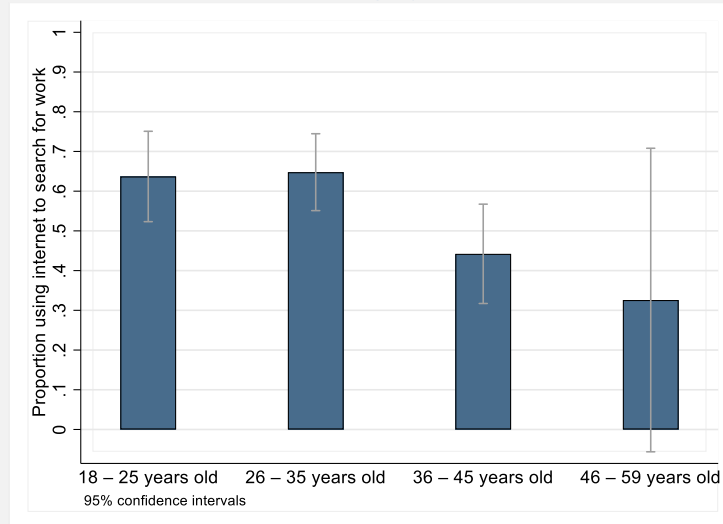
Case study (continued): Job search costs in Kayamandi before the roll-out of low-cost fibre

The internet is the most popular job search method in Kayamandi. The survey results show that 39% of respondents searched the internet for jobs. The internet is the most popular tool people use to search for work. Of all job-seeking respondents, 58% reported using the internet to look for a job. The second and third most common job search strategies are to inquire at workplaces, farms and factories (place-to-place job searching) and to register in person at an employment agency (formal job searching channel). Using the internet to look for work could be impactful. Among the survey respondents that have jobs, just under 39% of the youth reported that they found their jobs online, compared to 24% of older respondents.

Forty-five per cent of employed respondents in the sample report finding their current job through household members, friends, and relatives. Counter-intuitively, few unemployed respondents use this job search strategy, with only 9% of job seekers stating that they have asked friends and relatives about work. Using an online recruiter or responding to a job advertisement enabled 35% of respondents to find their current job.

The youth is more likely than older cohorts to look for work using the internet. Disaggregating job-seeking behaviour by age reveals that younger people are more likely to use the internet to search for work (Box Figure 1). Given that unemployment among the youth is exceptionally high, instruments that lower their cost of finding a job could be impactful.

Figure 5: Proportion of Kayamandi using the internet to search for work, disaggregated by age category

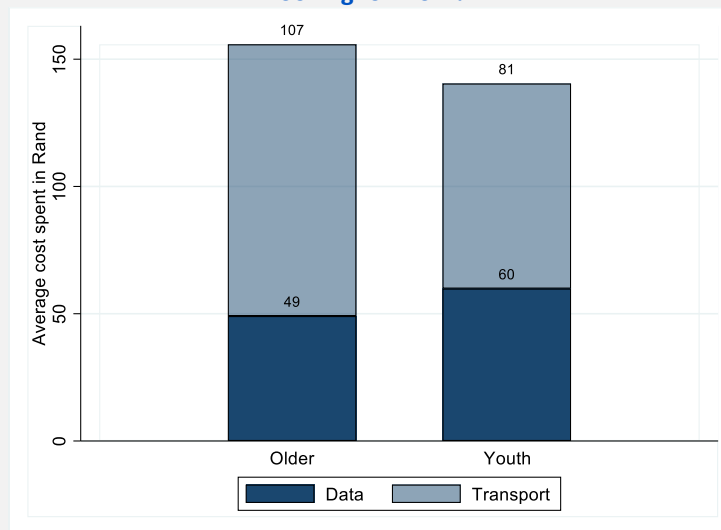


Source: African Response (2022)

The survey found that many respondents use the internet to search for jobs and apply to job advertisements. In addition, the youth use the internet in different ways to search for a job. According to the survey, the most popular strategy is to search for and answer job ads online. Some survey respondents report sending their CVs via email or registering on an online job search platform.

