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DIANA KANGWA*

Binary University of Management & Entrepreneurship

JOSEPH THOKOZANI MWALE**

Mulungushi University

JUNAID M. SHAIKH***

University of Technology

**CO-EVOLUTIONARY DYNAMICS
OF FINANCIAL INCLUSION OF GENERATION Z
IN A SUB-SAHARAN DIGITAL FINANCIAL ECOSYSTEM**

Keywords: digital finance, financial inclusion, co-evolutionary dynamics, generation Z.

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Abstract: The growing digital consumerism in modern society is associated with higher expectations of customer experience, and as such the business environment is expected to co-evolve by developing more consumer-centric, sharing-based and fast-

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* Contact information (corresponding author): d_kangwa@yahoo.co.uk, Binary University of Management and Entrepreneurship, Selangor, Malaysia, phone: +260966794849; ORCID ID: <https://orcid.org/0000-0002-2101-7923>.

** Contact information: jt_mwale@yahoo.com, Mulungushi University, P.O. Box 80415, Kabwe, Zambia, phone: +260762719898; ORCID ID: <https://orcid.org/0000-0002-5884-8085>.

*** Contact information: junaid9nine@gmail.com, Senior Assistant Professor Accounting, University of Technology, Brunei, phone: +6732461020 ext 5341; ORCID ID: <https://orcid.org/0000-0003-3312-4635>.

-paced business models. This calls for deeper understanding of consumer aspirations and preferences in a given local context. Therefore, this paper explores the co-evolutionary dynamics of digital financial inclusion of Generation Z against a backdrop of limited understanding of the dynamic complexity of the financial business environment in the digital age. A case study of a digital financial ecosystem in Zambia within sub-Saharan Africa is then employed herein to reveal the co-evolutionary dynamics of financial inclusion of Generation Z within the framework of complex adaptive systems. For this purpose, a system dynamics modelling tool of Causal loop analysis is used to visualise the co-evolutionary dynamics. The paper has demonstrated that digital financial inclusion occurs within a continuum of co-evolutionary dynamics in which the financial institutions build consumer demand for digital financial services based on the participatory accountability and financial capability of the clientele. The paper concludes that digital financial inclusion is an emergent outcome of the complex adaptive behaviour of a financial business ecosystem in the increasingly digitising society. Therefore, development of inclusive financial business models must embrace the digital consumerism of the clientele, particularly in sub-Saharan Africa where there is a demographic boom of Generation Z with a growing propensity for digital consumerism.

■■■ INTRODUCTION

Digitization is rapidly transforming modern lifestyles globally in unprecedented ways leading to a sociological construct of “digital society” by Lupton (2015). The Digital society is characterized by extensive utilization of new digital technologies such as artificial intelligence, cloud computing, robotics, 3D printing, the Internet of Things and advanced wireless technologies. In light of the disruptive nature and rapid pace of digitization in the first-half of the 21st century, Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum indisputably describes such a moment in time as the Fourth Industrial Revolution-4IR that is fundamentally changing the way humans live, work and relate to one another. The World Economic Forum (2020) accordingly foresees many intended and unintended consequences of the disruptive nature of this technological revolution. With regards to the financial business sector, the Alliance for Financial Inclusion (2019) observes that the application of digital technologies to finance has ushered in a new era of digital finance around the world. To this effect, Ndung’u and Signé (2020) assert that digitization has evidently impacted economic growth through inclusive finance that is enabling the unbanked to enter formality through retail electronic payments platforms, virtual savings and credit supply technological platforms; and more broadly, digitization is enabling entrepreneurs and businesses to rethink business mod-

els that are more impactful, sustainable and connected to other sectors of the economy.

The emergence of financial inclusion in the science and policy discourses is an unintended outcome of the interactive evolution of digitization and finance. A general understanding of financial inclusion is that it is the sustainable provision of affordable financial services that bring the poor into the formal economy (United Nations, 2016). In a high-level debate on financial inclusion in the 21st century, Mas and Porteous (2014) posit a single, broad vision of financial inclusion where digital financial services are relevant on a daily basis for the majority of the population. Ozili (2018) reiterates that an inclusive financial system is desirable and promises to provide opportunities for all people, particularly the poor, to access and move funds, grow capital and reduce risk. This view has echoed through the global policy discourse on sustainable financial sector development seeking to leave no one behind in the provision of financial products and services. Through the Universal Financial Access by 2020 (World Bank, 2020) initiative, the World Bank envisions adults worldwide, women and men alike, having access to a transaction account or an electronic instrument to store money, send payments and receive deposits as a basic building block to manage their financial lives. The Alliance for Financial Inclusion (2019) note that financial inclusion is a significant international policy goal; and Klapper, El-Zoghbi and Hess (2019) see it as an enabler of many of the United Nations Sustainable Development Goals-SDGs. As an emerging frontier of financial sector development, Digital finance promises welfare services provision centred on financial inclusion. To this end, the United Nations (2016) believes that digital financial services can contribute to poverty reduction and financial inclusion in the developing economies; and the Global Partnership for Financial Inclusion, GPFI (2019) encourages governments to embrace digital approaches to financial inclusion.

