

Ahmed, Shamira

Conference Paper

A Gender perspective on the use of Artificial Intelligence in the African FinTech Ecosystem: Case studies from South Africa, Kenya, Nigeria, and Ghana

23rd Biennial Conference of the International Telecommunications Society (ITS): "Digital societies and industrial transformations: Policies, markets, and technologies in a post-Covid world", Online Conference / Gothenburg, Sweden, 21st-23rd June, 2021

Provided in Cooperation with:

International Telecommunications Society (ITS)

Suggested Citation: Ahmed, Shamira (2021) : A Gender perspective on the use of Artificial Intelligence in the African FinTech Ecosystem: Case studies from South Africa, Kenya, Nigeria, and Ghana, 23rd Biennial Conference of the International Telecommunications Society (ITS): "Digital societies and industrial transformations: Policies, markets, and technologies in a post-Covid world", Online Conference / Gothenburg, Sweden, 21st-23rd June, 2021, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/238002>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

A Gender perspective on the use of Artificial Intelligence in the African FinTech Ecosystem: Case studies from South Africa, Kenya, Nigeria, and Ghana

Shamira Ahmed¹

Abstract

The use of artificial intelligence (AI) based systems complements the time-sensitive and data intensive nature of many activities in the financial services industry (FSI)—Specifically, in FinTech Ecosystems (FEs) that have disrupted many financial services landscapes in sub-Saharan Africa (SSA). However, FEs have distinct interrelated supply-side and demand-side dynamics that perpetuate gender disparity. As evidenced in many wealthier economies with more AI maturity, technology is not neutral, AI in particular is inherently biased and magnifies pervasive gender and racial discrimination that exist in the ecosystems where it is deployed. This raises questions regarding the manner in which AI can exacerbate or alleviate current dynamics in inequitable and unfair ecosystems. With the aforementioned in mind, this paper adopts a gender lens to examine the potential impact of using AI based systems in the FEs of four SSA countries—South Africa, Kenya, Nigeria, and Ghana.

1. Introduction

The ability of countries to create value from the data driven digital economy are not automatic and depend on other crucial prerequisites (World Bank, 2021; UNCTAD 2019; IMF 2019). Generally, countries with the following fundamentals are better equipped to leverage innovation and efficient productivity opportunities associated with the emergence of industries linked to new business models and data-driven artificial intelligence (AI) based solutions. (OECD, 2019; UNCTAD, 2019; Smith & Neupane, 2018)

- (i) collaborative dynamic policy and regulatory frameworks to shape the deployment of new technologies that create an enabling environment for innovation, market development, and ethical user well-being,
- (ii) efficient broadband network coverage, reliable energy supply, foundational digital infrastructure (FDI) (digital identity (DigiID), interoperable trustworthy payments, and open data sharing), and digital data infrastructure, and
- (iii) people equipped with the appropriate digital capability and skills,

The aforementioned prerequisites are critical in key areas such as financial markets which have become a significant source of national revenue growth and where for decades innovations in information technology (IT) as well as the Internet have played a key role across the majority of components in the financial services industry (FSI) value chain. The digitalisation of financial services which has been one of the key enablers of growing the digital economy and wider financial inclusion² in many regions, particularly in Sub-Saharan Africa (SSA) (Sy et al., 2019) is also a prerequisite for data driven AI deployment in the FSI (Biallas & O'Neill, 2020).

The application of AI based systems, in banking and the FSI has potential to: facilitate more secure faster transactions, encourage innovative credit scoring, greater product segmentation and development, and ease customer on-boarding and verification processes through DigiID solutions (Biallas & O'Neill, 2020). The use of AI can also strengthen compliance with global standards for financial stability, and increase the efficiency of domestic supervision (Broeders and Prenio, 2018). Furthermore, due to the nexus between financial services and technology, as well as the time-sensitive and data intensive nature of many activities in the FSI, AI is often considered a natural complement (WEF, 2018). Specifically, in FinTech Ecosystems (FEs) where FinTechs have

¹ Senior Researcher, Economist. Research ICT Africa.

² Financial inclusion refers to access to useful and affordable financial products and services, such as savings, credit and insurance, that meet the needs of the underserved and unbanked and is delivered in a responsible and sustainable way.

disrupted many financial services landscapes, in some cases ultimately fast-tracked indicator progress in achieving the United Nations's sustainable development goals (SDGs) (Suri and Jack, 2016).

Collaborative FEs are critical to nurturing the kind of technological innovation necessary to make financial markets and systems more efficient and improve the overall customer experience (Isenberg, 2018; Li & Shin, 2018). However, evidence suggests that FEs have distinct gender parity gaps—beyond the fact that the nature of most FinTech start-ups (FTSs) suggests that they operate at the intersection of three male-dominated fields: finance, technology, and entrepreneurship (WEF, 2021; Kelly & Mirpourian, 2021), the FSI also has interrelated supply-side and demand-side dynamics that perpetuate gender disparity in a FE.

As evidenced in many wealthier economies with more AI maturity, technology is not neutral (Han, 2020) AI in particular is inherently biased and can potentially magnify pervasive gender and racial discrimination that exists in the ecosystems where it is deployed (Niethammer, 2020; Valencia et al., 2020; West et al., 2019; Buolamwini & Gebru, 2018). Given that gender policies, ethics, and mainstreaming strategies differ in their contexts in different cultural, regional, and identity contexts—in so called “underdeveloped” markets there are greater possibilities for AI to exacerbate existing techno-social, cultural, and economic inequalities, particularly if policy makers fail to consider the significance of key human rights, intersectional inequalities and social justice dimensions of the domestic and regional market context that should be imbedded in the purposeful deployment of general use AI based systems (Gwagwa et al., 2020; Arun, 2019; Smith and Neupane, 2018).

The potential biases associated with AI coupled with FSI challenges such as has widely known misconduct and ethical issues³ (Schoen, 2017), existing FE gender disparity (Sparks and Eckenrode, 2020) and persistent systemic barriers that impact women's financial inclusion (Barajas et al., 2020) raise questions regarding the manner in which AI can exacerbate or alleviate current dynamics in inequitable and unfair ecosystems.

This research is vital as very little is known about the potential social-technical impact of new technologies such as AI in the global South, particularly in Africa (Sibal and Prateek, 2021; Sey and Ahmed, 2020; Arun 2019). There are also at least two additional related gaps in finance and development literature to which this study addresses: Firstly, although there is a growing body of work on AI and financial services in Africa (Ndero et al., 2021; Mhlanga, 2020; Mittal, 2020), there is limited literature specifically on FEs in African markets—the majority of ecosystem research is based primarily on well-established FEs in relatively more developed markets where the functional and foundational infrastructure (including institutions) are substantially more developed; these ecosystems are characterized by global ground-breaking research and innovation hubs, enabling regulatory and policy environments, massive domestic venture capital (VC) investments, knowledge intensive human capital, and relatively streamlined collaboration between the all the elements that make an FE (Qureshi, 2020).

With the aforementioned in mind, this paper adopts a gender lens to examine the potential impact of using AI based systems in the African FE in four sub-Saharan African (SSA) countries—South Africa, Kenya, Nigeria, and Ghana. The paper is broadly structured as follows; the first section provides a background on the FE. Next, will be a regional overview and summary of research findings from the country case studies. This paper ends with conclusions of the key findings.

