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Does the fintech ecosystem promote effective financial inclusion in Kenya?

Odongo Kodongo*

Abstract

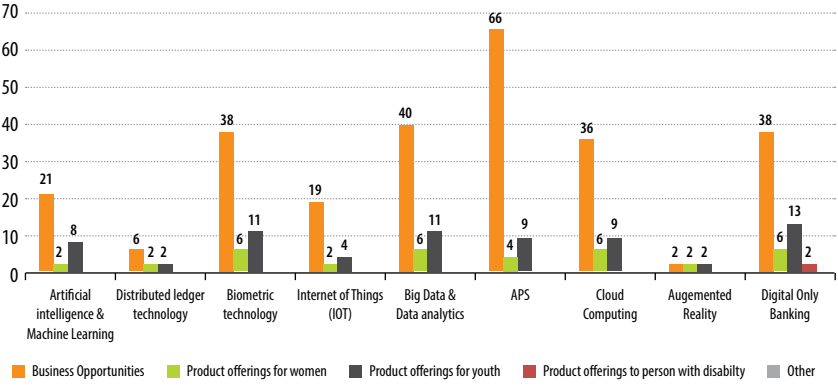
We examine the effect of the fintech ecosystem on the consumption of formal financial services such as savings, credit and use of capital markets instruments in Kenya. We deploy Probit regression on data from FinAccess Survey for 2016 and 2021. Findings suggest that the fintech ecosystem facilitates credit evaluation and fosters credit use, offer financial products and services that better match users' needs hence fostering usage of those services, but does not mitigate the distance barrier. Second, the probability of an individual enjoying fintech ecosystem services falls by at least 19% if the individual resides in Northern Kenya. Third, the fintech ecosystem increases the probability of usage of traditional services of financial institutions by at least 5.2%. Fourth, the financial inclusion gains of the fintech ecosystem are not uniform across all user categories. We recommend several policy actions such as improved provisioning of physical infrastructure in remote areas, fiscal policy incentives, and affirmative action on financial inclusion.

* Odongo Kodongo is affliated to The Wits Business School,
2 St. David's Place Parktown 2193, Johannesburg, South Africa)

1.0 Introduction

Kenya's fintech ecosystem has witnessed remarkable growth since the revolutionary m-pesa was launched in 2007. Data from the Central Bank of Kenya (CBK) show that the value of mobile money transactions conducted through agents during July 2022 stood at KES 722.52 billion[1], equivalent to about 6% of the country's GDP. The country had at least 385 registered fintech firms/startups by July 2022 operating in various fintech subspaces such as savings and credit, foreign exchange and cryptocurrency, insurance, and micro/neo-banking.[2] Additionally, the traditional banking subsector has increasingly incorporated digital technology into its product offerings as shown in **Figure 1**: for example, about 38% and 40% respectively of Kenyan banks use digital only banking and big data and data analytics. Indeed, CBK's 2021 Banking Sector Innovation Survey reports that banks' reliance on analytics (based on data gathered from social media) to understand customer needs and feedback grew by 74% during 2021, replacing exploratory customer interviews, the erstwhile preferred feedback and "intel" channel per the 2020 Survey.

Figure 1: Kenyan banks' utilization of technology in product offerings[3]



Source: Central Bank of Kenya

1. https://www.centralbank.go.ke/national-payments-system/mobile-payments/
2. https://tracxn.com/explore/FinTech-Startups-in-Kenya
3. Banking Sector Innovation Survey 2021

Interestingly, data from the 2021 FinAccess Kenya Household Survey, used in this study, also report remarkable growth in financial inclusion in the country since 2006.

Anecdotal observations, illustrated with stylized facts in Section 2, shows a close relationship between changes in financial inclusion and dynamics in the participation in the digital ecosystem in Kenya. Thus, this study sought to establish whether the fintech ecosystem has played an empirically identifiable role in promoting effective financial inclusion in Kenya. We argue that financial inclusion, if effective, should go beyond mere access to financial services typified by such concepts as "account ownership" used in many previous studies (e.g., Jack & Suri, 2014).

Accordingly, for this study, we define financial inclusion in the effective sense as "usage of a broad range of financial services offered by formal financial institutions, notably banks, and securities traded in the capital markets." The study empirically tests the argument of Arner et al. (2020) that the real opportunity afforded by fintech, in the long term, is that it develops "an entire infrastructure for a digital financial ecosystem that underpins financial development, inclusion, stability and integrity."

Arner et al. (2020) identify four pillars of digital financial infrastructure that constitute the fintech ecosystem: (i) digital ID and electronic know-your-customers and simplified account opening; (ii) open electronic payment systems, infrastructure and an enabling regulatory and policy environment; (iii) account opening initiatives and electronic provision of government services; and (iv) digital financial market systems and infrastructure that support value-added financial services and deepen access, usage and stability.

In the same spirit, Subramaniam (2020), groups the digital ecosystem into two sub-components: production (supply-side) ecosystems, which exploit data connectivity availed by digital technologies to shape interdependencies often founded upon traditional value chains; and, consumption (demand-side) ecosystems, which are largely nontraditional interdependencies founded upon data generated by product usage enabled by modern digital technologies. Both sub-components could play an important role for effective financial inclusion. For example, on the supply side, subject to government agencies providing a conducive regulatory environment (e.g., tax incentives, and expeditious licensing procedures), fintech start-ups, through their innovative activities, transform and unbundle traditional financial services to create highly personalized products that target specific markets (Senyo et al., 2022).

To deliver these unbundled products to their niche markets, fintech firms rely on platforms such as mobile devices, cloud computing and big data analytics availed by technology developers in the ecosystem. The efficiency benefits of these innovations relative to traditional modes of financial service delivery can be enormous.[4]

4. For example, cloud computing may help fintech firms to rollout web-based services at a small cost relative to the cost of in-house infrastructure development, while the availability and reach of mobile services, including extensive coverage of remote locations, reduces the costs of service provision to a tiny fraction of that of distributing services through traditional models that deploy brick and mortar branches.

Although the early adopters of fintech services and products are, generally speaking, the wealthy and the tech-savvy younger individuals (Lee & Shin, 2018), the ubiquity of smart phones and of big data analytics could be, and have been, used in developing countries (see e.g., Lashitew et al., 2019), to channel these services to less affluent and typically disadvantaged populations, further indicating that well-developed fintech ecosystems could facilitate effective financial inclusion. It is in this respect that mobile money have long been regarded as a convenient, secure, and efficient way to provide access to formal financial services to individuals typically excluded from the formal financial services sector (Natile, 2020).