With the digital transformations currently taking place in the financial sector, the policy goal of financial inclusion of the marginalized segments of human society is realistically achievable. In this vein, Arner, Barberis and Buckley (2016) proclaim that digital technologies such as cloud computing, smartphones and high-speed Internet are definitely creating smart pathways to digital financial transformation for inclusive participation of the excluded segments of the society. The wave of digital transformation of society that has been promulgated by the Fourth Industrial Revolution has come along with

notable socio-demographic transitions towards digital consumerism. Within these transitions, there is an emerging population of young people, born between the years 1995 and 2010, whose consumer behavioural characteristics are shaped by the digital age which has exposed them to the Internet, social networks and mobile systems. Distinctively describing this demographic cohort of young people as “Generation Z”, Francis and Hoefel (2018) observe that the digital age has produced a hyper-cognitive generation that is very comfortable with collecting and cross-referencing many sources of information, and with integrating virtual and offline experiences.

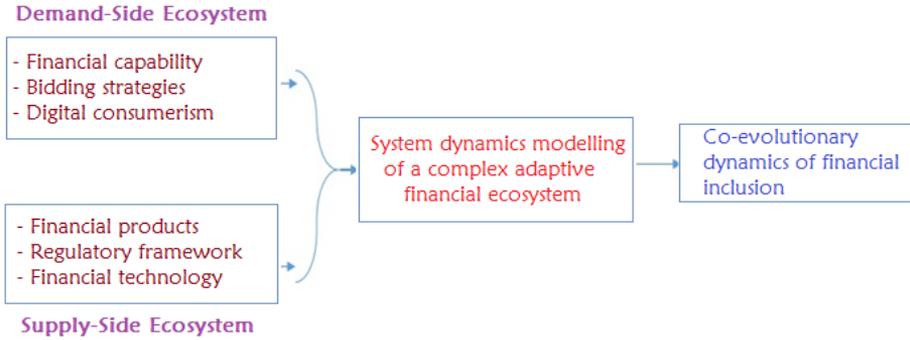
The growing digital consumerism in modern society is associated with higher expectations of customer experience, and as such the business environment is expected to co-evolve by developing more consumer-centric, sharing-based and fast-paced business models. This calls for deeper understanding of consumer aspirations and preferences in a given local context. With regards to digital financial services (DFS) delivery, Buckley and Malady (2014) explain the importance of financial regulators understanding and building consumer demand so as to encourage sustainable DFS ecosystems which can enhance financial inclusion. While the introduction of financial technologies is increasingly seen to be a key driver of digital financial services delivery towards financial inclusion of the marginalised segments of society, Mas and Porteous (2014) submit that transitioning towards financial inclusion entails digital financial services being more aware of people’s circumstances and needs. Therefore, this research considers the circumstances and needs of Generation Z as a spectrum for building the consumer demand for digital financial services, and for understanding the dynamics of financial inclusion in the increasingly complex digital financial ecosystem.

The study of the nexus of digital finance and financial inclusion as conceptualised in this research adopts a co-evolutionary perspective, which is founded on the biological construct of “co-evolution” by Ehrlich and Raven (1964) to describe genetic change of one species in response to the evolution of a second species. The co-evolutionary process (Thompson, 1994) typically describes the change that occurs between pairs of mutually dependent entities as each party exerts selective pressures on the other, thereby affecting each other’s evolution. Thus, co-evolution takes many forms including mutualistic, parasitic, predatory and competitive relationships between species. The biological co-evolutionary process has been widely adopted and used metaphorically in other scien-

tific disciplines including technology studies (Rammel, Stagl & Wilfing, 2007), sociology (Kauffman, 1993), environmental management (Anderies, Janssen & Ostrom, 2004), and business studies (Uli, 2018). The theoretical underpinnings of co-evolution are well-developed, and demonstrate that co-evolution can play an important role in driving major evolutionary transitions (Nuismer, 2017). In the main, the co-evolutionary research domain tests the hypothesis of interactive evolution that can provide a useful framework for studying complex adaptive systems such as “business ecosystems”. Business ecosystems comprise business entities that interact and co-operate within a specific industry for mutual benefit (Moore, 1996). Each business ecosystem member aims at driving institutional and technological co-evolution across the ecosystem in order to become the dominant and attractive business ecosystem (Iansiti & Levein, 2004). In so far as business ecosystems behave as dynamic systems of agents and organisations that experiment, explore, self-organise, learn and adapt to changes in their environment, they can be described as complex adaptive systems (Axelrod & Cohen, 2001).

Within the co-evolutionary research domain, the study of complex adaptive systems is increasingly seen as a scientific frontier transcending the natural and social science disciplines and having a profound effect on the future of science, engineering and industry. To model the co-evolutionary dynamics of financial inclusion, the financial ecosystem is herein reasonably considered as a Complex adaptive system whose functionality depends on the interactive evolution of its constituent entities that interact in complex ways. The interacting entities are the customers and financial service providers, which respectively constitute the demand and supply sides of the complex financial ecosystem. Therefore, the conceptual model for the study (see figure 1) is based on the building blocks of digital financial inclusion herein conceptualised as financial capability, bidding strategies and digital consumerism of the clientele on the demand side; and of the availability and accessibility of financial products, regulatory frameworks and financial technology on the supply side of the financial ecosystem.

Figure 1. Conceptual model for understanding the co-evolutionary dynamics of financial inclusion of Generation Z



Source: own study.