Younger cohorts spend more on data to search for a job relative to older cohorts. Job search behaviour varies between age groups. On aggregate, older people spend more on job search (R156 in the past seven days) than youth (R141 in the past seven days). For both the youth and the elderly, transport costs associated with looking for work outweigh data costs (Figure 6). However, as one might expect, younger people spend a larger share on data costs (42%) in their search for a job than older people (31%), who spend disproportionately more on transport.

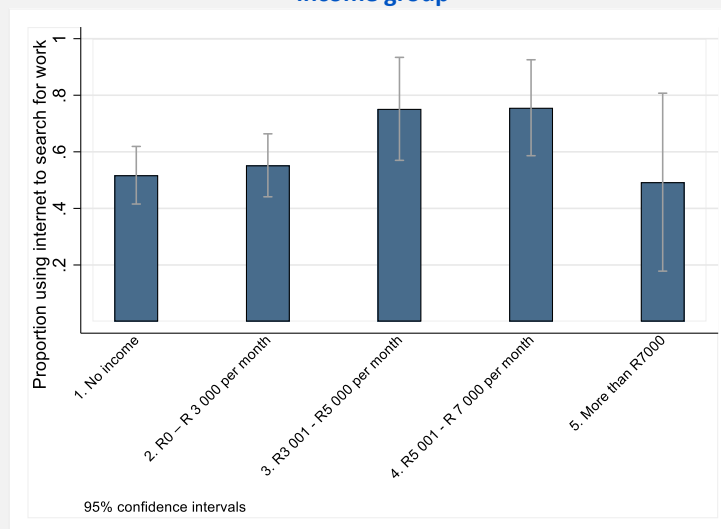
Figure 6: 'In the past seven days, how much did you spend on data and travel costs associated with looking for work?'



Source: African Response (2022)

Higher-income households are more likely to use the internet to search for work than lower-income households. This finding suggests that internet access costs might be a constraining factor in job search behaviour. Access to a lower-cost network could help to equalise opportunities to use the internet to find a job (Figure 7).

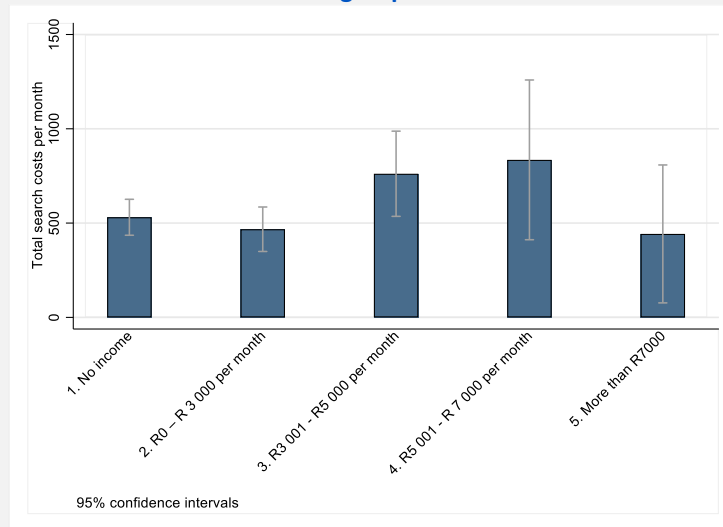
Figure 7: Proportion of Kayamandi using the internet to search for work, disaggregated by household income group



Source: African Response (2022)

Higher-income households spend more on searching for work. Total job search costs (the sum of data and transport costs) are positively correlated with household income – the survey finds that people that are part of households with an income of between R5 001 and R7 000 per month spend more on finding a job than if household income is below R3 000 per month (Figure 8). Depending on a household’s income, people in Kayamandi spent between R110 and R210 per week (or R440 to R840 per month) searching for a job.

Figure 8: Total search costs (travel and data costs) per month, disaggregated by household income group



Source: African Response (2022)

One of the questions that the baseline survey asked of respondents in Kayamandi was how the Paygozo data offering would 'help you in your life'. The impact that was cited the most was the opportunity to save money by spending less on data costs. The second most cited impact was being able to apply for jobs online. While the initial effect of lower job search costs might seem small, it could help alleviate one of the constraints to finding employment.