However, the literature on the role that the fintech ecosystem could play in informing effective financial inclusion is still scarce. We identify a few studies employing Kenyan data that are remotely related to ours. Kim (2020) finds that mobile money has improved the quality of life of the poor in Nairobi by providing a savings service that better suits their needs enabling them not only to save but to do so more frequently. Ntwiga (2019) finds that consumption of credit is influenced by perceptions on cost, trust, source of financial advice, and financial literacy and that fintech intervention positively influences these perceptions. Osoro & Muriithi (2018) make a strong case for going beyond the mobile payments services and incorporating "deeper usage of financial services" when interrogating financial inclusion. They find that mobile money is an essential input contributing to the utilization of formal financial services but does not, on its own, constitute financial inclusion.

The common thread running through these studies is their emphasis on usage of financial services (beyond mere access). This is in line with existing studies such as World Bank (2014), which argue that while mobile payment services facilitate financial access, they should not be regarded as an end in themselves and that financial inclusion should be inferred only when an individual uses a multiplicity of welfare-enhancing intermediated services such as savings, credit, insurance, pension and, where possible, capital markets products (e.g., shares, bonds and mutual funds).

Importantly, these studies' emphases on usages beyond payment services is consistent with our study, which defines effective financial inclusion from the "usage dimension". The three studies nonetheless focus on only one aspect of the fintech ecosystem, mobile money usage, and neglect other facets especially the supply side in the fintech ecosystem, a gap that our study attempt to address.

Our study contributes to the strand of the literature that has examined fintech ecosystems and related it to financial inclusion. For example, Gabor & Brooks (2017) have documented the linkages between digital "revolution" and financial inclusion, pointing out that fintech thrives on commodification of new financial consumers' personal data and use of data analytics to nudge individual behavior in desired

directions and to inform risk management strategies. They adopt a cynical view, suggesting that due to its foundation in data analytics, financial inclusion (in the context of digital finance) is merely "a process of bringing the 'unbankable' into the market, making governable subjects more legible to the state, and importantly, deploying the assets they generate for broader strategies of capital accumulation."

Adopting a similar view, Natile (2020) criticizes the 'philanthrocapitalism' narrative of digital finance, arguing that mobile money (specifically m-pesa), although touted as a development agent, focuses on private profit and fails to address the underlying causes of financial exclusion, such as lack of resources and irregular/low income. The data appear to bear out this sentiment. For example, Fuliza, Safaricom's short-term credit service linked to m-pesa, charges a minimum daily maintenance fee of KES 18 on transactions between KES 1001 and KES 1500, which translates to approximately 36% monthly interest rate.[5] This is rather too expensive to facilitate lasting welfare improvement, the expected outcome of effective financial inclusion for previously excluded individuals (e.g., N'dri & Kakinaka, 2020). Observations of this nature strengthen the need to empirically examine the nature of the relationship between consumption of fintech services and the consumer's effective financial inclusion.

It is no surprise therefore that there are mixed views on the linkages between the fintech ecosystem and financial inclusion and/or economic development. Mallinguh et al. (2017) observe that the launch of m-pesa has ignited a remarkable digital revolution in Kenya, the result of which has been the merger of mobile and financial services that has improved connectivity, expanded financial inclusion, and pressured the government to address the provisioning of relevant infrastructure, address cyber-security threats, and, importantly, develop an enabling regulatory environment. However, Yue et al. (2022) find that digital finance has created perverse incentives such as lack of self-control and impulsive spending, whose consequences have been increased debt burden amongst the newly included financial consumers, which has overshadowed the positive benefits of improved access to the credit market, namely, the newly included individuals' propensity to consume.

Some recent studies have sought to establish a closer role for fintech ecosystems in financial inclusion. Kangwa et al. (2020) find that digital financial inclusion is the result of the complex adaptive behavior of the financial ecosystem and recommend that the development of inclusive financial business models should consider the clientele's digital consumerism especially in Sub-Saharan Africa where a boom in youthful tech-savvy consumers (Generation Z) has spurred growth in digital consumerism. In discussing some possible impediments to full adoption of digital technologies and therefore their utility in enabling financial inclusion, SKOLKOVO (2015) points out that potential customers often have limited capabilities due, say, to constraints in access (e.g., unavailability of a stable, affordable internet connection) or lack of requisite skills (e.g., literacy and computer

5. The complete list of charges is available on Safaricom's Fuliza/m-pesa website (accessed 03.10.2022).

proficiency). Thus, successful digital platforms must not only create a well-functioning technological solution but also develop an interface that can address the capability constraints if technical feasibility and simplicity in financial transactions is to be achieved.

Focusing on one aspect of the fintech ecosystem, Rauniyar et al. (2021) proposes a conceptual model for understanding the role of fintech and innovations on digital financial inclusion. They submit that digital technology promotes trust, and deepens unity among parties, in the process, boosting digital financial inclusion. They argue that digitalization can benefit the underprivileged by bringing them into the formal financial system where they can realize welfare gains from increased usage of financial services. The model implies that a positive relationship exists between fintech and (digital) financial inclusion. This study tests, and provides evidence on, the existence of the positive nexus implied in Rauniyar et al. (2021).

Our study contributes to this literature in several ways. First, using the FinAccess data, covering over 7000 randomly chosen households, we provide evidence on reasons for the use of fintech services by Kenyans. We demonstrate empirically that fintech services by leaving a record of usage, provides a history of financial transactions of clients thereby facilitating their (clients') evaluation and scoring and hence fosters credit access to individuals who would ordinarily be denied access due to lack of history. Further, we ascertain that the fintech ecosystem, perhaps due to its application of big data analytics which uses algorithms to model customer preferences, is able to offer products and services that are more attuned to the needs of individuals than does the traditional financial institutions. The findings also dispel the commonly held view that fintech services addresses financial access and usage by obviating the distance to financial institutions. Indeed, we establish that fintech services and traditional financial services are complements as far as distance is concerned and distance to mobile money agent, for example, discourages fintech use as much as distance to a bank discourages the use of traditional financial institutions. Lastly, we document that the probability of an individual enjoying services available in the fintech ecosystem falls by at least 19% if the individual resides in Northern Kenya, where the fintech infrastructure is relatively underdeveloped.