On the demand-side of the financial ecosystem, *financial capability* is considered an essential ingredient for building consumer demand for financial inclusion. Financial capability is based on the functional knowledge of the financial concepts, financial products and financial behaviour and attitudes. *Financial literacy* refers to being in possession of skills and knowledge that allows an individual to make informed and effective decisions about the available financial resources. A financially literate individual has then the ability to understand and effectively use various financial skills including personal financial management, budgeting and investing (Fernando, 2020). With the functional knowledge of financial concepts, an individual can easily learn about the financial products offered by the financial service providers in the market. Accordingly, financial literacy shapes the financial behaviours and attitudes of an individual to live within his or her means. Furthermore, financial literacy is conceptually linked to financial inclusion as evidenced by Cole, Thomas and Bilal (2009) who found financial literacy to be an important factor in determining the demand for financial products, especially among uneducated and financially illiterate segments of the population.

Another important concept on the demand-side of the financial ecosystem considered in this study is the *bidding strategy* of the clientele for financial inclusion. A bidding strategy is in this context considered as an objective function of the clientele to participate in the formal financial sector in such a manner

that maximises customer satisfaction. The bidding strategies are determined by the customer perception of financial services provision. In this regard, this research takes into consideration the perception of Generation Z towards the formal financial services. In respect of Generation Z, *digital consumerism* is a critical ingredient for building consumer demand for digital financial inclusion. Digital consumerism is then typified by digital device ownership, social media networking and the propensity and ability to use digital technologies. On the supply-side of the ecosystem, there exist the financial service providers of various financial products that create and capture value in a given socio-economic context. The delivery of financial products is undertaken within a regulatory framework with a view to militating against risks and ensuring consumer protection. In pursuit of the goal of financial inclusion, the financial service providers make use of financial technology to deliver products and services to the unbanked or marginalised segments of society, principally through mobile money services.

Given the dynamic complexity of the financial business ecosystem, this research adopts the System dynamics approach to reveal the hypothesised inherent co-evolutionary dynamics of financial inclusion. System dynamics modelling was pioneered by Forrester (1958) to develop understanding of the nonlinear behaviour of complex systems over time using stocks, flows, internal feedback loops, table functions and time delays. It's a widely used approach with exemplar applications to modelling the earth's climate, agro-ecological systems, social systems and healthcare systems. In respect of business management, Sterman (2001) notes that system dynamics modelling combines aspects of decision and process modelling by describing complex interaction and feedback mechanisms within business systems while supporting the use of quantitative decision modelling. System dynamics also draws strongly on the concept of endogeneity, meaning that it seeks to find explanations for system behaviour by understanding the internal structure of a system rather than focusing on factors external to the system (Sterman, 2001). Currie, Smith and Jagals (2018) further explain that the system dynamics approach involves causal mapping, and has demonstrated considerable value across a number of different fields to help decision-makers understand and predict the dynamic behaviour of complex systems in support of the development of effective policy actions.

The intended outcome of this research involving the application of the system dynamics modelling approach is a revelation of the co-evolutionary dy-

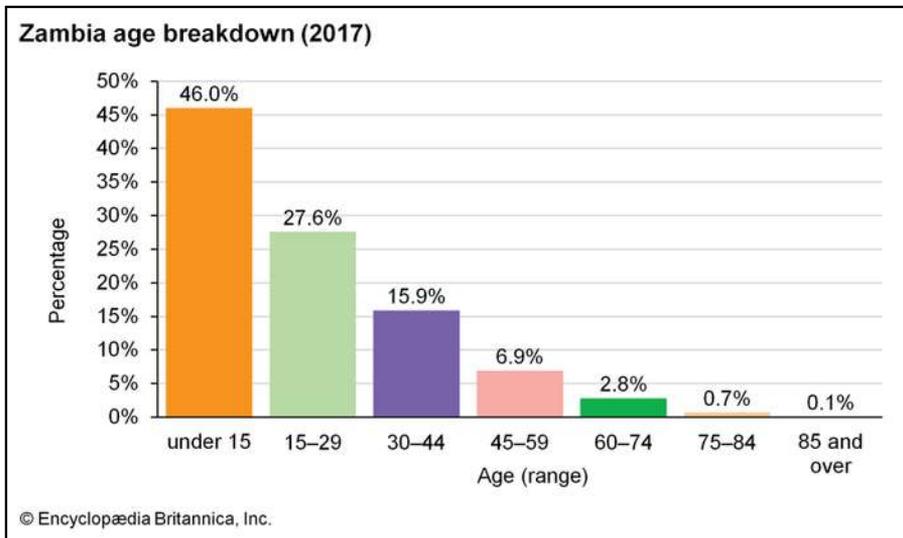
namics of financial inclusion within the increasingly complex and digitising financial ecosystem. The co-evolutionary dynamics are the interconnectedness, feedback loops and emergent behaviour of the system that is in dynamic transition driven by digitisation. McKelvey (2002) outlines the necessary conditions for co-evolution, highlighting that there must firstly be an existence of heterogeneous agents which could be quanta, particles, molecules, bio-molecules, genes, chromosomes, organelles, organs, organisms, species, language concepts, organizational processes, people, groups, firms, populations, and so on. Secondly, the agents must have adaptive or learning capability; and thirdly, the agents must be able to interact and mutually influence each other. Fourthly, there must be some kind of higher-level constraint to adaptation that motivates the co-evolutionary process; and finally there needs to be the initiating event. Based on these building blocks of a co-evolutionary process, this present study identifies Generation Z and a banking institution as agents of co-evolution that is driven by digitisation towards the ideal of financial inclusion.