Potential impact: Higher employment

Studies relating internet access to employment in *LMICs* have only recently emerged as broadband penetration increased. **Several studies find a positive correlation between broadband penetration and job creation in Latin America:**

- One study finds that for Latin America and the Caribbean, a 10% increase in broadband penetration would result in around 67 000 new jobs being created (Zaballos and López-Rivas, 2012).
- Another study (though slightly dated) estimates that in 2009 Latin America had a broadband penetration gap of 11 000 lines. The author calculates that bridging this gap could create 378 000 job opportunities (Katz, 2009).
- When broadband penetration in Ecuador increased from 4.19% to 5.21% in 2012, it reportedly resulted in the creation of 85 000 new jobs. Of these jobs, 93% were filled by individuals who were previously economically inactive or in lower-skilled occupations. The remaining positions were filled by previously unemployed individuals (Katz and Callorda, 2013).
- A study in Peru (2007-2009) found that internet use was associated with faster income growth (particularly for rural households) but that it had no significant impact on an individual's chances of finding employment (De Los Ríos, 2010).

Some studies in Africa find broadband penetration leads to greater labour force participation and employment:

- Bahia et al. (2020) investigate the correlation between mobile broadband and employment outcomes in Nigeria. They find evidence of greater labour force participation and employment,

mostly among women, and increasing consumption. The improved labour force participation outcomes are also more prevalent for individuals from households that initially had low consumption levels.

- Bahia et al. (2021) found similar results in Tanzania, where internet access increased non-farm wage employment. Moreover, a study set in Senegal shows that improvements in welfare were partly attributed to increased formal employment that resulted from 3G mobile network coverage (Masaki et al., 2020).
- In a survey of 1 300 small and medium businesses across Senegal, Nigeria, Ghana, and Kenya, most owners indicated that internet use has led to expanding their businesses and that these expansions would lead to hiring more employees (Dahlberg, 2013).

An early South African study by Klonner and Nolen (2010) confirms some of these findings, looking at early *mobile network coverage*. Using data from 1996 to 2001, they test the impact of mobile network coverage on labour market outcomes. They find that when an area receives full network coverage, employment increases by 15 percentage points, particularly among women. This finding supports Efobi *et al.* (2018), who show that improved information technology increases the number of economically active women. Interestingly, Klonner and Nolen (2010) also found that self-employment did not vary much and that agricultural employment among males decreased significantly. The latter might be because of new opportunities that arose in other industries.

The literature suggests that increased internet penetration improves labour market outcomes in high-income countries (HIC) and LMIC economies, with the caveat that people in highly skilled occupations seem to gain the most.

Potential impact: Opportunities for entrepreneurship

There are several cost and access barriers to successful entrepreneurship in South Africa.

Entrepreneurship is essential to economic development and can impact GDP, employment, and innovation (Bowmaker-Falconer and Meyer, 2022). Despite the relatively well-established supply chains and markets within South Africa, structural barriers impede entrepreneurial progress. The economy remains characterised by a concentration of control and ownership in key industries and insufficient economic participation. Another concerning fact is that only 52% of respondents in the Total Early-stage Entrepreneurial Activity (TEA) index indicated that they aim to use digital tools and technology to market their goods and services within the next six months. This is likely the result of cost and access barriers (Bowmaker-Falconer and Meyer, 2022).

Information technologies reduce some of these barriers. Information technologies can contribute to expanding entrepreneurial activities (Del Giudice and Straub, 2011). By reducing barriers to entry into specific markets, entrepreneurial activity is spurred (Houngbonon *et al.*, 2022). This leads to more competition among firms, which has the additional effect of encouraging innovation.

Internet access reduces information barriers and communication frictions. ICT development and access to the internet give firms and entrepreneurs access to large amounts of market information. It also enables better communication across organisational borders (Zhang and Li, 2018). This helps to lower search and transaction costs (Houngbonon *et al.*, 2022) by reducing communication frictions and expediting the search for information.