Second, we provide evidence on the role played by the fintech ecosystem in supporting effective financial inclusion in Kenya. That is, we demonstrate a robust positive relationship between the consumption of financial services such as credit, savings and investments and the fintech ecosystem. Specifically, the results show that the fintech ecosystem increases the probability of usage of products/services of traditional financial institutions by at least 5.2 percentage points after controlling for various individual-level factors and after controlling for locational factors typically associated with access and usage of financial services and products. Similar results are documented for the usage of mobile bank products: the probability of usage of such services increases by at least 9.6% for individuals who can exploit the fintech ecosystem. Expectedly, the fintech ecosystem has a weaker relationship (the coefficient is significant at 10%) with the usage of capital markets products such as securities (e.g., shares, bonds, bills) and wealth management products/services offered by investment companies such as unit trusts and hedge funds, whose presence in Kenya is still in its infancy, with

usage appealing largely to sophisticated and wealthy investors who can access investment advice, usually at a fee.

Third, we sought to establish the demographic characteristics of the key beneficiaries of fintech as far as financial inclusion is concerned. We find that the fintech ecosystem has little or no effect on the savings appetites and interest in the capital markets amongst Kenyans. However, we document time-variation in the effect of the fintech ecosystem especially on the consumption of capital markets products (shares, bonds, unit trusts etc.) between 2016 and 2021. For 2021, our findings show that the uptake of capital markets investments improved, interestingly, for women, the low-income earners, and the less educated (primary school or less). The effects also differ by usage, with formal credit consumption appearing to be influenced by the fintech ecosystem especially among females, people in the upper income groups, older individuals (people aged above 34 years) and individuals with superior education (secondary school or better). Therefore, the fintech ecosystem appears to have played an important role in capacitating women and improved their ability to access and use formal credit services. This is important in a country where a large number of women, and especially women-owned enterprises, due to inadequate or lack of access to formal financial institutions, depend largely on informal financial services such as "table banking"[6] to meet their financing needs (Cherotich et al., 2022; Gichuki et al., 2015).

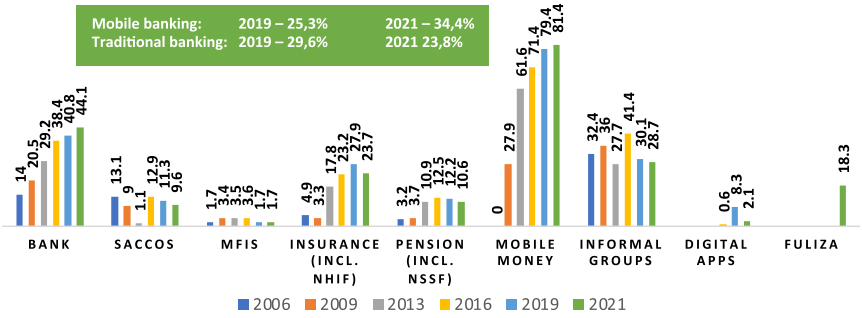
The balance of this paper is organized as follows. We provide some stylized facts on the fintech ecosystem and financial inclusion in Kenya in Section 2; and describe the conceptual framework, empirical approach and data in Section 3. We present and discuss the empirical results in Section 4; and conclude in Section 5.

6. Table banking is a form of rotating savings and credit organizations in which members pool their savings and borrow immediately from the contributions "on the table" for periods typically not exceeding one year. Interest is charged on the borrowing usually at 1% per month, on a simple interest basis.

2.0 Stylized Facts and Study Objectives

This study sought to establish the role of the fintech ecosystem in promoting effective financial inclusion, in Kenya, whose financial inclusion data are available for 2021. Further to data considerations, we chose Kenya for several reasons. First, as the pioneer of mobile money technology (Jack & Suri, 2014), Kenya has witnessed notable expansion in the fintech sector in recent years (Bachas et al., 2018) cash transfer beneficiaries who already received their transfers in bank accounts and subsequently received debit cards reduce their median distance to access the account from 4.8 to 1.3 kilometers and report being less likely to forgo important activities (childcare, work, with many innovations around the mobile wallet concept. Second, the country ranks first in Africa (and second only to China in the world) in mobile payment usage, with transactions via mobile wallets and phones amounting to about 87% of its GDP.[7] Thus, given its leadership role in mobile money technology, Kenya is a natural laboratory for examining the dynamics of the fintech ecosystem and its implications to financial inclusion.

Figure 2: The changing landscape of financial services, 2006 – 2021

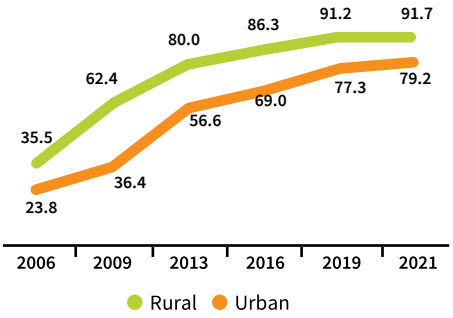


Source: FinAccess Kenya Household Survey, 2021

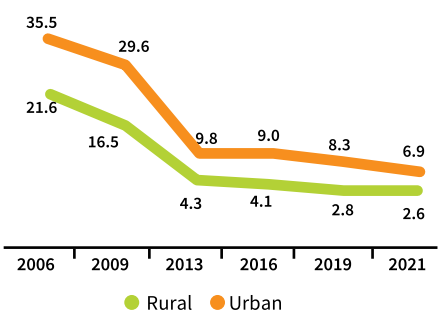
7. This is according to a discussion paper recently posted the Boston Consulting Group website.

Figure 3: Access to financial services by residence, 2006 – 2021

(a) formal access: Rural vs. Urban



(b) informal access: Rural vs. Urban



Source: FinAccess Kenya Household Survey, 2021

Stylized facts appear to bear out the intuition that financial inclusion may be associated with growing usage of the fintech ecosystems in Kenya. For example, using the FinAccess Kenya Survey 2021 data, **Figure 2** shows an increasing trend in digital finance uptake, with mobile money usage, for example, having grown over the decade from 27.9% of the population in 2009 to 81.4% in 2021.