This research is set within sub-Saharan Africa (SSA), a region that presents an excellent opportunity for studying financial inclusion on account of its early stage of demographic transitions and socio-economic development. In spite of the structural constraints on closing the digital divide in sub-Saharan Africa, there is resounding progress on financial inclusion. According to the World Bank (2017), the share of adults in Sub-Saharan Africa with access to accounts in financial institutions or mobile money (MM) services increased from 34 percent to 43 percent in the period, 2011 to 2017. The specific location of the study is Zambia, a country geographically located between latitudes 08° and 18° South of the Equator and between longitudes 21° and 38° East of Greenwich Meridian.

Zambia is a land-linked country in Southern-Central Africa with neighbours including the Democratic Republic of the Congo to the north, Tanzania to the north-east, Malawi to the east, Mozambique to the south-east, Zimbabwe and Botswana to the south, Namibia to the south-west, and Angola to the west. The capital city is Lusaka that is located in the south-central part of Zambia. As a land-linked country, Zambia's socio-economic development is driven by the extractive industry of copper mining and other minerals from its rich natural resources base, commerce and trade, tourism and agriculture. With a tropical continental climate that is modified by an altitude of 900-1,500 metres above sea level, Zambia is generally favourable to human settlement and comfort (Roberts, 2020). The country's socio-economic sectors presently support

an estimated human population of 18.5 million with a median age of 17.6 years (Worldometer, 2020). The World Bank (2020) remarks that Zambia is one of the world's youngest countries by median age, and is experiencing a large demographic shift that is expected to continue as the large youth population enters reproductive age. Roberts (2020) puts Zambia's demographic transition into perspective, highlighting that 73.6 percent of Zambia's population is under the age of 30 (see figure 2). Of interest to this research is Generation Z that is at least 27.6 percent of Zambia's youthful population, and is herein postulated to have a high consumer demand for digital financial services given its relatively high digital consumerism.

Figure 2. Zambia's population breakdown

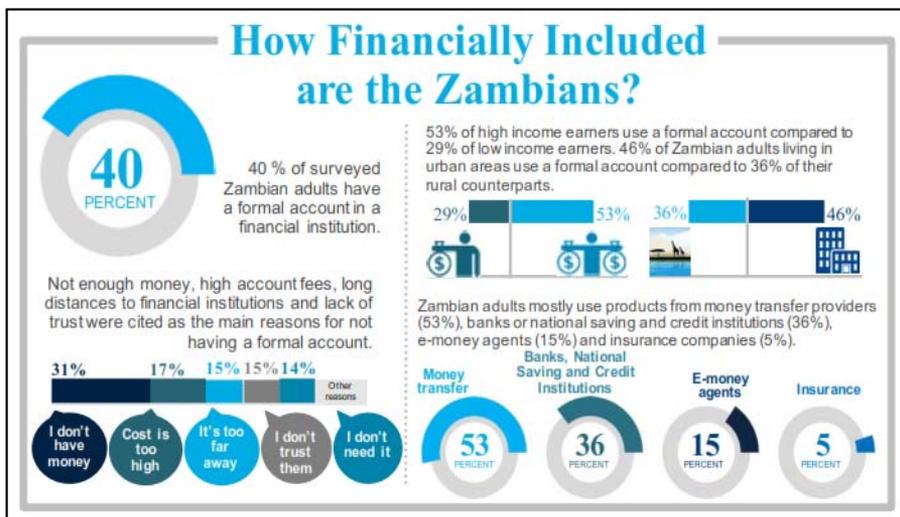


Source: Encyclopædia Britannica, Inc.

In the matter of digital financial inclusion of the marginalised segments of Zambia's human demographic including Generation Z, the World Bank (2017) strongly recommends the development and provision of financial services geared towards specific needs of customers, including through providing cheaper avenues for low income consumers to obtain mobile phones. This recommendation arises from a demand-side assessment of enhancing financial ca-

pability and inclusion in Zambia that showed that only 40 percent of Zambians were formally included in the financial ecosystem (see figure 3). Across the main socio-economic and demographic characteristics, income level was found to have the most significant impact on financial inclusion, followed by whether or not adults were located in rural areas and their gender differences (World Bank, 2017).

Figure 3. Status of financial inclusion in Zambia



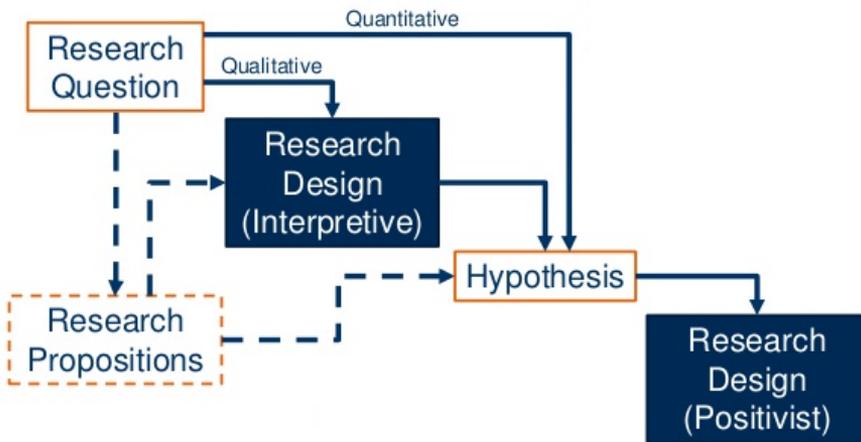
Source: World Bank.