Internet access provide an opportunity for low-cost marketing of entrepreneurial endeavours. With the dominance of social media, it is also becoming easier to start a business. Small businesses can utilise the free marketing tools provided by various social media platforms to reach large, targeted, often international, audiences. In addition, these sites often serve as a platform for business exchanges. The

tools of social media and other online platforms assist entrepreneurs in identifying opportunities and finding cost-effective ways to set up new ventures.

There is (limited) empirical evidence linking internet access and entrepreneurial activities.

Houngbonon *et al.* (2022) provide further evidence of the relationship between internet access and entrepreneurial activity. They find that the probability of an African household running a non-farming business increases by 17% if it has access to high-speed internet. This relationship is seen mainly in the service industry, where startup costs are comparatively low, rather than in the agricultural- or manufacturing sectors. In a study of 15 Middle East and North African (MENA) countries, Ghosh (2017) found that one of the channels through which broadband coverage enhances economic growth is increased entrepreneurship and research and development.

These studies suggest that deeper fibre penetration in South Africa could support more entrepreneurial activity. This may be especially effective in township areas with high unemployment and large informal economies.

Potential impact: Higher productivity

Productivity is a crucial driver of economic growth and better living standards (OECD, 2023). South Africa fares poorly compared to developed regions (OECD, 2023).

Internet access has the potential to improve productivity but with some caveats.

- A study in the US found that broadband improves productivity outcomes, but only in areas with high levels of human capital and high-skilled professions (Mack and Faggian, 2013).
- Fornefeld *et al.* (2008) find that broadband access in the EU positively impacts firm and macro-level productivity with an increase of around 5% for manufacturing firms and 10% for service industry firms.
- In Latin American and Caribbean countries, a 10% increase in broadband coverage led to a 2.61% increase in productivity, on average (Zaballos and López-Rivas, 2012).

Sub-Saharan African firms that use the internet in their day-to-day operations see improvement in their business organisation, internal information, and supply chain management, increasing their productivity (Guerriero, 2015). In Ethiopia, the arrival of fast internet increased firms' productivity within the manufacturing sector by 13%. This increase in productivity, in turn, led to higher levels of employment (Hjort and Poulsen, 2019).

Evidence also shows that internet access in Africa positively impacts product- and process innovation through digitalising marketing, sales, and distribution (Houngbonon *et al.*, 2022). Besides the impact on organisational productivity and efficiency, internet access can also increase the productivity of workers (Hjort and Tian, 2021).

- Allowing the use of time-saving technology can directly lead to higher worker productivity. Seymour and Naidoo (2013) show that South Africans who can work from home due to access to broadband internet can save time.
- Productivity is also enhanced through human capital development as the internet allows for on-the-job or additional training opportunities outside of the workplace.
- Productivity can also increase due to better firm-to-worker matching.

LOWER POVERTY AND FASTER GROWTH

South Africa has high levels of poverty and inequality. Roughly 55% of the adult population lives under the South African upper-bound poverty line (R992 per month), and 18.9% live under the international poverty line (R12 per day) (World Bank, 2020). Furthermore, female-headed households experience more severe poverty than male-headed households (Stats SA, 2019).

The internet can affect poverty alleviation via different channels, such as through better labour market outcomes (explained above) or higher income.

Potential impact: Income growth

ICT access can lead to a reduction in household poverty status. Surveys conducted across Kenya, Rwanda, Uganda, and Tanzania (2007 to 2010) found that gaining access to ICT led to a reduction of 2.5% in household poverty (Galperin and Fernanda Viécens, 2017). In Nigeria and Tanzania, broadband coverage lowered the percentage of households under the basic poverty line. In Tanzania, 3G coverage is associated with a 5%-point reduction in the proportion of households under the extreme poverty line. In Nigeria, one year of coverage is associated with a 4.3% reduction in the number of households under the poverty line. These improvements were mainly derived from increased employment made possible through deeper broadband penetration (Bahia et al., 2021, 2020). This finding is supported by the World Development Reports (World Bank, 2019, 2016), which find that shifts from informal- and self-employment to formal employment is a possible pathway for poverty alleviation in Africa.

Internet access has been shown to lead to higher household income, improving poverty outcomes.