The growth in consumption of fintech services appears to coincide with increasing access to, and possibly consumption of, formal financial services (e.g., commercial banks, pension firms and insurance companies) during the same period, indicating potential linkage between effective financial inclusion and the fintech ecosystem. Interestingly, the use of digital loan apps has grown over the three years to 2021 alongside a decline in the usage of services of microfinance institutions (MFIs), suggesting a possible trend away from MFIs towards digital financing of small-scale ventures, attributable to the rigidity in the evaluation and approval procedures of a typical credit application in the traditional MFI model relative to the digital credit model; similarly, mobile banking, an important aspect of fintech ecosystem, expanded from 25.3% in 2019 to 34.4% in 2021.

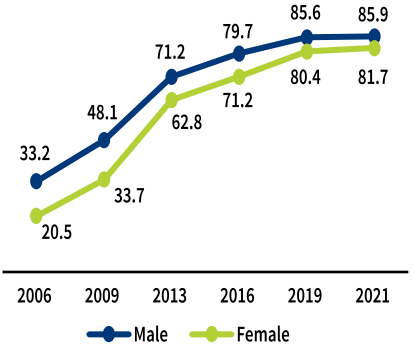
Overall, the data appear to indicate a steady growth in access to (and possibly consumption of) formal financial services since 2006 when the first FinAccess Household Survey was conducted. As **Figure 3** shows, the gains in access to formal financial services appear to be realized at the expense of informal financial services (e.g., table banking and Saccos). Given this observation, and the fact that the uptake of fintech products has increased over roughly the same period (**Figures 1** and **2**), it is interesting to establish whether the fintech ecosystem has played any role in promoting access to formal financial services in Kenya. This is the first objective of this study.

Access to financial services in the country differs by demographic characteristics. For example, there are discrepancies in access by location, with urban dwelling apparently favoring its residents in access (with the access inequities appearing to diminish with the passage of time) relative to rural dwelling (see Figure 3). Similarly, the female-folk appear to be on the trail of their male counterparts in access to formal financial services even though the gender divide also appears to have narrowed over time (**Figure 4**). Given the increasing presence of digital financial services (Figure 2), it is interesting to establish whether the observed diminishing of differences in access to formal financial services by several demographic characteristics can, in any way, be attributed to the fintech ecosystem. Our study seeks to empirically investigate this possibility as the second objective.

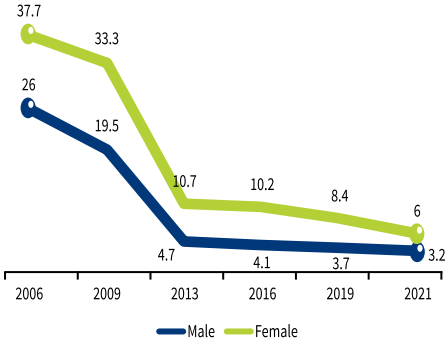
An important question that arises when one argues that the fintech ecosystem may have a role to play in the evolution of effective financial inclusion is *"how*, conceptually, this could happen". Digital ecosystems may be linked to effective financial inclusion through various channels. First, access to financial services in the traditional brick-and-mortar sense does not guarantee effective usage (savings, investments, credit etc.) of the services. In countries, such as Kenya, where the informal sector creates at least 80% of total employment, physical access to financial institutions entails large costs (transactional costs, travel costs, and opportunity costs in terms of daily earnings lost) which discourage usage of the services offered by those institutions (Muralidhar et al., 2019). Because digital money transfer (a key aspect of the fintech ecosystem) helps save costs such as travel and lost

Figure 4: Access to financial services by gender, 2006 – 2021

4(a) Access to formal financial services



4(b) Access to informal financial services



Source: FinAccess Kenya Household Survey, 2021

earnings, it may help to address the problem of access (i.e., financial inclusion) without usage (i.e., effective financial inclusion).

Second, where credit access is often tied to the borrower's credit history, as is often the case, an important facilitation role of the digital ecosystem is that digital transactions leave an electronic trail which not only creates transparency but also establishes a financial history. Third, through big data and data analytics enabled by digital ecosystems, service providers (e.g., fintech start-ups, commercial banks, and insurance companies) have better understanding of the risk profiles of consumers (Gabor & Brooks, 2017), which enables them to channel appropriate products to potential users. Thus, our third purpose, in this study, is to empirically ascertain whether the fintech ecosystem works through channels such as history, and transaction costs (e.g., distance to financial institution) to foster effective financial inclusion in Kenya.

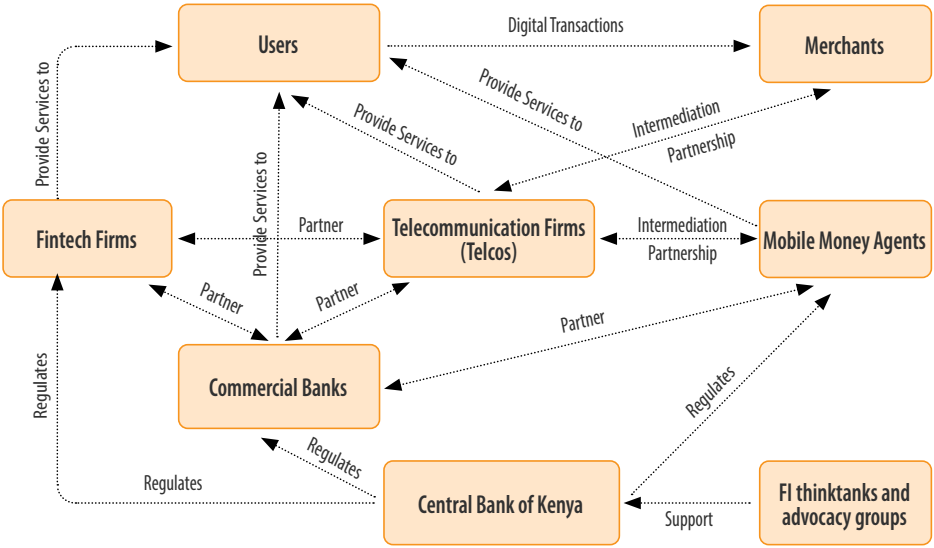
3.0 Empirical strategy

3.1 Conceptual framework

We define the fintech ecosystem following Barykin et al. (2020) and Oborn et al. (2019) as a self-organizing, dynamic, and interconnected, network that facilitates efficient exchange of information and resources amongst various categories of interested, but usually autonomous, economic agents (e.g., service providers, regulators, and customers), and allows them to leverage new and legacy digital technologies to organize processes in ways that enable them to advance their separate, but interlinked objectives.