In view of the foregoing theoretical background to this present work, the objectives of this paper are twofold: firstly, to characterise the dynamic complexity of a digital financial ecosystem; and secondly, to visually quantify the co-evolutionary dynamics of financial inclusion of Generation Z in the digital financial ecosystem set within sub-Saharan Africa. The rest of the research paper then goes about presenting the research methodology and research process with narratives of the research approach, data and sources and data analysis techniques. Thereafter, the results and conclusions of the study are presented based on a thoughtful discussion to highlight the implications of the results for policy and future research.

RESEARCH METHODOLOGY AND RESEARCH PROCESS

This research is founded upon the interpretive and positivist epistemologies with the ontological assumptions that there is subjective and objective reality that can respectively be understood by observation and empirical evidence (see figure 4). This philosophical worldview points to a mixed-methods research design involving both qualitative and quantitative approaches. Wisdom and Creswell (2013) clarify that the term “mixed methods” refers to an emergent methodology of research that advances the systematic integration, or “mixing,” of quantitative and qualitative data within a single investigation or sustained program of inquiry. The mixed-methods approach is herein employed to test the hypothesis of interactive evolution in a digital financial ecosystem. Galkin (2011) considers the hypothesis of interactive evolution as a cross-road interdisciplinary conceptualization of social dynamics and technological growth.

Figure 4. Intepretive and positivist research paradigms



Source: Farshchian, 2020.

A case study of a digital financial ecosystem is then undertaken with a view to revealing the co-evolutionary dynamics of financial inclusion of Generation Z. The case study approach is premised on its efficacy in examining contempo-

rary real-life situations thereby providing a basis for the application of concepts and theories and extension of methods. This approach has been seen to excel in bringing researchers to the understanding of complex issues through detailed contextual analysis of natural and social phenomena. In this regard, the case study design is most suited to the research phenomenon of financial inclusion, and how it evolves in the complex adaptive system of a financial ecosystem.

DATA COLLECTION AND ANALYSIS

For this case study, a schema (see table 1) was developed for exploring the dynamic complexity and the co-evolutionary dynamics of financial inclusion within the digital financial ecosystem of the Zambia National Commercial Bank (Zanaco) in sub-Saharan Africa. The schema incorporated the building blocks of complex systems and financial inclusion. To model the dynamic complexity of a digital financial ecosystem, a structured observation of the complex behaviour of the agents was undertaken to reveal the interconnectedness, feedback and emergent properties using *thematic analysis* with deductive logic. Thematic analysis is a method for identifying, analysing, and reporting patterns (themes) within a dataset (Clarke & Braun, 2017). Structured interviews on both the demand-side and supply-side of financial inclusion were then conducted to reveal the co-evolutionary dynamics of financial inclusion using a *causal loop diagram* created on the Vensim PLE software platform, Version 8.1.0. Vensim is a system dynamics modelling software developed by Ventana Systems Inc. It primarily supports continuous simulation, with some discrete event and agent-based modelling capabilities.

Primary data was collected using the structured questionnaire that was administered to the banking personnel in decision-making positions (n=36), and Generation Z (n = 360) involved in Agency banking with Zanaco, which had more than 1,200 agents on its Zanaco-branded Xpress mobile service across the country. The selection of respondents for the interviews was based on the purposive sampling design. Purposive sampling is a form of non-probability sampling in which researchers rely on their judgment when choosing members of the population to participate in their study (Black, 2010). Notwithstanding its susceptibility to bias, the purposive sampling method is most appropriate when researchers intend to access a particular subset of the study population that fits a particular profile of the research.

Table 1. Schema of data collection and analysis for the research

Objective	Variables	Data collection methods	Data Analysis Techniques
1. Characterising the dynamic complexity of the digital financial ecosystem	<ul style="list-style-type: none"> - Interconnectedness - Feedback mechanisms - Emergent behaviour 	<ul style="list-style-type: none"> - Structured observation of the complex behaviour of the agents 	<ul style="list-style-type: none"> - Thematic analysis with deductive logic
2. Exploring the co-evolutionary dynamics of financial inclusion	<ul style="list-style-type: none"> - Financial capability 	<ul style="list-style-type: none"> - Structured interview on the demand-side perspective on financial inclusion 	<ul style="list-style-type: none"> - Causal loop analysis and structural equation modelling.
	<ul style="list-style-type: none"> - Bidding strategies 		
	<ul style="list-style-type: none"> - Digital consumerism 		
	<ul style="list-style-type: none"> - Financial products outlay 	<ul style="list-style-type: none"> - Structured interview on the supply-side assessment of financial inclusion 	
	<ul style="list-style-type: none"> - Regulatory framework 		
	<ul style="list-style-type: none"> - Financial technology 		

Source: own study.