2. Methodology

This study adopts a mix of research methods with three main overlapping research components:

- (i.) Desk research based on secondary sources of data from multiple sources and integrating the latest appropriate statistics from credible sources to triangulate data in an attempt to strengthen the validity of the case studies.

³ <https://sevenpillarsinstitute.org/case-studies/>

- (ii.) Next, an explorative multiple case study approach was also adopted in this study that utilizes quantitative data and analytical techniques, where appropriate to understand a case and not to generalize or predict (Teiu & Juravle, 2011; Yin, 2009);
- (iii.) Third, the study employed semi-structured, open-ended interviews with key informants (C-suite executives, senior technology experts, product developers, regulators, and AI related practitioners) who make up elements of the FE in the case countries. Insights from these interviews are included throughout the paper, along with anonymous quotes from interviewees.

The case countries, South Africa, Kenya, Nigeria and Ghana were chosen as there is evidence that AI based systems are currently used to enhance operational efficiency and develop products and services to benefit the financial services user base in their FEs. Given the evidence that existing bias and discrimination impacts AI based systems, the following research questions guide our study:

- (i.) What potential opportunities or current exclusions are created and/or exacerbated by the use of AI in FEs?
- (ii.) How does the introduction of AI in the FE impact gender equality at each FE element in the case countries?

2.1. Limitations

The following are key limitations in the study:

- (i.) Gender identity in this study was based on a binary definition of gender which influenced how data was collected.
- (ii.) For ease of reference, the FE in this paper encompassed only five key elements: FinTech start-ups (FTS), technology developers (Talent), the government (legislature and regulation), traditional financial institutions (incumbents), and financial customers (individuals, households, and businesses) (Muthukannan et al., 2020; Lee and Shin, 2018; Lee and Shin, 2008). Restricting the FE to only five elements may not adequately capture the complexity and dynamism of inter-industry symbiosis of FEs or the influence other key FE elements such as mobile network operators (MNOs), Big Tech, infrastructure providers, industry associations, academia, consultancy firms/legal advisors have to facilitate the rapid expansion of a collaborative domestic FE.
- (iii.) There is limited availability of AI experts to interview in African FEs, thus their knowledge of how AI based systems interact in developing economies and its associated opportunities and challenges may have been limited. Consequently, the descriptive findings cannot be generalised since personal values and viewpoints profoundly influence the data collected. The well-known entrenched gender barriers in different elements of the FEs (Sparks and Eckenrode, 2020) also resulted in limited representation of women in the data collection, thus the opinions are male dominated, but on the other hand arguably reflect the context of many African FEs.
- (iv.) In contrast to the publicized anecdotal evidence of AI use in African FEs, there is generally limited current use of sophisticated automated decision making (ADM) in these ecosystems, the few firms that do make use of AI, many deploy AI to enhance operational efficiency and improve risk management. Regarding AI use cases to develop innovative customer products and services, the firms adopt more hybrid techniques more suited to address the deficits mentioned later in this paper that limit AI deployment in local African contexts. Thus, amongst other factors, the nascent use of AI in African FEs ultimately contributed to data collection challenges in the study.

3. Ethical Considerations

By virtue of the research problem, transparency and accountability, privacy, dignity, and integrity are ingrained in the research as per RIA's code of ethics⁴. All interview and survey participants were provided with a research guide and/or consent forms outlining the purpose of the study, the intended use of any information they provided, and agency was awarded to them to approve their participation in the research.

4. Country Case Studies

4.1. Background and Regional Context

A wide range of literature suggests that the convergence between financial services, data and frontier technologies, such as AI can boost efforts to achieve sustainable and meaningful financial inclusion in countries where a large part of the population remains underserved or unbanked (Salman, 2020; Sey, 2020; BIS, 2020).

For Africa, technology based innovative financial solutions can potentially facilitate so called "leapfrogging" in the digital economy. As the region with the most unbanked and underserved citizens combined with a growing mobile penetration rate that facilitates digital financial inclusion (DFS)—the further development of FEs where data driven FTS are already one of the main drivers for financial inclusion could prove fertile ground for beneficial AI uses which can empower women and enhance socio-economic development. However, there are significant structural challenges that will prove problematic for beneficial AI deployment (Bihane, 2020; Arun, 2019; Hagerty & Rubinov, 2019; Penner, 2019; Hamann, 2018; Smith & Neupane, 2018).

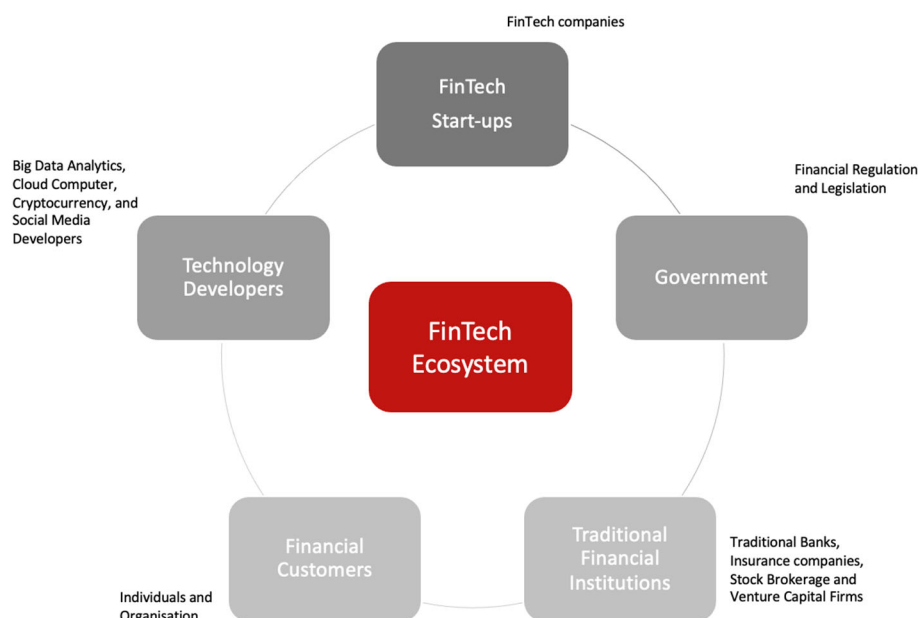
In increasingly connected commercial industries, adopting an ecosystem perspective assumes that markets consist of a heterogeneous, but interconnected, set of elements/actors that are continuously adapting and evolving to survive, with participants spanning across multiple systems, which are embedded within other systems, that are nested within a variety of other complex systems (Muthukannan, 2020; Roundy et al., 2018; Martin & Sunly, 2015). For instance, FTSs are complex systems, which are imbedded in the FE, which in turn is nested in the regional and global financial market ecosystem. Moreover, adopting an ecosystem approach to the potential impacts of AI deployment facilitates a relational investigation to understand how elements in the ecosystem have unique characteristics and functions and simultaneously require dynamic interaction which impact the generation of innovation and the overall development and growth of the of the system (Miller & Page, 2007). This approach defies a narrow siloed approach in defining the digital economy (WB, 2019N). A collaborative FE that has a degree of integration is particularly significant for sponible AI deployment as it highlights the synergies required amongst stakeholders to co-create responsible AI deployment for ecosystem development and existence (Stahl, 2021).