Thus, a fintech ecosystem can be described as a network of relationships in which various interrelated parties, each pursuing their own objectives, interacts with others through partnerships, regulatory linkages, service provision, intermediation,

Figure 3: The fintech ecosystems in Kenya



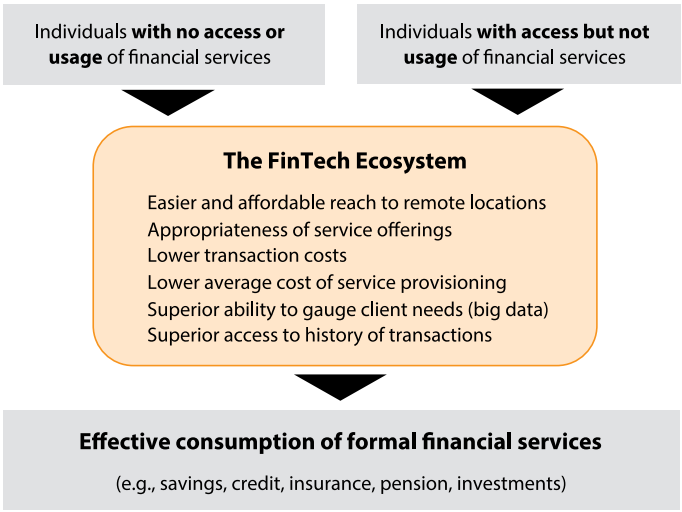
Source: Senyo et al. (2022), adapted

and advisory/advocacy in ways that yield results and benefits that are likely superior to those that could be realized by individual players each acting on their own. For example, if each mobile money agent were to develop and use a mobile money platform, the resulting duplication of infrastructure would drive the cost of provisioning of such services beyond the societally optimal levels.

That is, fintech ecosystems enable participants to specialize in the provision of services in which they have comparative advantage, which lowers the aggregate cost of provisioning of the interrelated services. Thus, higher levels of effective financial inclusion should be realized with the presence of a fintech ecosystem than would be attainable under the traditional system of provisioning financial services. For example, commercial banks could provide services directly (through the traditional channels such as banking halls) or by partnering with telcos to use mobile service platforms, with the partnership fostering access to remote locations and lowering costs of service provision (e.g., eliminates the need for direct investment in bricks and mortar or renting of space).

The wider reach enabled by mobile provisioning means that more people, including those hitherto unbanked, can access financial services, whilst the lower costs of service provision foster effective utilization of such services (e.g., for loan applications, transactions and savings).

Figure 6: The Conceptual Framework



Source: Author's construction

Further, Senyo et al. (2022)limited research theorises how new entrants and incumbents work together in FinTech ecosystems to shape financial inclusion. We undertake a theory-generating case study with multilevel interacting organisations in Ghana, where, like many other African countries, the growth in FinTech has led to new opportunities for financial inclusion. We conceptualise three practices, as building blocks at the ecosystem level, through which incumbents and new entrants shape financial inclusion: (1 argue that to have an effect on financial inclusion, the development of fintech services requires a conscious and well-thought-out integration of capabilities and resources from three competing but complimentary traditional supply-side sectors, namely, information technology, telecommunications, and banking. Similarly, the government, an important part of the ecosystem, must step up on its mandate to enact regulations that are both protectionist and equitable to traditional and emerging actors in the fintech ecosystem. Following these arguments, Senyo et al. (2022)limited research theorises how new entrants and incumbents work together in FinTech ecosystems to shape financial inclusion. We undertake a theory-generating case study with multilevel interacting organisations in Ghana, where, like many other African countries, the growth in FinTech has led to new opportunities for financial inclusion. We conceptualise three practices, as building blocks at the ecosystem level, through which incumbents and new entrants shape financial inclusion: (1 construct the fintech ecosystem for Ghana, which we adapt to Kenya. The adapted ecosystem is shown in Figure 5. Based on these arguments, we evolve a conceptual framework depicted in Figure 6. In brief, the framework indicates that greater effective financial inclusion is enabled by the fintech ecosystem (the totality of participants, each acting in their in pursuit of their selfish objectives, in the digital financial space and the interrelated networks governing their relationships) through various channels, identified in the literature, such as greater ability to reach remote locations at the lowest possible cost of service provision, and availability of information to facilitate client screening and to anticipate customer preferences. Our study tests the implications of this framework in various ways as discussed in the empirical models.

3.2 Empirical strategy

3.2.1 The role of fintech ecosystems in informing effective financial inclusion in Kenya

We start by hypothesizing that the savings in service provisioning costs, greater efficiency in the allocation of roles (e.g., arising from increased specialization on the supply-side), and benefits from superior ability to gauge clients' needs, due largely to big data analytics (Bachas et al., 2018)cash transfer beneficiaries who already received their transfers in bank accounts and subsequently received debit cards reduce their median distance to access the account from 4.8 to 1.3 kilometers and report being less likely to forgo important activities (childcare, work, among others, availed through the fintech ecosystem collectively facilitate effective financial inclusion. That is, we hypothesize as follows.

H1: The fintech ecosystem promotes effective financial inclusion in Kenya

To test this hypothesis, our identification strategy is guided by the following econometric specification, which enables us to examine the fintech ecosystem as an important agent of effective financial inclusion.

$$\text{Effinincl}_i = \gamma_0 + \gamma_1 \text{Fintecosys}_i + \gamma_2' \text{Controls}_i + \varepsilon_i \quad \ldots\ldots (1)$$

where Effinincl_i represents the effective financial inclusion[8] of the th individual, proxied alternately by various metrics of non-transactional usage of financial products/services such as credit, investments, and savings. Fintecosys_i is constructed as a "usage score" for the th individual, using data obtained from the FinAccess Kenya Financial Inclusion Household Survey. Controls_i represents various characteristics of individuals believed, in the literature (e.g., Allen et al., 2021; Kodongo, 2018)financial inclusion, and profitability for Equity Bank. Unlike traditional banks, including foreign and government owned banks in Kenya, Equity Bank targets less developed territories and less privileged households. Its presence increased financial inclusion by 31% of the adult population between 2006 and 2015, especially for Kenyans who were less educated, did not own their own home, and lived in less-developed areas. The bank's business model proves to be highly effective, with branch-level profits rising in areas with a smaller number of operating banks. Overall, the growth of Equity Bank demonstrates that financial inclusion can be achieved and sustained through profitable branching and service strategies that also serve the needs of underserved regions and populations. Thus, financial inclusion need not come at the sacrifice of bank profitability. © 2020 The Author(s, to be able to explain financial inclusion in Kenya and include age, level of education, earnings, rural vs urban dwelling, gender, possession of (various types of) assets, ability to speak Swahili and/or English, among others. Equation (1) is estimated using Probit regression. In Kenya, there is notable disparity in the aggregate income of counties[9], which may also reflect in the degrees of financial inclusion of residents. To control for this, we cluster standard errors by county. ε_i is the random error term assumed to have zero mean and variance $\sigma^2_{\varepsilon_i}$.