Structural equation modelling (SEM) is herein used to quantify the causal relationships in the construct of digital financial inclusion with respect to Generation Z. SEM is a multivariate statistical framework that is used to model complex relationships between directly observed and indirectly observed or latent variables. SEM particularly estimates a system of linear equations to test the fit of a hypothesized “causal relationship” model, which is visually presented as a “path diagram” based on prior knowledge and/or theories (Stein & Morris, 2012). Path diagrams are constructed with rectangles representing observed or directly measured variables, and circles or ovals representing unobserved or latent constructs that are defined by measured variables. Unidirectional arrows then represent causal paths, where one variable influences another directly, and double-headed arrows represent correlations between variables. The path diagram visualizes two sub-models using a system of linear equations. The first model is the Measurement model that estimates relationships between the observed variables or indicators, and latent variables. The Measurement model is given by Equation 1; where, the x and y symbols are observed indicators for latent variables, the ξ and η symbols are latent variables, the λ symbols are factor loadings, and the ϵ and δ symbols are the error, or disturbance terms.

$$\begin{aligned}
 x_1 &= \lambda_{11}\xi_1 + \delta_1 & y_1 &= \lambda_{31}\eta_1 + \varepsilon_1 \\
 x_2 &= \lambda_{22}\xi_2 + \delta_2 & y_2 &= \lambda_{41}\eta_1 + \varepsilon_2 \\
 x_3 &= \lambda_{33}\xi_3 + \delta_3 & y_3 &= \lambda_{51}\eta_1 + \varepsilon_3
 \end{aligned} \tag{1}$$

The second model in SEM is the Structural model that develops the relationships between the latent variables based on the endogenous and exogenous variables. The structural model is then described by Equation 2; where, the γ and β terms are factor loadings for the latent variables, and ξ and ζ are error terms. The structural model can then evaluate potential causal relationships between the endogenous and exogenous variables.

$$\begin{aligned}
 \eta_1 &= \gamma_{11}\xi_1 + \zeta_1 \\
 \eta_2 &= \beta_{21}\xi_2 + \zeta_2
 \end{aligned} \tag{2}$$

The systems of equations in SEM are fitted to the data using the Maximum likelihood estimation fitting functions assuming that the data are normally distributed and the observations are independent. Hancock (2003) notes that the use of SEM is commonly justified in the social sciences because of its ability to impute relationships between unobserved constructs (latent variables) from observable variables.

RESULTS AND CONCLUSIONS OF THE RESEARCH PROCESS

This section presents the results and discussion of the qualitative and quantitative analyses of data primarily collected for modelling the dynamic complexity of a digital financial ecosystem and the co-evolutionary dynamics of financial inclusion of Generation Z within the digital financial ecosystem.

DYNAMIC COMPLEXITY OF THE DIGITAL FINANCIAL ECOSYSTEM

The first objective of the paper was to characterise the dynamic complexity of a digital financial ecosystem for subsequent visual quantification of the co-evolutionary dynamics of financial inclusion of Generation Z in the digital financial ecosystem set within sub-Saharan Africa. This necessitated the use of structured observation of the complex behaviour of the agents of the digital finan-

cial ecosystem. Thematic analysis based on deductive logic resulted in results depicted in table 2.

Table 2. Thematic analysis of the dynamic complexity of a digital financial ecosystem

Agents	Coded Thematic Areas	Interactions	Feedback	Emergent behaviour
1. Generation Z on the demand-side ecosystem	- Financial capability	- Financial literacy - Knowledge of financial products - Financial attitudes and behaviours	- Consumer demand for digital financial services - Trust and cyber-security concerns	- Adoptive response to digital financial services delivery
	- Bidding strategies	- Holding mobile money accounts - Engagement in agency banking		
	- Digital consumerism	- Ownership of a mobile phone - Social networking with family and friends		
2. Zanaco Bank on the supply-side ecosystem	- Financial products outlay	- Affordability - Accessibility - Profit maximisation	- Customer-centralism - Consumer protection	- Building consumer demand for digital financial inclusion
	- Financial technology	- Cash-in/cash-out (CICO) networks - Multiple inter-connected payment platforms		
	- Regulatory framework	- Customer identification - Risk management		

Source: own study.

INTERACTIONS

In all its complexity, a digital financial ecosystem is characterised by the interactive behaviour of agents represented by Generation Z on the demand-side ecosystem, and by Zanaco Bank on the supply-side ecosystem. The demand-side ecosystem has complex interactions under the coded thematic areas of financial capability, bidding strategies and digital consumerism. Access to finan-

cial services is shaped in part by the financial capability of the clientele. To this effect, the consumer demand for financial services depends on financial literacy, knowledge of financial products, and financial attitudes and behaviours. Financial capability in itself depends on the socio-economic status of the clientele, particularly income status. The bidding strategies of Generation Z include holding mobile money accounts, and engaging in agency banking. These interactions tend to influence the adoptive response to financial service delivery along with digital consumerism that engenders ownership of a mobile phone, and social networking with family and friends. The nature of interactions on the supply-side ecosystem includes the delivery of financial products and services with objectives of affordability, accessibility and profit maximisation. The financial services are delivered via financial technology platforms with cash-in/cash-out networks and multiple interconnected payment platforms. The financial technology frontier entails customer identification and risk management within a regulatory framework.

FEEDBACK

Feedback is another defining feature of complex systems on account of the continuous ability of the systems to change, adapt and re-organise in response to their environment. With respect to the digital financial ecosystem under this present study, the feedback mechanism is characterised by consumer demand for digital financial services by the clientele amidst trust and cyber-security concerns. Trust concerns arise from the customers' susceptibility to cyber-thefts on digital payment platforms. This invokes a sense of insecurity, and the need for guaranteed consumer protection by the financial service providers. In responding to the growing consumer demand for financial services amidst security concerns, the business model of financial service delivery must be underpinned by customer-centralism with consumer protection mechanisms in place. Malady (2016) intonates that this can help reduce the level of voluntary financial exclusion whereby the excluded population do not want to participate in digital finance because they have ex-post data security concerns.