Another caveat is that AI impacts depend on the use cases—general global use cases of AI based systems in FSI are based on predictive analytics, virtual assistants, and process and application automation across the entire financial services value chain (front-office, middle-office, and back office). Front-office applications include biometric authentication and improved financial decision making (lending and credit score applications, forecasts and hyper-personalisation) ; in the middle-office, AI is being used for security & fraud detection (anti-money laundering and countering financing of terrorism (AML/CTF) and KYC) to monitor real-time customer transactions . For back office operations AI based systems such as robotic process automation (RPA) systems are used to automate repetitive business processes such as credit underwriting (Kshetri, 2021; Ndero et al., 2021

Figure 1 visualizes the relationships between the five elements of a collaborative FE and the symbiosis between all the elements. Together the elements in the FE contribute to a number of positive outcomes such as ecosystem growth, innovation, and competition in the FinTech sector and broader FSI. However, there are persistent gender parity issues in all elements of the FE which creates an interconnected vicious cycle, where the FE is a male-centric landscape created by and for men.

Figure 1: FinTech Ecosystem (FE)

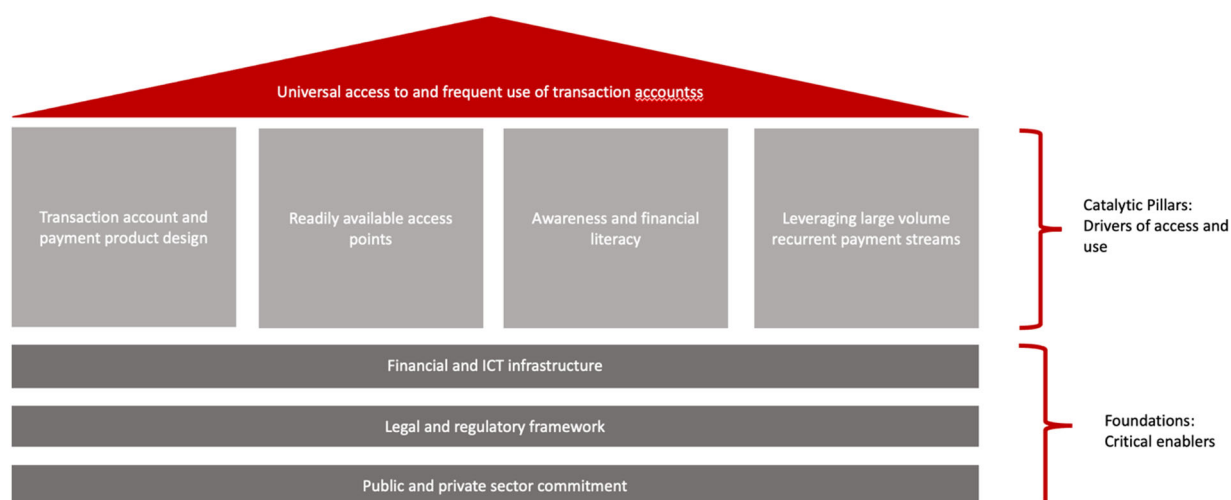
⁴ <https://researchictafrica.net/research-code-of-ethics/>



Source: Lee and Shin (2018)

Given the interaction between digital inequality and DFI, particularly effective use and access of formal financial access, it is also critical to assess both ICT supply-side and demand side dynamics that influence the level of Internet access, usage, and smartphone penetration (Sy et al., 2019 ; Gillwald et al., 2018). These are necessary proponents to facilitate (data driven) digital financial products and services that reduce DFI barriers and enhance the payments landscape (BIS, 2020a). As shown in Figure 2 below, other foundational critical enablers for effective access and use of transactional accounts include legal and regulatory framework and public-private collaboration to enhance DFI (World Bank, 2016).

Figure 2: Foundations and Catalytic Pillars for Effective Access and Use of Transactional Accounts



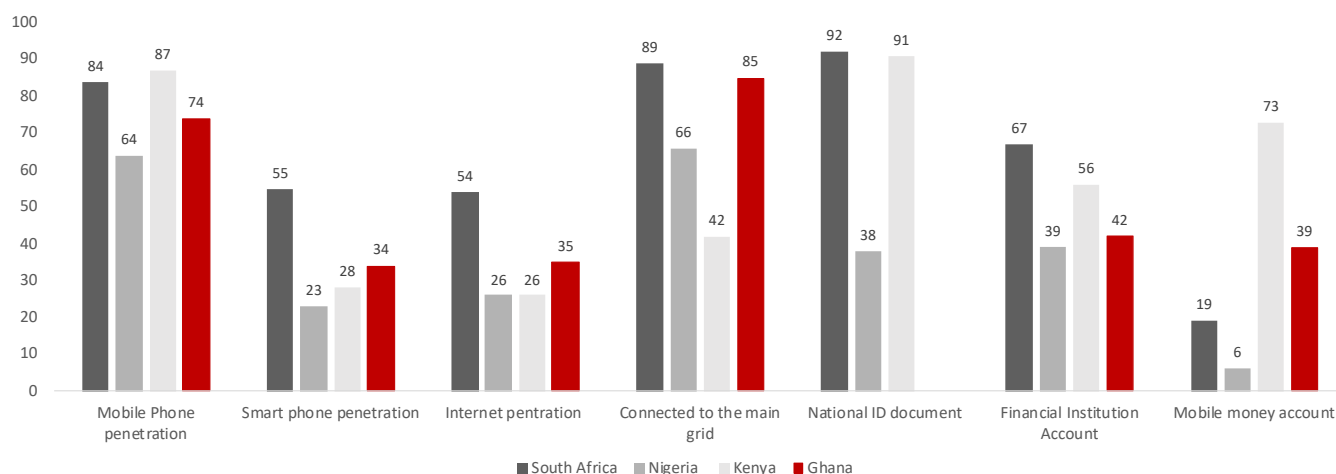
Source: World Bank, 2016

While there are country commonalities in SSA, Figure 3 highlights the heterogeneity in African economies. People with some form of national ID are more likely to own bank accounts and mobile phones, and financial and mobile services are among the most frequently reported uses of one's ID. Having an ID can also support state social protection and financial inclusion efforts. While there are well-developed national identification systems in Kenya and SA which form part of FDI there are gaps in Nigeria and Ghana⁵. There is also variation in smart phone

⁵ No available data for Ghana

penetration, electricity access and access to financial institution or mobile money account. Access to stable energy supply varies across the case countries, but rolling blackouts are a common phenomenon in all the case countries. The variations suggest that the success of FinTech solutions to enhance socio-economic welfare are often country specific and usually fill gaps in the financial services landscape that serve rather narrow niche markets (Walchek, 2015). For example in Kenya, M-Pesa was a success story and poster child for the region, meanwhile it failed to launch in South Africa and Nigeria.

Figure 3: Select contextual indicators



Source: RIA After Access, 2018; World Bank Findex, 2018





As this study uses a gender lens to understand the dynamics of the FE, the following gender based challenges have been identified at each stakeholder element of the FE in each case country:

3.1.1. Fintech startups

FinTech start-ups (FTSs) are usually small technology-based entrepreneurial firms that often operate on the boundaries of new technologies, entrepreneurship, and financial services, through unbundling different financial service segments (payment, wealth management, lending, crowdfunding, capital market, and insurance) and providing more personalized services than traditional incumbents. FTSs often use alternative data sources to enable so called credit invisibles (no-file or no-score customers such as immigrants, youth, the unbanked, the underbanked etc.) who cannot provide traditional data on financial credentials, which limits their access to meaningful financial services (Sy, 2019).