3.2.2 Channels through which fintech ecosystems influence effective financial inclusion in Kenya

The special agent theory of financial inclusion (Ozili, 2020) provides the framework for analyzing barriers to financial inclusion. The theory argues that complex issues relating to the nature of the population,

8. Financial inclusion entails the expansion of provisioning of financial services/products in ways that intentionally integrate segments of society such as women, individuals with low education, rural inhabitants, low-income individuals and the like, all of which ordinarily would not have meaningful, if any, access to the financial services and products typically offered by formal establishments" (Ojah & Kodongo, 2022). A key aspect of this definition, "meaningful access", speaks to our study's focus on "effectiveness" of financial inclusion. Effective financial inclusion goes beyond mere access to financial services. Effective financial inclusion, in the context of this study, therefore, relates to utilization of standard financial services/products offered by formal establishments and includes, among others, usage of bank-offered credit services, and consumption of savings and investments products available in the capital markets.

9. See, e.g., Kenya National Bureau of Statistics Report, available at: https://dc.sourceafrica.net/documents/118586-Gross-County-Product-Report-2019.html (accessed 17.03.2022).

the characteristics of its people, and geography, may impede the provisioning of financial services to a section of the population. To address these impediments, specialized agent(s) (e.g., fintech and technology firms) may be required to facilitate the provisioning of financial services to those who are excluded.[10] To effectively address the financial inclusion barriers, the specialized agent(s) must, among others, be able to understand the peculiarities of the financial excluded (in the fintech ecosystem, this is often achieved through big data and big data analytics); devise ways of integrating the informal financial system into the formal financial system (e.g., through the use of digital savings products such as M-Shwari); and identify areas of improvement and modalities of intervention (e.g., through product innovation). The modalities of intervention form the main subject of discussion in this section.

That is, we explore the specific mechanisms through which the fintech ecosystem may influence effective financial inclusion in Kenya. Understanding the channels of transmission is important for several reasons. First, it informs our appreciation of how the fintech ecosystem works and generates insights for policy formulation. Second, it also reduces the concern that the relation between fintech ecosystems and financial inclusion may be spurious and perhaps driven by extraneous factors that may contemporaneously affect both. A well-functioning fintech ecosystem should promote financial inclusion by mitigating barriers to financial inclusion, which may be price- or non-price-related. Price-related barriers include, but not limited to, inadequate or no income to maintain a financial institution account, cost of financial services (e.g., loan origination fees), and complicated products; while non-price-related

10. In some cases, the specialized agent may be created and/or purposed by a principal (e.g., government) specifically to facilitate financial inclusion: for example, the Indian government's 2016 Jan Dhan Yojana program to encourage bank account ownership (Demirguc-Kunt et al., 2017) and the more recent India Stack, purposed to bring India's population into the digital age (Das & Das, 2020)banking and financial services have widened their scope. India achieved FinTech adoption rate of 87 percent as against the global average of 64 percent mostly contributed by FinTech startups aiming for providing access to financial services even in the remotest areas. Realizing the potential of FinTech to contribute toward financial inclusion and stability, the Governments have taken requisite steps toward digital transformation and promote FinTech ventures. In order to meet the customers' needs, collaborative moves with FinTech firms have been initiated by financial institutions as well. This article aims to investigate the relationship between different demographic profiles, the adoption of FinTech services, the perception, user pattern, and constraints faced by the bank customers in using FinTech services. The results based on survey of 215 respondents reveal significant association between usage of FinTech services and different demographic profiles. However, the awareness and use of such services is found more among millennials and generation Z as compared with generation X and baby boomers. While the FinTech companies gained the popularity in payment space, it is observed that misconception is an important factor that hinders the growth of technology-based services among respondents.","author":[{"dropping-particle":"","family":"Das","given":"Ankita","non-dropping-particle":"","parse-names":false,"suffix":""},{"dropping-particle":"","family":"Das","given":"Debabrata","non-dropping-particle":"","parse-names":false,"suffix":""}],"container-title":"Emerging Economy Studies","id":"ITEM-1","issue":"1","issued":{"date-parts":[["2020"]]},"page":"7-22","title":"Perception, adoption, and pattern of usage of fintech services by bank customers: Evidences from Hojai District of Assam","type":"article-journal","volume":"6"},"uris":["http://www.mendeley.com/documents/?uuid=e31340c5-9871-4483-8af5-ba3eb510afbf"]}],"mendeley":{"formattedCitation":"(Das & Das, 2020, have ushered millions of hitherto excluded Indians into the formal financial system. In other cases, the specialized agent may emerge organically through "normal" product innovation to claim a place in the financial inclusion space (e.g., m-pesa in Kenya).

barriers include distance from financial institutions (see, e.g., Bachas et al., 2018; Jack & Suri, 2014) cash transfer beneficiaries who already received their transfers in bank accounts and subsequently received debit cards reduce their median distance to access the account from 4.8 to 1.3 kilometers and report being less likely to forgo important activities (childcare, work, distrust of financial institutions, financial literacy (Kodongo, 2018)we find that: (i, psychological fear of traditional financial institutions, and poor knowledge of financial services and products.[11] For example, some researchers argue that the exclusion of individuals without history can be addressed by gaining better insights about them and reducing information asymmetry using fintech tools such as big data (Daniel & Grissen, 2015; Jagtiani & Lemieux, 2018). We investigate whether fintech ecosystems indeed play a role in mitigating some of these barriers (channels through which fintech ecosystem works) by estimating the following model:

where constitutes respondents' reasons for not using formal financial services such as distance from the institution which Osoro & Muriithi (2018) find to be associated with usage of banking services in Kenya; history of transactions, and appropriateness of financial products, used alternately. These reasons, like other data, are obtained from the FinAccess Kenya Household Surveys.