EMERGENT BEHAVIOUR

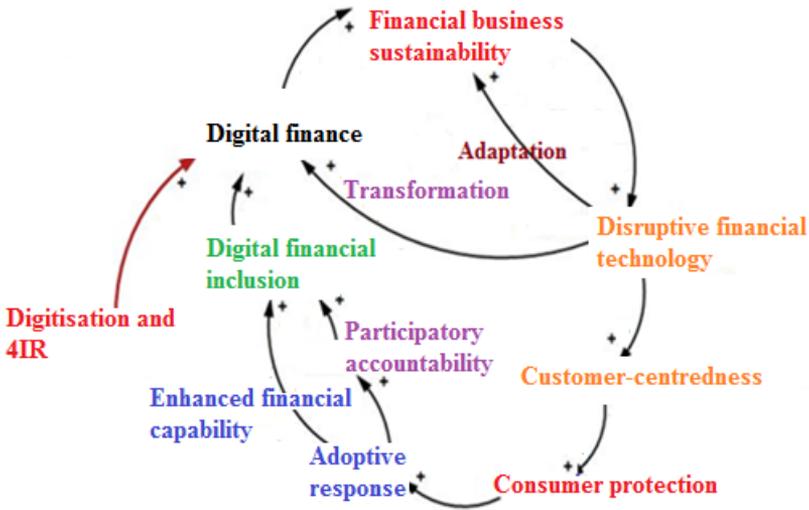
Emergent behaviour stems from the interactions and feedback mechanisms in complex systems. From the foregoing narratives of the interactions and feedback mechanisms in the digital financial ecosystem, financial inclusion appears to be an emergent property of the digital financial ecosystem. Financial inclusion is driven by the adoptive response of the clientele to digital financial services delivery by the banking institution. The banking institution then remodels its financial product offering by building consumer demand for digital financial inclusion with enhanced participatory accountability and financial capability of the clientele. The emergent behaviour of Zanaco in the wake of disruptive financial technologies represents financial innovation towards financial inclusion of the unbanked demographic segments of society. Financial innovation is a process, carried out by any institution, involving the creation, promotion and adoption of new including both incremental and radical products, platforms and processes (Zouari & Abdelmalek, 2020). Sadrul Huda, Kabir, Popy and Saha (2020) discuss financial innovation in the context of Bangladesh, and argue that financial innovation is critical to the development of the financial system in modern society. For banking institutions to survive in the competitive financial business environment, financial innovation should be the cutting edge of sustainability and growth. Piotrowska (2016) adds to this perspective emphasising that banks are no longer the only institutions active in the payments market: new market players emerge such as mobile operators and virtual payment services.

CO-EVOLUTIONARY DYNAMICS OF FINANCIAL INCLUSION OF GENERATION Z

In pursuit of the second objective of the research, causal loop analysis was used to visually quantify the co-evolutionary dynamics of financial inclusion of Generation Z within a digital financial ecosystem. The analysis was underpinned by the theoretical perspective of Complex adaptive systems. Causal links were identified from the thematic analysis of the data that revealed the interactions, feedback mechanisms and emergent properties of the financial ecosystem under study. A co-evolutionary dynamics model of financial inclusion of Generation Z was then developed and represented as a causal loop diagram. A causal loop diagram typically consists of four basic elements: the variables, the links between

them, the signs on the links showing how the variables are interconnected, and the sign of the loop showing what type of behaviour the system will produce. By representing a phenomenon from a causal perspective, the dynamics that produce complex behaviour can be understood to assist in decision-making.

Figure 5. Co-evolutionary dynamics of digital financial inclusion of Generation Z



Source: own study.

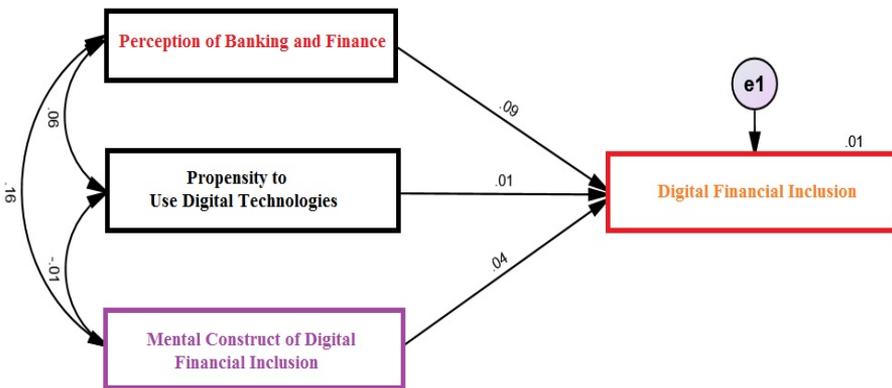
The co-evolutionary dynamics model shown in figure 5 demonstrates that the structural force driving digital finance is the Fourth industrial revolution (4IR). As elaborated in the introductory section of this paper, the 4IR is rapidly transforming modern lifestyles thereby creating a digital society. Thus, financial business sustainability is positively influenced by the digitising financial ecosystem, which engenders the emergence of disruptive financial technologies. The disruptive nature of financial technologies is evidenced by revolutionary pathways of adaptation and transformation. Therefore, the sustainability of a financial business institution depends on adapting to the disruptive force of financial technology, which at the same time transforms the digital financial service delivery. Financial technology further provides scope for financial institutions to be customer-centred in the delivery of financial services with enhanced consumer protection against insecurity of the cyber-space. A guar-