As of May 2021, Table 1 shows the approximate number of FTSs which have headquarters in the case countries that actively make use of AI (Crunch Base, 2020). In all the countries, the main use cases of AI in FTSs is commonly for B2B tech support purposes that increase operational efficiency such as conversational AI, and robotic process automation (RPA) systems which are used to automate repetitive business processes associated with B2B payment and risks and anti-money laundering and countering financing of terrorism (AML/CTF) and (know your customer (KYC) operations. While there is also use of AI for direct credit and lending purposes, it is still relatively nascent in comparison to other AI use cases.

Table 1: Women in FTSs that use AI

| | SOUTH AFRICA  | NIGERIA  | KENYA  | GHANA  |
|---|--|--|---|---|
| Number of FTSs | 200 —250 | 200 —250 | 50 —100 | 0—50 |
| Number of FTSs that use AI | 15—20 | 20—25 | 10—15 | 5—10 |
| Women in C-suite positions/Founders/Co-founders | 1 —5 | 1— 5 | 1 —10 | 1— 5 |
| Female Principal Analyst/Data Scientist/Senior (Lead) Engineer etc. | 0 | 1—5 | 1—5 | 0 |
| Source: CrunchBase, LinkedIn | | | | |

Based on FTSs that have information on their public use of AI, Kenya has the highest number of women who are co-founders, founders or C-Suite executives. Only Kenya and Nigeria have women in senior data science related roles. Most of these digital entrepreneurs and/or FTS founders are male across all the case countries. In SA, similar to other related reports in SA gender disparity also has significant racial dimensions, as the majority of FTSs consist on mostly of white males (World Bank, 2019b; RMB, 2019). Furthermore, other factors that perpetuate exclusions that relate to FTSs in all the case countries, are that there are high operational requirements and limited market opportunities outside of the major cities.

According to a Deloitte global study on the FinTech community, only 7% of FinTech founders or leaders are women (Sparks and Eckenrode, 2020). Diverse FTS cofounders are more likely to influence the work culture, encourage parity in hiring and management promotion opportunities, and better understand the needs of women who are still an underserved customer segment for financial services in general (Demirgüç.-Kunt et al, 2017). As there is evidence that the traditional fundraising process favors men, the low representation of women as FTS founders can also be attributed to inequitable funding (Kelly & Mirpourian, 2021).

"FinTechs need more than data science and computer skills to thrive, you need other skills to use AI in business"

If deployed responsibly AI can potentially eliminate the discrimination arising from cases that highlight discrepancies, it can counteract human heuristics based on biases and limited information such as when a lending officer denies a female entrepreneur credit. Besides explicit variables such as "male", "female", "man" , "woman", etc., there are numerous proxies for gender and other non-tangible barriers in the credit lending system that impact women. For instance, in some countries women still experience legal and cultural challenges when opening bank accounts in their maiden name or without their husband (Demirgüç.-Kunt et al., 2013), and female entrepreneurs face credit loan officer bias and discrimination (Salman et al, 2019).

3.1.2. Technology developers (Talent)

The availability of human capital correlates positively with high innovative technology production, trade and usage, which boost a country's overall productivity and competitiveness (Romer, 1990). In the FE, this human capital are usually technology developers (Li and Shin, 2008). Although AI is arguably a multidisciplinary field

(Stahl, 2021; Baum, 2020) and effective AI application in an organisation requires cross-functional teams with a mix of skills and perspective (McCarthy and Saleh, 2018; Ghosh et al., 2019) — the majority of talent needed to develop the skill and knowledge to use and create valuable insights from big data analytics, cloud computing, cryptocurrency, and social media analytics, amongst others, will require Science Technology Engineering and Mathematics (STEM) related capability, which according to the World Economic Forum (WEF) are poised to be one of the fastest-growing segments of the global workforce over the next decade (2020). But due to talent shortages has created a “Global AI Talent Race”.

Globally there are still barriers that inhibit women’s participation in the STEM pipeline and workplaces where AI based solutions are developed, these barriers include societal norms that perpetuate gendered career paths, a lack of exposure to STEM role models at a young age, and the culture in many AI related workforces (AAS, 2020; Best and Modi, 2019).

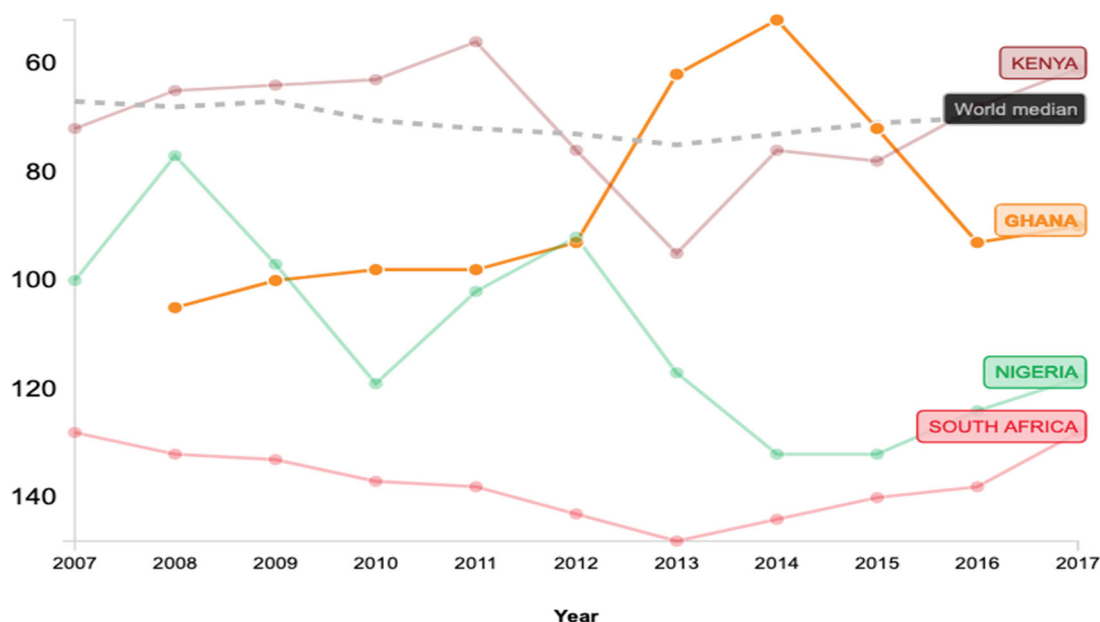
“Women definitely add value, they bring a certain perspective that an all male team can’t have....some of the best engineers I’ve worked with are women..”

There are prominent gender differences in all the case country labour markets, women are overrepresented in the socio-economic indicators with worse labour market outcomes (e.g., high unemployment rates, low STEM education, low labour-force participation, occupation type, etc) (WEF, 2020; UNDP, 2016). Given that ML requires competency in STEM subjects, an additional matter of concern in SSA is that it is the region with most countries that have poor quality basic education and the lowest levels of student achievement in mathematical competence and numeracy (Bethell, 2016).

“We essentially have an old education system that doesn’t work with what the world needs now..”