3.3 Data

3.3.1 Survey design

Our analysis uses data obtained from the 2016 and 2021 FinAccess Kenya Household Financial Inclusion Surveys. Since the designs of the two surveys are similar, we describe the design with reference to the 2021 data. The sampling frame was drawn from the 5th National Sample Survey and Evaluation Program (NASSEP), which consists of 5,360 clusters stratified into urban and rural areas of each of Kenya's 47 counties. Being largely urban, Nairobi and Mombasa counties were not stratified, implying that the number of strata was 92. A three-stage stratified cluster sampling design was employed. In the first stage, 1000 clusters (434 in urban areas and 566 in rural areas) from NASSEP were selected, whilst in the second stage, systematic random sampling was used, to generate a uniform sample of 11 households per cluster. In the third stage, one eligible individual, aged at least 16 years, was selected from a roll of all eligible individuals in the household using the KISH grid. All selections were done without replacement.

A total of 8669 (out of 9709 eligible) households were interviewed, of which adults (individuals aged 18 years and above) comprised 92.4%. After collection and cleaning, the data were weighted back to the population to be representative at the national level and regional levels. The FinAccess Survey is preferred

11. https://financialmarketsjournal.co.za/enabling-financial-inclusion-through-fintech/ (accessed 20.03.2022)

for this analysis for many reasons. First, since the survey was specifically designed to measure financial inclusion, it covers the many facets of financial inclusion in Kenya (Allen et al., 2021). Second, as is clear from the stylized facts, the surveys provide information on individual/household characteristics that are useful for exploring potential heterogeneities. Third, the implementation of the surveys over several years (2006 through 2021) enables us to compare the role of the fintech ecosystem across time.

3.3.2 Measuring the digital ecosystem

In a simple framework for understanding the fintech ecosystem, Kangwa et al. (2020) submit that the building blocks of the fintech ecosystem include factors on the demand side and factors on the supply side. On the demand side, the key factors include ***digital consumerism*** (Kangwa et al., 2020), characterized by ownership of digital devices, social media networking, and the propensity and ability to use digital technologies, ***financial capability*** (SKOLKOVO, 2015), defined as possession of functional knowledge of the financial concepts, and financial products, as well as behavior and attitudes that can facilitate the usage of digital financial products, and ***financial literacy*** (Kodongo, 2018)we find that: (i, defined as possession of knowledge and skills that enable an individual to make informed and effective financial decisions). The supply side factors are ***availability*** and ***accessibility*** of financial products, regulatory frameworks, and financial technology.

We construct the digital ecosystem using data from Kenya FinAccess Household Survey. Accordingly, on the demand side, we represent ***digital consumerism*** with responses to the following questions in the survey instrument: (i) currently registered on a mobile money platform, (ii) owns a mobile phone or has access to someone else's mobile phone, (iii) mobile phone can access the internet, (iv) member of the household owns fixed internet at home (e.g., Fiber, Satellite dish, LAN, Wi-Fi), and (v) currently registered on mobile money. ***Financial capability*** is represented by ***transactional*** usage of digital money services, namely, (i) paid monthly bills using a mobile money account, (ii) paid monthly bills using pay bill/till no. using mobile money, (iii) paid school fees using a mobile money account, (iv) paid school fees using pay bill/till no. using mobile money, (v) paid daily expenses using a mobile money account, (vi) paid daily expenses using pay bill/till no. using mobile money, (vii) Sent/gave money inside Kenya using a mobile money account, (viii) sent/gave money inside Kenya using pay bill/till no. using mobile money (ix) received money from inside Kenya using a mobile money account, (x) received money from inside Kenya using pay bill/till no. using mobile money, (xi) paid a bill for medical treatment using a mobile money account, and (xii) paid a bill for medical treatment using pay bill/till no. using mobile money.

Financial literacy is proxied by responses to the following question: "Suppose you take a loan of KES 10,000 with an interest rate of 10 percent per year. How much more money would you have to pay at the end of the year?" On the ***supply side***, we use the information from the following questions in the questionnaire: (i) mobile money account inability to transact due to system down time, (ii) mobile money account agent float unavailability, (iii) mobile

money account holder unable to get to an agent, (iv) mobile money account fraud/attempted fraud (e.g., received less money from agent). These four questions represent a "dysfunction" in the provision of digital money services and are, accordingly, penalized in the construction of the fintech ecosystem score with a negative sign.[12] We take the existence of some supply side factors, such as regulatory quality, as given (Kenya, as already mentioned, has one of the more advanced digital finance platforms in Africa with a well-functioning regulatory framework).

3.3.3 Summary statistics

Descriptive statistics are shown in **Table 1.** As explained, the fintech ecosystem is represented by a score that increases by 1 for every relevant question on the demand side to which the respondent answers "Yes" and reduces by one for every question on the supply side to which the response is "Yes" (the only supply side issues captured in our score relate to dysfunctions in the ecosystem that discourage its use). The mean value of the fintech proxy is 3.655 during 2016, increasing to 4.517 during 2021, out of a plausible maximum[12] of 17; and the standard deviations are respectively 2.626 and 2.671, indicating that about 68% of the polled individuals score between (approximately) 1 and 6 during 2016 and between 2 and 7 during 2021, both below the conceptual midpoint of 8 (assuming a normally distributed population). Thus, despite the reported growth in the consumption of fintech services (**Figure 1**), the average Kenyan has yet to be adequately integrated into the fintech ecosystem. Women and rural dwellers constitute approximately 27 – 57% and 56 – 68% respectively of the sampled individuals in each of the two years. The average respondent is 37 years old in 2016 and 39 years old in 2021; and the bulk (43 – 48%) of the respondents are youthful, i.e., aged between 18 years and 34 years (the 16–17-years age group serves as the benchmark).

The table also shows that majority of our sample (53 – 60%) speaks Swahili; that only a small proportion of the respondents (about 10%) have attained or been exposed to some tertiary (university or technical) education; and that a large proportion of the respondents were either casual laborers (39%) or engaged in farming (31%) during 2021; during 2016, the majority of the sampled individuals were either farming (14%) or waged (12%). Asset ownership also reports a weak improvement between the two years with an average score of 1.27 in 2016 and an average of 1.30 in 2021 relative to a plausible maximum of 10 (the score increases by a factor of one for every asset owned), potentially indicating very low levels of welfare in the population. It is also interesting to note that those who are financially literate (ability to estimate interest on a loan), on average, also grew from about 30% of the population during 2016 to over 40% during 2021, and that the proportion of those

12 The observed minimum and maximum scores are, respectively, 13 and -1 for 2021 and 13 and 0 for 2016 (not reported in the Table).