anteed consumer protection leads to adoptive response to digital financial services. The critical pathways to digital financial inclusion are then the enhanced financial capability and participatory accountability at the regulatory frontier of digital finance. On participatory accountability, Participate (2020) explain that it is necessary for the realities of the marginalised to be understood and for their voices to be heard; and this can be achieved through processes that enable personal empowerment, collective identity building and knowledge of rights. Knowledge generated by people in the margins must complement statistical data in order to build a deeper understanding of the issues that perpetuate poverty and inequality and how to address them (Participate, 2020).

STRUCTURAL EQUATION MODELLING OF DIGITAL FINANCIAL INCLUSION

In all its complexity, the digital financial inclusion of Generation Z was befittingly modelled using the multivariate statistical technique of Structural equation modelling. The structural equation model was constructed with digital financial inclusion as the endogenous variable, while perception of conventional banking and finance, propensity to use digital technologies, and mental construct of digital financial inclusion constituted the exogenous variables. The resultant path diagram of the structural equation modelling was generated to show the standardized estimates of the causal relationships as represented in figure 6.

Figure 6. Path diagram for the mental construction of digital financial inclusion of Generation Z



Source: own study.

The path diagram in figure 6 demonstrates that the digital financial inclusion of Generation Z is highly influenced by the perception of Generation Z of the exclusivity of conventional banking and finance. This is based on the resultant standardized coefficient of 0.09, which is twice the coefficient for the mental construct of digital financial inclusion, and nine times the coefficient for the propensity to use digital technologies. However, one salient feature of the results is that all the exogenous variables as well as the unobserved variables were all statistically significant in predicting the endogenous variable. Table 3 shows a p-value of 0.001 for all the variables. However, the mental construct of digital financial inclusion has the highest direct effect (1.883) on the dependent variable.

Table 3. Statistical significance of the exogenous and unobserved variables

Parameters	Estimate	S.E.	C.R.	P-value
1. Perception of banking and finance	0.755	0.056	13.398	0.001
2. Propensity to use digital technologies	0.030	0.002	13.398	0.001
3. Mental construct of digital financial inclusion	1.883	0.141	13.398	0.001
4. Unobserved, e1	0.330	0.025	13.398	0.001

Source: own study.

Another important result of the data analysis is of the two-tailed test of significance (see table 4), which showed that the mental construct of digital financial inclusion had the most direct effect on the need for digital financial inclusion of Generation Z as compared to the perception of banking and finance, and the propensity to use digital technologies.

Table 4. Two-tailed test of significance of the standardized direct effects

	Mental construct of digital financial inclusion	Propensity to use digital technologies	Perception of Banking and Finance
Digital financial inclusion	0.365	0.051	0.166

Source: own study.

This research brings a balanced perspective to the quest for the development of inclusive financial business models, particularly in sub-Saharan Africa where there is a demographic boom of young people with a growing propensity for digital consumerism. As such the research contributes an advanced understanding of the co-evolutionary dynamics of financial inclusion within a complex adaptive financial ecosystem that is rapidly undergoing digital transformation. To this effect, financial business models in the era of the Fourth industrial revolution must focus on enhancing financial capability and participatory accountability of the clientele. While a co-evolutionary perspective may be appropriate for studying the increasingly complex business ecosystems, clearly identifying the co-evolutionary mechanism can be challenging. In this vein, Breslin, Romano and Percival (2016) suggest that co-evolutionary studies need to identify measures at multiple levels within the organization's hierarchy to capture the co-evolutionary nature of changing ideas, capabilities and knowledge. Another challenge is taking the temporal dimension into account. Lewin and Volberda (1999) advise that co-evolutionary studies need to be conducted over a long period of time within a historical context. This research was delimited to an instrumental case study of a digital financial ecosystem. Consequently, latent variables for the co-evolutionary dynamics of financial inclusion may not have been captured. Therefore, future research of this nature needs to consider modelling the digital financial inclusion as an evolutionary game.

■■■ CONCLUSIONS

With the growing digital consumerism in modern society that weaves higher expectations of customer experience, this paper explored the co-evolutionary dynamics of financial inclusion of Generation Z in digital financial ecosystems. The objectives of the paper were twofold: firstly, to characterise the dynamic complexity of a digital financial ecosystem; and secondly, to visually quantify the co-evolutionary dynamics of financial inclusion of Generation Z in the digital financial ecosystem set within sub-Saharan Africa. The paper has demonstrated that digital financial inclusion occurs within a continuum of co-evolutionary dynamics in which the financial institutions build consumer demand for digital financial services based on the participatory accountability and financial capability of the clientele. The paper concludes that digital financial inclusion is an emergent outcome of the complex adaptive behaviour of a fi-

nancial business ecosystem in the increasingly digitising society. Therefore, development of inclusive financial business models must embrace the digital consumerism of the clientele, particularly in sub-Saharan Africa where there is a demographic boom of Generation Z with a growing propensity for digital consumerism.

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