At a case country level, Figure 4 shows that except for Kenya, all the case countries have poor quality of math and science education ranks that is below the world median in 2017. These inadequacies hinder the potential for these countries to fully engage in a globally competitive market that is increasingly shaped through knowledge intensive capabilities using new technologies such as AI.

Figure xx: Quality of math and science education by case country (2007—2017)



Source: World Bank Data

Using AI based systems has potential to lessen gender bias in recruitment processes—AI may present opportunities for financial service providers (FSPs) to drive better gender balance. For example, AI that is trained on a company’s historical recruiting data in a test environment can highlight biased outcomes against a particular group, this can provide valuable information for diversity and inclusion efforts, and better match candidates and

employers based on skillset, years of experience, and number of accomplished projects which allows women and men to have access to job opportunities in an equal manner (Kelly & Mirpourian, 2021; UNESCO, 2020).

However, the limited representation of girls in the STEM pipeline, particularly in AI related subjects and the manner in which female candidates are treated in the workplace will ultimately retention and representation of AI talent (Kelly & Mirpourian, 2021; OW, 2020).

"We have a few women who study computer science or I.T related subjects, so we can't even employ them even though we would like to"

3.1.2. Financial customers

Individuals, companies, and merchants are essentially the drivers of consumer FTS acceleration. While FTS bridge the gaps that TFI's cannot fill, as the end user base, financial consumers play the predominant role in the widespread adoption of disruptive technologies and innovative solutions and services (Lee & Shin, 2018). Furthermore, for FSPs, a larger customer base facilitates in-house data accumulation that can be leveraged for risk management and to develop insights to facilitate dynamic pricing of products and services.

In SSA, there is still low account usage and low levels of financial capability within the heavily reliant cash market (Ahmed 2020). Leveraging increasing mobile phone and internet penetration enables FSPs to use AI to scale their service provision, overcome consumer financial literacy barriers, and provide hyper-personalised DFS such as financial planning and robo-advisory services which allow more consumers access to a broader range of products that meet their needs, thus enhancing financial inclusion. But the potential of these opportunities depends on addressing the pre-existing affordability challenges that hinder DFI. For example, the cost of a smartphone and data in many African countries is still expensive for most of the population (Gillwald et al., 2018).

Table 2 : Gender differences in select DFI indicators in case countries (%)

| | NIGERIA | | | SOUTH AFRICA | | | GHANA | | | KENYA | | |
|-----------------------|----------|------|--------|--------------|------|--------|----------|------|--------|----------|------|--------|
| | National | Male | Female | National | Male | Female | National | Male | Female | National | Male | Female |
| Mobile phone | 64 | 70 | 57 | 84 | 83 | 85 | 74 | 61 | 58 | 87 | 84 | 68 |
| Smart Phone | 23 | 26 | 19 | 55 | 60 | 43 | 34 | 34 | 23 | 28 | 38 | 28 |
| Internet | 26 | 37 | 20 | 54 | 57 | 50 | 34 | 31 | 29 | 26 | 32 | 22 |
| Bank account | 39 | 47 | 28 | 67 | 58 | 56 | 42 | 62 | 54 | 56 | 86 | 78 |
| Use Mobile money | 6 | 7 | 4 | 19 | 19 | 25 | 39 | 44 | 42 | 73 | 77 | 78 |
| Credit card ownership | 3 | 3 | 2 | 9 | 10 | 8 | 6 | 7 | 4 | 6 | 8 | 4 |

Source: RIA After Access, 2018; World Bank Findex, 2018

Table 2 reveals that women are generally overrepresented in the underserved population in terms of bank account use and access. They are also more likely to be without a smartphone and/or mobile internet access. When presented with innovative FinTech products and solutions (provided by both FTSs and TFIs), women are less likely to adopt these products as many are not tailored to adequately meet their needs (Chen et., al 2021; Vossenburb, 2018). This implies that there should be more concerted efforts from other FE stakeholders to design tailor-made financial products and services that better satisfy the needs of women. Furthermore, since women in the region are not a heterogenous group, there should also be consideration for interactional barriers that limit financial capability⁶ (Baraja et al., 2020; Vossenburb, 2018) and local context.

Deploying data driven AI solutions can enable FSPs to leverage their accumulated data to offer better products and services to customers that meet their needs based on insights from their data. But given that AI reinforces

⁶ <https://www.centerforfinancialinclusion.org/what-is-financial-capability>

existing inequities, the use of AI can potentially result in unfair customer profiling, data privacy violations, or spur predatory lending and indebtedness. For example, if there is a degree of sexism embedded within the training data, the algorithms will exhibit the same sexist behavior in their output which will result in indirect sex discrimination which can impact end user's ability to leverage DFS to enhance their financial lives (Kelly & Mirpourian, 2021). Moreover, in relation to safeguarding financial customers, beyond technical competence, the application of AI in the FE and those involved in the use or processing of data need a strong ethical grounding as they strive for collection of quality data, fair data use, and model outcomes (Stahl, 2021).

3.1.3. Traditional financial institutions

Traditional financial institutions (TFIs) (Traditional banks, Insurance firms, stock brokerage and VC firms) are a major driving force in the FE, often TFIs are the most entrenched in FEs, they typically hold the largest customer networks, and have competitive advantages over new entrants, such as economies of scale, brand trust, deep content and market expertise, consumer data, and financial resources (Li & Shin, 2018). While the banking sector in the case countries have wide variety of foreign and local TFI, they all have oligopolies where only a few major commercial retail banks dominate the FE.

Arguably due to the innovative core disruptions brought by FTS, the main incumbents in the respective case countries have ramped up their own innovation strategies and/or collaborated with innovative and disruptive FTSs to drive operational efficiencies, leverage their reputation and trust, and capture new markets with services that offer simpler, faster solutions particularly in the payments landscape (Mittal, 2020). Apart from deploying FinTech in their service delivery, some incumbents in all the case countries have also taken steps to support FinTech companies through the provision of funding and infrastructure to promote research, innovation and development in the industry. For example, in SA three leading retail banks have set up technology and innovation hubs that serve as incubators for FTSs and app developers.

However, the dynamism and transformation efforts from retail banks to enhance their customer value proposition and operations is not well reflected in the bank executive workforce in all the case countries. While there have been recent efforts to drive gender parity in C-Suite positions from the incumbent banks that use AI. The few banks that have C-Suite executives, have women mostly in corporate/ administrative roles such as human resources, marketing and corporate governance.

In relation to AI in TFI's the banking sector has the most public use cases, specifically in relation to AI's impact on the banking workforce. For example, even before the COVID-19 Pandemic, major banks in all the case countries announced closures of "brick and mortar" branches under claims of operational efficiency, increased competition in the FSI, and the emergence of technology driven customer expectations (Gitonga, 2020; Ohuocha, 2020; Tarrant, 2019). In Ghana, the longstanding banking crises, added further complexity to the bank closures (Afolabi, 2018).