Katz and Callorda (2013) found that the rollout of broadband in Ecuador led to a 3.67% annual increase in average income. Likewise, Yang et al. (2021) show that, in China, mobile internet use decreases the probability of a household experiencing poverty due to low income.

Potential impact: More consumption

Through reducing poverty, access to the internet has been found to increase consumption causally.

Household consumption is an essential component of GDP: when it rises, GDP grows because it creates a demand to produce more goods and services. High poverty levels, and hence low household disposable income, suppress consumption.

Access to the internet introduces households to a broader range of consumer markets and creates an opportunity to purchase goods and services online. In this way, internet access and broadband coverage could lead to higher household consumption levels.

Better labour market outcomes lead to more employment, which enables higher consumption, which feeds through to alleviating poverty (Bahia *et al.*, 2021; Masaki *et al.*, 2020).

- Masaki *et al.*, (2020) show that households in Senegal with access to fixed and mobile broadband (3G) consume 14% more than households without 3G coverage. Non-food consumption by households with 3G coverage is approximately 26% higher than those without 3G access.
- Bahia *et al.* (2021) find that 3G coverage in Tanzanian households is associated with a 7% increase in total consumption. The effect of internet access is particularly evident in poorer households. Similarly, in Nigeria, broadband coverage increases total household consumption by 5.8% if the household has had access to broadband for at least a year. This increase is also

seen to grow at a decreasing rate the longer a household has access to broadband (Bahia *et al.*, 2020).

- In China, the construction of broadband networks increased consumption by rural households by 17%. This increase resulted from mobile phone use rather than computers (which limited consumption due to their high cost) (Wan *et al.*, 2021).

These impacts suggest that access to the internet can decrease poverty through better labour market outcomes and increased consumption.

Potential impact: Economic growth

The surest way to reduce poverty is by growing the economy. There appears to be a causal relationship between broadband access and growth, although the effect varies between economies.

- Qiang *et al.* (2009) find that broadband access substantially impacts economic growth in HIC and LMIC economies. Contrary to what one might expect, the authors find that the observed effect is smaller for LMIC economies.
- Another study that looks at the impact of internet access in Chinese regions also finds that it positively affects economic growth but that the spill-over effects are more significant in developed areas (Li *et al.*, 2020).
- Niebel (2018) conducts a cross-section analysis of 59 LMICs and HICs and finds a positive correlation between ICT and GDP growth. Like Qiang *et al.* (2009), he finds that advancing ICT does not deliver more significant benefits to LMIC than in HIC economies.
- Thompson and Garbacz (2011), however, do find that broadband's impact is much more substantial for low-income than high-income countries.
- Evans (2019) studies 45 countries in Sub-Saharan Africa and finds evidence that internet use has a significant bi-directional effect on economic well-being: higher internet use leads to improved economic outcomes, but improved economic outcomes also increase internet use.
- Katz and Koutroumpis (2012) found that GDP in Senegal increased by 3.19% when broadband penetration increased by 10%.
- A study of MENA countries found that ICT had a positive GDP growth effect (Sassi and Goaid, 2013).
- Edquist *et al.* (2018) studied the effect of broadband penetration in 90 countries and found that a 10% increase in broadband leads to a 0.8% increase in GDP. Ishida (2015), however, found that increased ICT investment in Japan did not result in higher GDP.
- Koutroumpis (2019) evaluates the impact of broadband adoption on OECD countries. Not only does he find that broadband affects the economy, but also that **the quality of the network plays a role**. As network speed improves, the returns to GDP are positive but diminishing. The upper limit increases as individuals and firms become more equipped to make productive use of the internet. He found that between 2002-2016, broadband technology allowed GDP in OECD countries, on average, to grow by 0.38% each year. Countries that achieved speeds of 9.8Mbps (which is slow in the context of a fibre network) would gain 0.08% more than an identical country with network speeds below 1Mbps. Internet speed, therefore, does matter.

On balance, studies that consider the impact of broadband penetration on poverty reduction and economic growth find a positive relationship. We posit that the same dynamics could transpire if township communities gain access to high-speed, affordable fibre networks.