Another relevant AI related concern is that unlike more traditional FICO scores or highly interpretable and transparent linear/logistic regression models, that are commonly used in econometrics and mathematics (Wrg, 2019), the non-linearity of some AI based "black box models" suggest that even the algorithm creators have difficulties explaining the model predictions and outcomes (Rizzi et al, 2021; Beud, 2020). To create some form of accountability and evidence in the event of discrimination, a fair lending system requires that lenders inform loan applicants why their application was denied (KPMG, 2021b). This transparency also empowers consumers with information on the correct steps required to improve their chances for a successful loan application. However, isolating the underlying actions behind AI decisions in multi-layered data from complex interconnected systems may be difficult. Validating the data quality (integrity and standards), governance of the data used, and the mechanisms through which the ML algorithm makes decisions through black box models often become opaque (Rizzi et al., 2021; KPMG, 2021a), this complexity increases as new data are fed into the database. Identifying discriminatory elements from these types of ML can be very technically challenging to reveal and explain.

Consequently, the lack of algorithmic transparency and explainability can mean that there is no accountability for: intended or accidental bias on individual credit applicants, algorithmic collusion/fraud, or other financial services misconduct (Rizzi et al., 2021; KPMG, 2021b; Johnson et al., 2019).

3.1.4. Government (financial regulators and legislature)

Financial regulators play a crucial multifaceted role in the growth, expansion and longevity of FEs, the general responsibility of government (financial regulators and legislature) in FEs is to implement and enforce policies, as well as create a regulatory environment that will: (i) ease the barriers that hinder innovation and development of the FE; (ii) encourage entrepreneurial activity and employment by financial services and technology firms; (iii) ensure overall competitiveness in the market; and, (iv) safeguard user well-being (GCC, 2019). Emerging new regulatory issues in FEs increasingly relate to data governance (which impacts AI use) and interoperability (open banking standards), where TFIs ease restrictions on their application programming interfaces (APIs) to enable select partners or (often foreign) third-party developers to build financial services and develop new apps on top of banks' data and infrastructure that enhance data interoperability, competition, and DFI in the FE (Kühlcke, 2018).

The governments in the case countries need to consider policy regimes, data quality standards, infrastructure (credit bureaus and APIs etc.), open banking frameworks that govern a country, the regional dynamics to support cross-border payments as part of their regional economic community (REC) commitments, as well as maintain compliance with global financial market regulations related to remittances, FinTechs, and AI governance in FSI (Barne and Pirelea, 2019; Taylor et al., 2019) — the synergies needed to address multiple priorities are crucial to develop a competitive interoperable data sharing ecosystem where AI can be deployed in a responsible manner.

"The government needs to have a coherent approach that allows different regulators to support innovation and growth with FinTechs without compromising on the delivery of their mandates."

Consequently, the government faces difficult policy dilemmas and questions relating to the trade-offs required and source, nature, and scope of regulatory oversight responsibilities that need to be addressed to encourage a thriving complex cross-sector FE that simultaneously ensures that commercial activity is circumscribed in the public interest.

None of the case countries have a national strategy on AI. However, in SA the Government has set up a Presidential Commission on the 4IR to develop a strategic plan for South Africa's 4IR vision and Nigeria has a National Agency for Research in Robotics and Artificial Intelligence (NARRAI). In all the case countries advances in the FE occur faster than the establishment of regulation. The main regulatory compliance issues in that may impact AI deployment in FEs involve:

- (i.) Consumer protection.
- (ii.) Data protection.
- (iii.) Cybersecurity.
- (iv.) and financial crime (AML/CTF)

Furthermore, in all the case countries there are currently no specific regulations governing FinTech businesses, most Fintech products and services are currently regulated under the existing and applicable financial services regulatory framework which may not be adequate as it is designed for more traditional financial products and services that are not based on adm. In an attempt to create an enabling regulatory and policy framework for FTSS there are several initiatives in the four case countries— The Central Banks of Ghana and South Africa have established dedicated FinTech units, and all the central banks have announced intention to support FinTech incubators or have initiated regulatory sandboxes.





Table 3 shows that collectively through various legislation, all the case countries are pursuing policy positions that will: shape FE innovation through open data systems; (digital) financial inclusion; data, AI, and digital skills

development; influence data governance in each country FE. For example, all the case countries have data protection laws and regulations that are also applicable to AI within existing infrastructures that relate to personal data in AI-based transactions which place restrictions on how personal data can be collected, used, re-used, stored, and shared in the FE.

In terms of gender parity, despite empirical evidence that outlines the beneficial effects of greater diversity, globally, women are also underrepresented in government (central bank supervision and FSI regulatory agencies) (Sahey & Cihk, 2018). Evidence suggests when more women are involved in politics and public sector leadership positions, women's rights, priorities, needs, and interests are less likely to be ignored (Sahey & Cihk, 2018; OECD, 2017). As shown in Table 2, all case countries have legislation and policies to drive women's financial inclusion and intervention strategies to enhance the economic empowerment and participation of women in each respective economy. However, in all the case countries there are very few women in FSI regulatory boards and leadership in central banks. Furthermore the ubiquity of AI in the FE suggests that the government will also require AI related talent to provide technical expertise, manage the datafication and digitisation of state records, and leverage quality data to enhance service delivery.

"With globalisation and remote work, emerging local talent might be attracted to Big Tech and the private sector and will not be interested in working for the government...we hope when they are more established they will be altruistic and work with us"

Table 2: Selected country policies and instruments

| FOCUS OF POLICIES AND INSTRUMENTS |  SOUTH AFRICA |  NIGERIA |  GHANA |  KENYA |
|--|---|---|---|--|
| STI Gender Equality | <p>National Policy Framework for gender equality, (2001)</p> <p>Framework on Gender-Responsive Planning, Budgeting, Monitoring, Evaluation and Auditing, (2020)</p> <p>The Broad-Based Black Economic Empowerment Act, 2003</p> | National Gender Policy, (2006) | National Gender Policy, (2015) | <p>National Policy on Gender and Development (NPGAD), (2021)</p> <p>Kenya Industry and Entrepreneurship Project (KIEP), (2019)</p> |
| Women's (Digital) Financial Inclusion | Women's financial inclusion framework, (2019). | <p>National Financial Inclusion Special Interventions Working Group (NFISIWG), (2018)</p> <p>National Financial Inclusion Strategy (NFIS), (2012)</p> | Digital Financial Services Policy, (2020) | National Policy on Gender and Development, (2019) |
| Digital Skills | National Digital and Future Skills Strategy (2020) | "Digital Job Creation Programme, 2018 | The Ghana Jobs and Skills Project (2020) | — |
| Data protection | Protection of Personal Information Act (POPIA), (2013) | Data Protection Regulation, (2020) | Data Protection Act, (2012) | Data Protection Act, (2019) |
| FinTech Policy Initiative | <p>Intergovernmental FinTech Working Group (IFWG), (2017)</p> <p>Crypto Assets Regulatory Working Group (CARWG), (2019)</p> | Regulatory Framework for Sandbox Operation, (2021) | FinTech and Innovation Unit, (2020) | No information available |
| AI Policy Initiative | <p>Centre for the Fourth Industrial Revolution Network for Global Technology Governance (C4IR), (2019)</p> <p>Presidential Commission on Fourth Industrial Revolution (2019)</p> | No information available | No information available | Kenyan Blockchain & Artificial Intelligence task (2018). |

Source: Various Sources

4. Conclusions

As AI and big data are increasingly viewed as a panacea to address pre-existing socio-economic developmental challenges in SSA, it is crucial to ensure that there are efforts to address intersectional gender inequalities such as socio-cultural norms, access to economic opportunities, and the gendered division of labour, which are embedded in at different elements in multiple ecosystems that impact women's livelihoods. While there are variations based on each case country context, AI is still nascent in all the case FEs. In all the case countries there are current gender barriers in all elements of the FE, the findings suggest there are systemic dimensions of gender inequality that perpetuate gendered career paths which perpetuate sexism in traditional credit scoring systems, inhibit financial inclusion, and contribute to multi-dimensional inequality hurdles that ultimately exacerbate the gendered digital divide and inhibit women's participation in digital entrepreneurship.