ACCESS TO HEALTHCARE

South Africa faces a quadruple burden of disease. It has some of the highest rates of HIV/AIDS and tuberculosis globally and rising rates of non-communicable diseases (NCDs) such as cancers, cardiovascular diseases, and mental illness. The country has poor maternal, infant, and child health outcomes and a high incidence of injury and trauma due to substance abuse, crime, and violence (Achoki *et al.*, 2022). In addition, there are stark inequalities in health outcomes perpetuated by deeply entrenched wealth and income inequalities within the country. Approximately 71% of the South African population uses underfunded and over-utilised public healthcare, leading to a shortage of public healthcare and inefficiencies within the system (Rensburg, 2021).

Research is emerging on the potential use of internet access and digital technologies to improve health in South Africa. The impact could occur through various mechanisms.

Potential impact: More information and awareness

Access to the internet can improve access to health information and improve health awareness. Individuals can use the internet to check whether symptoms require medical attention and to understand potential treatment options. Information on healthy lifestyle choices may also result in health behaviour changes.

During the COVID-19 pandemic, accessing social media via the internet was a valuable way of distributing health information on non-pharmaceutical interventions. In South Africa, a study found that in early 2020, social media users were significantly more likely to know the top three symptoms of COVID-19 (12% versus 5%) and adopt the most effective behaviour changes (physical and social distancing and mask-wearing) (42% versus 31%) compared to non-social media users (Burger *et al.*, 2020).

A cross-sectional analysis in the US similarly found that people who received information from online sources were significantly more likely to adopt these non-pharmaceutical behavioural responses to prevent the spread of COVID-19 (Li *et al.*, 2020).¹¹ However, the benefits of access to information about health need to be weighed against the potential pitfalls of misinformation which might impact health outcomes negatively. An online survey in the UK found that social media users were likelier to believe COVID-19 conspiracy theories than individuals who received information from broadcast media (Allington *et al.*, 2020).

Potential impact: Health and Healthcare apps

Access to a reliable internet connection can also help users to access health applications (apps) which work to improve specific health outcomes. Mobile applications have been used to address a range of health outcomes, including salt intake (Ali *et al.*, 2019), emergency response to gender-based violence (Eisenhut *et al.*, 2020), tuberculosis (Keutzer *et al.*, 2020), nutrition, and contact tracing during pandemics (Anglemyer *et al.*, 2020), to name a few. The World Health Organisation also recently released their digital health worker called *Florence*, an artificial intelligence online tool that can assist people with improving their health behaviour, such as quitting tobacco. Unlike other chatbots, the

¹¹ These are cross-sectional and not causal studies. Therefore, other factors, such as selection bias, may impact these findings.

WHO tool uses real-time emotional responses and facial expressions¹². Systematic evidence on the effectiveness of these applications provides mixed results and depends to a large extent on the application design and implementation. In addition, these applications are primarily developed in high-income settings and address the health issues these countries face (Morse *et al.*, 2020).

Potential impact: Telecare and telemedicine

The internet introduces the possibility of telecare or telemedicine and remote consultations with healthcare workers and practitioners. This will be particularly helpful in reaching individuals in rural areas, where healthcare options are often limited. These interventions will also minimise the transportation and time costs that patients might face. Telecare can be particularly effective in detecting and monitoring health conditions. One NGO in Durban introduced web-based tools to screen potential patients for hearing loss. Patients are directed to their online hearing screening test via social media and Google AdWords. They would seek follow-up care using WhatsApp instant messaging, a tool they preferred to other means of communication. The NGO is particularly effective in reaching older individuals, and when asked, the patients reported that they liked the hybrid model of care (Ratanjee-Vanmali *et al.*, 2020).