The growing evidence of significant exclusions related to AI deployment in more mature economies such as gender gaps in the global AI workforce need to be addressed in SSA where women already face challenges. This is important not only to ensure employment equity, but also to mitigate potential exclusions so that AI based solutions are more sensitive to women and marginalized groups, and are founded on minimizing patriarchal biases that are entrenched in the local markets where AI is deployed

The FE gender workforce disparity also contributes to gender barriers in the FEs that impact women's access to many financial services and resources such as credit facilities, loans, guarantees, investment opportunities, and start-up funds. Use of AI in these ecosystems is likely to learn existing behaviour and amplify these biases. Beyond ensuring diversity and inclusion in the workplaces where AI based solutions are developed, actively applying a gender lens to processes in the financial services value chain will also help avoid gender bias or stereotypes in key units such as product design and data science, which may cause a degree of harm for financial consumers.

There are proactive regulatory and policy initiatives in all the case countries that are geared towards exploratory eco-systemic collaboration to grow each respective FE. These include public-private collaboration initiatives to balance AI related innovation and growth of the FinTech sector through appropriate data regulation frameworks. However, since global AI deployment is spurred by countries where home-grown tech-oligopolies arguably lead most data and AI related technology development, data quality and algorithmic modelling standards, and discourse on global AI ethics (fairness, accountability and transparency)—The cross-cutting key data policy issues in domestic FEs also extend to cross border transactions and compliance with global FSI data management. Moreover, in SSA countries with nascent digital economies there is also limited FE guidance and experience regarding FE actor's legal obligations in terms of consumer protection, data standards, fair treatment of customers and privacy and data protection.

Finally, when addressing exclusions and opportunities associated with AI, there needs to be simultaneous reforms to address various challenges such as inadequate computing infrastructure, the lack of digitised data to facilitate AI algorithms, digital access and usage gaps, and weak human capital which are critical for boosting digital technology adoption, and generating African women (and men), who are equipped to thrive in workplaces of the future.

5. References

- 1) Ahmed, S. (2020). Three ways the lockdown highlights the importance of localised digital solutions to “build back better”. Retrieved from <https://researchictafrica.net/2020/05/25/three-ways-the-lockdown-highlights-the-importance-of-localised-digital-solutions-to-build-back-better/>
- 2) Alpaydin E (2020) Introduction to machine learning. The MIT Press, Cambridge MA
- 3) and Supervision
- 4) Arun, C. (2019). AI and the Global South: Designing for Other Worlds Forthcoming in Markus D. Dubber, Frank Pasquale, and Sunit Das (eds.), *The Oxford Handbook of Ethics of AI*, Oxford University Press, Available at SSRN: <https://ssrn.com/abstract=3403010>
- 5) Ballim, F. and Breckenridge, K. (2018). *Divinatory Computation : Artificial Intelligence and the Future of the African continent*
- 6) Bank of International Settlements (BIS), 2020. Payment aspects of financial inclusion in the fintech era. Retrieved from <https://www.bis.org/cpmi/publ/d191.pdf>
- 7) Barne, D., and Pirelea, F. (2019). Money Sent Home by Workers Now Largest Source of External Financing in Low-and-Middle-Income Countries (Excluding China). <http://blogs.worldbank.org/opendata/money-sent-home-workers-now-largest-source-external-financing-low-and-middle-income>.
- 8) Best, M. & Modi, D. (2019). Where are the women? Gender disparities in AI research and development. In A. Sey & N. Hafkin, (Eds.). *Taking stock: Data and evidence on the state of gender equality in digital access, skills, and leadership* (p.96). United Nations University Institute on Computing & Society/International Telecommunications Union. <http://collections.unu.edu/view/UNU:7350>
- 9) Biallas, M., and O’Neill, F. (2020). Artificial Intelligence Innovation Bias in Finance: Toward Responsible Innovation, 88 *Fordham L. Rev.* 499
- 10) Broeders, D., and Prenio, P. (2018). Innovative technology in financial supervision (suptech) – the experience of early users
- 11) Brunori, P., Ferreira, F. H. G., & Peragine, V. (2013). Inequality of opportunity, income inequality, and economic mobility: Some international comparisons. In *Getting development right* (pp. 85–115).
- 12) Buolamwini, J., & Gebru, T. (2018). Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification. *Conference on Fairness, Accountability and Transparency*, 77–91. <http://proceedings.mlr.press/v81/buolamwini18a.html>
- 13) Cowgill, B., and Tucker, C.E. (2020). Algorithmic Fairness and Economics. *Columbia Business*
- 14) Deloitte. (2018b). *Challenges Artificial Intelligence in Financial Services—Deloitte Forward*, Deloitte. Available online: <https://www.deloitteforward.nl/en/artificial-intelligence/challenges-to-widespread-artificial-intelligence-in-financial-services/>
- 15) Demirguc-Kunt, A. and Klapper, L. (2013). *Measuring Financial Inclusion: Explaining Variation in the Use of Financial Services Across and Within Countries*. Economic Studies Program, The Brookings Institution. *Brookings Papers on Economic Activity*, Volume 46, Issue 1.
- 16) Demirguc-Kunt, A. and Klapper, L. and Singer D. (2013). Financial Inclusion and Legal Discrimination against Development, 26:2, 201–213, DOI: 10.1080/02681102.2020.1736820
- 17) Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2018). *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution*. Washington, DC: World Bank. 1007
- 18) Gillwald, A., & Mothobi, O. 2019. *After Access 2018: A Demand-Side View of Mobile Internet From 10 African Countries (After Access 2018: A Demand-Side View of Mobile Internet from 10 African Countries After Access: Paper No. 7 (2018); Policy Paper Series No.*
- 19) Gwagwa, A., Kraemer-Mbula, E., Rizk, N., Rutenberg, I., & De Beer, J. (2020). Artificial intelligence (AI) deployments in Africa: Benefits, challenges and policy dimensions. *The African Journal of Information and Communication (AJIC)*, 26, 1–28. <https://doi.org/10.23962/10539/30361>
- 20) Han, A. (2020) *Technology is Not Neutral*. <https://towardsdatascience.com/precautions-in-using-tech-for-public-health-part-i-technology-is-not-neutral-ff533acbf7e>
- 21) Isenberg, D. (2011). *The entrepreneurship ecosystem strategy as a new paradigm for economic policy: Principles for cultivating entrepreneurship*. The Babson Entrepreneurship Ecosystem Project. Wellesley College. <http://www.innovationamerica.us/images/stories/2011/The-entrepreneurship-ecosystem-strategy-for-economic-growth-policy-20110620183915.pdf>. Accessed 26 Nov 2020
- 22) Johnson, K., Pasquale, F., and Chapman, J., (2019). Artificial Intelligence, Machine Learning, and Bias in Finance: Toward Responsible Innovation, 88 *Fordham L. Rev.* 499.

- 23) Kelly S. and Mirpourian, M. (2021). Algorithmic Bias, Financial Inclusion, and Gender: A primer on opening up new credit to women in emerging economies. Women's World Banking
- 24) KPMG. (2021 a) The shape of AI governance home.kpmg/ShapeofAIGovernance
- 25) KPMG. (2021b). Algorithmic Bias and Financial Services. Retrieved from:
https://www.finastra.com/sites/default/files/documents/2021/03/market-insight_algorithmicbias-financial-services.pdf
- 26) Kshetri, N. (2021). The Role of Artificial Intelligence in Promoting Financial
- 27) Kuhlcke, K. (2018). Open APIs and financial services: Some questions answered.
<https://finmark.org.za/knowledge-hub/articles/open-apis-and-financial-services-some-questions-answered?entity=news>
- 28) Lee, I. and Y.J. Shin, Fintech: Ecosystem, business models, investment decisions, and challenges. Business Horizons, 2018. 61(1): p. 35-46.
- 29) Mhlanga, D. (2020). Industry 4.0 in Finance: The Impact of Artificial Intelligence (AI) on Digital Financial Inclusion. International Journal of Financial Studies.
- 30) Miller, J., and Page, S.(2007). Complex adaptive systems : an introduction to computational models of social life. Princeton University Press. ISBN 9781400835522. OCLC 760073369
- 31) Ndoro, H., Johnston, K., and Seymour, L. (2020). Artificial Intelligence Uses, Benefits and Challenges: A Study in the Western Cape of South Africa Financial Services Industry
- 32) Niethammer, C. (2020). AI Bias Could Put Women's Lives At Risk—A Challenge For Regulators. Forbes.
<https://www.forbes.com/sites/carmenniethammer/2020/03/02/ai-bias-could-put-womens-lives-at-risk-a-challenge-for-regulators/>
- 33) O'Reilly, K. (2009). Interpretivism. In Key concepts in ethnography (pp. 119-124). SAGE Publications Ltd,
<https://www.doi.org/10.4135/9781446268308>
- 34) OECD (2019), Artificial Intelligence in Society, OECD Publishing, Paris, <https://doi.org/10.1787/eedfee77-en>.
- 35) OECD, 2017. Better governance for gender equality. <https://www.oecd.org/gov/gender-public-life-flyer.pdf>
- 36) Ohuocha, C. (2020). Nigeria bank layoffs barred as crisis hits economy.
<https://www.reuters.com/article/health-coronavirus-nigeria-banks-idUSL8N2CM584>
- 37) Qureshi, S. (2020) Why Data Matters for Development? Exploring Data Justice, Micro-Entrepreneurship, Mobile Money and Financial Inclusion, Information Technology for Development, 26:2, 201-213, DOI: 10.1080/02681102.2020.1736820
- 38) Rizzi, A., Kessler, A and Menajovsky, J. (2021). The Stories Algorithms Tell: Bias and Financial Inclusion at the Data Margins
- 39) Romer, P. (1990). Endogenous Technological Change. Journal of Political Economy 98(5): S71-102.
- 40) Sahay, R., von Allmen, U. E., Lahreche, A., Khera, P., Ogawa, S., Bazarbash, M., & Beaton, K. (2020). The Promise of Fintech; Financial Inclusion in the Post COVID-19 Era (No. 20/09). International Monetary Fund
- 41) Schnitzer M, & Watzinger M (2014) Measuring the spillovers of venture capital, Annual vc Conference 2014: Evidence-based Economic Policy, September 7–10, 2014, Hamburg, School Research Paper, Available at SSRN: <https://ssrn.com/abstract=3361280> or
- 42) Sey, A., & Ahmed, S. (2020). An African perspective on gender and artificial intelligence needs African data and research (Policy Brief No. 5). Research ICT Africa. <https://researchictafrica.net/publication/an-african-perspective-on-gender-and-artificialintelligence-needs-african-data-and-research/>
- 43) Smith, M., and Neupane, S. (2018). Artificial Intelligence and Human Development (International Development Research Centre, 2018), <https://www.idrc.ca/en/stories/artificial-intelligence-and-human-development>.
- 44) Sparks, A., and Eckenrode, J. (2020). Achieving gender equity in the fintech community: Enlisting key stakeholders to drive change. <https://www2.deloitte.com/us/en/insights/industry/financial-services/women-in-fintech.html>
- 45) Stahl, B. (2020). Artificial Intelligence for a Better Future: An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies
- 46) Suri, T. and W. Jack, "The long-run poverty and gender impacts of mobile money," Science, 354 (2016), 1288–1292.
- 47) Suri, T. and W. Jack, "The long-run poverty and gender impacts of mobile money," Science, 354 (2016),
- 48) Sy, A., Maino, R., Massara, A., Saiz, H. P., & Sharma, P. (2019). FinTech in Sub-Saharan African Countries. In Departmental Papers / Policy Papers (Vol. 19). Retrieved from <https://doi.org/10.5089/9781484385661.087>

- 49) Tarrant,H.(2019). SA's 'big four' banks have shut down almost 700 branches this decade
citizen.co.za/business/2140329/sas-big-four-banks-have-shut-down-almost-700-branches-this-decade/
- 50) Taylor, C., Holttinen, E., and Morozova, A.(2019). Institutional Arrangements for Fintech Regulation
- 51) The AAS (2020). Mukhwana A.M., Abuya T., Matanda D., Omumbo J., Mabuka J. Factors which Contribute to or Inhibit Women in Science, Technology, Engineering, and Mathematics in Africa. Nairobi
- 52) United Nations Conference on Trade and Development (UNCTAD). (2019). Digital Economy Report—Value Creation and Capture: Implications for Developing Countries
- 53) Valencia, A., Rementeria, M. J., Chadha, A. S., & Mavridis, N. (2020). Sex and gender differences and biases in artificial intelligence for biomedicine and healthcare. *Npj Digital Medicine*, 3(1), 1–11.
<https://doi.org/10.1038/s41746-020-0288-5>
- 54) Vossenbergh, S., Rappoldt, A., D'Anjou, J. 2018.Beyond access : exploring gender-transformative approaches to financial inclusion. Retrieved from <http://hdl.handle.net/10625/57156>
- 55) West, S.M., Whittaker, M. and Crawford, K. (2019). Discriminating Systems: Gender, Race and Power in AI. AI Now Institute. Retrieved from:<https://ainowinstitute.org/discriminatingystems.html>
- 56) Women: Evidence from Developing Countries. Policy Research Working Paper 6416. Washington, DC: World Bank.
- 57) World Bank Group. 2019a. Nigeria Digital Economy Diagnostic Report. Washington, DC: World Bank. License: Creative Commons Attribution CC BY 3.0 IGO.
- 58) World Economic Forum .(2018). The New Physics of Financial Services – How artificial intelligence is transforming the financial ecosystem
- 59) World Economic Forum (WEF) 2016 Global Information Technology Report page at www.weforum.org/gitr.
- 60) WEF Global Gender Gap Report 2020
- 61) WEF(2020).A Global AI in Financial Services Survey .<https://ssrn.com/abstract=3532038>
- 62) Yin, R.K., Case Study Research: Design and Methods. 2003: SAGE, 2003.