There are also potential avenues for using online tools to address HIV care in South Africa. The UNAIDS current strategy for addressing HIV at a country level is to reach a target of 95-95-95 (95% of HIV-positive people should know their status, 95% of HIV-positive diagnosed people should receive treatment, 95% of those receiving treatment should have viral suppression by 2025)¹³. One of the barriers to reaching the HIV testing target is that it is mainly done at a public healthcare facility with a counsellor. Given the stigma still associated with HIV, testing at a public facility can deter potential testers. Although HIV self-testing kits are available to purchase, one of the major concerns is a lack of counselling support for testers to process their test outcomes and assist with their follow-up care options. A recent study explored using the *Nolwazi_bot* isiZulu-speaking chatbot to support users of home-based HIV self-testing kits during the process in rural KwaZulu-Natal, South Africa. The tool was tested among a convenience sample of 120 participants, of which 79.2% reported that they preferred discussing their results with the bot compared to a human healthcare provider. In addition, 77.5% of participants felt they were discussing their results with a human counsellor, indicating the advanced development of these digital tools (Ntinga *et al.*, 2022).

Potential impact Health monitoring

Reliable internet access can improve health outcomes via health monitoring, usually wearable technology, and mobile health apps. For instance, a South African health insurance company has used tracking activity levels and gamifying 12 achievements to motivate a more active lifestyle (Devar and Hattingh, 2020). A systematic review of randomised controlled trials using gamification to improve physical activity found a significant and sustainable effect, especially compared to other interventions targeting physical activity (Mazeas *et al.*, 2022). However, using internet access to improve health outcomes with wearables requires a costly initial investment in these devices, which may not be feasible in a low- and middle-income country (LMIC) context.

¹² <https://www.who.int/europe/news/item/14-02-2021-meet-florence-who-s-digital-health-worker-who-can-help-you-quit-tobacco>

¹³ https://www.unaids.org/sites/default/files/2025-AIDS-Targets_en.pdf

Potential impact: Impact on mental wellness

Access to the internet has the potential to alleviate some of the social isolation and ensuing depression, especially among an older population. Given the burden of poor mental health in South Africa, the potential impact of internet access on mental wellness is worth noting. A 2015 analysis of 67,173 individuals aged 50 years and older from 17 European countries found much lower rates (12.9%) of self-reported social isolation among internet-connected individuals compared to the non-connected (31.4%) (Silva et al., 2022). Digital interventions also have the potential to manage mental health symptoms, monitor and dissuade harmful substance use and promote healthy lifestyle choices, support care coordination, and assist with clinical training, which can help with poor mental health outcomes (Naslund and Aschbrenner, 2019).

But the opposite effect should also be considered, namely whether access to the internet, particularly social media, affects mental health negatively. Quasi-experimental evidence from the roll-out of Facebook across 775 US colleges in the early 2000s found that it hurt mental health (Braghieri et al., 2022).

Potential impact: Healthcare delivery

Finally, healthcare delivery can be improved through better internet connectedness. During the COVID-19 pandemic, contact tracing digital systems were used by healthcare workers to monitor and notify citizens if they had contact with infected persons and limit the potential secondary infection of the virus. A systematic review found that healthcare workers in low- and middle-income countries reported that these digital systems were much easier to use than paper-based systems and improved accuracy with extensive data sets (Anglemyer *et al.*, 2020). In South Africa, one of the barriers to providing quality healthcare is the need for an electronic health record system in the public sector, which would allow healthcare providers to register and track patients across healthcare facilities and time (Katurura and Cilliers, 2018). Access to reliable and affordable internet can assist with creating an integrated health record system. Finally, internet access and distance learning can help train healthcare workers and build capacity to address shortages in health human resources in Lower Middle-Income Countries (Nartker *et al.*, 2010).

Conclusion

Better education and labour market outcomes, lower poverty and more consumption, and improved health are all factors that can contribute to faster economic growth. If access to affordable fibre in township neighbourhoods can improve these outcomes, it is highly likely to impact South Africa's GDP positively.

The literature on balance suggests that fibre access – if ubiquitous, unfettered and cheap – may lower unemployment and poverty, increase consumption, and improve health and education outcomes. Establishing affordable fibre networks can help uncover economic potential, especially in areas where capped, expensive mobile broadband is the only alternative.

The baseline study of current internet use in Kayamandi – before an affordable fibre network is rolled out – reveals two findings: (1) the current cost of internet access through mobile networks is a constraint on internet use, and (2) job search costs may lessen if the cost of internet access becomes lower. **Funding-permitted, the goal is to do two follow-up surveys to determine if there were changes in these outcomes following the introduction of the network.**

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