13 Vulnerability is captured by four questions in the questionnaire that seek to establish whether respondents have (1) Gone without enough food to eat; (2) Gone without medicine or medical treatment that was needed; (3) Had to miss an important family event (funeral, wedding, etc.) because they did not have money to attend; and (4) Child or any person they support sent home for lack of school fees. Respondents choose between three answers: "often" (which we interpret as "most vulnerable"), "sometimes" (vulnerable) or "never" (least vulnerable).

who are most vulnerable[13] remained stable at less than 10% of the population, which appears to counter the low-levels-of-welfare inference when using asset ownership. Finally, because Northern Kenya is by far the least serviced by infrastructure in the country, we include a dummy to represent it if a respondent is drawn from there: about 19% and 13% of the respondents are drawn from the sparsely populated, semiarid region, respectively for the 2016 and 2021 surveys.

Table 1: Summary statistics

Variable	2016 (8665 observations)		2021 (7230 observations)	
	Mean	SD	Mean	SD
Fintec ecosystem (score)	3.655	2.626	4.517	2.671
Rural dwelling	0.560	0.496	0.679	0.467
Gender: female	0.268	0.443	0.566	0.496
Age	37.197	16.571	39.203	18.051
Age group (18–24 years)	0.185	0.389	0.179	0.383
Age group (25–34 years)	0.293	0.455	0.251	0.434
Age group (35–44 years)	0.193	0.395	0.182	0.386
Age group (45–54 years)	0.114	0.317	0.121	0.326
Age group (55–64 years)	0.074	0.262	0.086	0.281
Age group (over 65 years)	0.088	0.283	0.122	0.327
Language: English	0.203	0.402	0.323	0.467
Language: Swahili	0.526	0.499	0.597	0.491
Education: Primary	0.446	0.497	0.409	0.492
Education: Secondary	0.279	0.448	0.289	0.453
Education: Technical	0.061	0.240	0.068	0.251

Variable	2016 (8665 observations)		2021 (7230 observations)	
	Mean	SD	Mean	SD
Education: University	0.034	0.181	0.040	0.197
Occupation: business	0.095	0.293	0.002	0.044
Occupation: waged	0.122	0.327	0.113	0.317
Occupation: farming	0.141	0.348	0.309	0.462
Occupation: casual	0.097	0.297	0.392	0.488
Asset ownership (score)	1.269	1.180	1.295	1.222
Possession of ID document	0.857	0.350	0.879	0.326
Financial literacy	0.299	0.458	0.424	0.494
Vulnerability: most	0.065	0.247	0.068	0.252
Vulnerability: least	0.577	0.494	0.399	0.490
Northern Kenya	0.193	0.394	0.131	0.337

4.0 Empirical results

In the empirical analysis, we conduct several tests to establish whether the fintech ecosystems explain effective financial inclusion in Kenya. As explained in Section 3, our baseline tests employ Probit regression.

4.1 Reasons for using fintech services in Kenya

We begin by attempting to ascertain the possible reasons for individuals' usage of the fintech ecosystem in Kenya. We test the hypotheses that individuals' propensity to use fintech platforms is shaped by constraints that they face in accessing physical branches of financial institutions such as distance, or because their ability to effectively utilize financial institutions for welfare enhancing activities such as credit is subject to constraints such as lack of a history of financial transactions and availability of products that suit their needs. That is, we hypothesize that individuals use the fintech space as a medium that enables them to overcome the barriers that constrain their effective formal financial inclusion. To test these hypotheses, we estimate the following equation using Probit regression using the 2021 survey data.[14]

$$P(Fintecosys_i=1|X_i)=\Phi(\delta_{0+}\delta_1 Hist_i+\delta_2 Dist_i+\delta_3 Approducts_i+\delta_4 NKenya_i+\lambda' Controls_i) \quad \ldots\ldots\ldots\ldots\ldots (4)$$

where Φ is the cumulative standard normal distribution function indicator, and $\mathbf{X}$, the vector of explanatory variables listed on the right-hand-side. The explanatory variables are proxies respectively for "having a history of transactions with a financial institution", "distance to a financial institution" and "appropriateness of product offerings of financial institutions". The variables are constructed from the following reasons given by respondents for not having a bank account: $\mathbf{Hist}$ = "I do not have a regular income"; $\mathbf{Dist}$ = "The bank is too far from where I live" or "I spend at least KES 200 to travel by public means to the nearest bank"; and $\mathbf{Approducts}$ = "I can do all the transactions I need using a different kind of institution (e.g., chama or

14. We use the Probit estimator for consistency with the subsequent analyses. To facilitate this, we construct "Fintecosys" as a dummy variable that takes the value of 1 when the fintech score is above the median and 0 elsewhere.

Sacco)". We add a dummy variable (**NKenya**) that takes the value of "1" if the individual is from Northern Kenya where the fintech infrastructure is relatively less developed, and "0" elsewhere, and **Controls.** δ_x $(x=1,2,3)$ should be positive and significant if fintech services are a substitute for physical financial institutions services and negative and significant if fintech services complement physical financial institutions. Because of the relatively underdeveloped fintech subsector in Northern Kenya, we expect δ_4 to be negative and significant.

Results of the Probit regression are presented in Table 2. Columns (1) through column (4) report results with each of the barriers alternately, the Northern Kenya dummy and the intercept while Column (5) reports the results for the regression with all four variables included. In column (6)[15], we incorporate additional demographic controls. We report robust standard errors, clustered by the respondents' counties of residence. Our findings suggest that residents of Northern Kenya appear to be disadvantaged in accessing, and therefore enjoying the services available on the fintech ecosystem. Indeed, the probability of an individual enjoying services available in the fintech ecosystem falls by at least 19 percentage points if the individual resides in Northern Kenya. Possession of an ID document is highly economically significant in informing usage of fintech services in the country, which speaks to the fact that most individuals perform fintech activities using mobile phones for which SIM card registration is conditional on meeting know-your-customer requirements. The results also show, interestingly, that younger individuals are more likely to use fintech services than older individuals and that rural dwellers are a disadvantaged lot possibly because, like residents in the northern districts, they have relatively less developed infrastructure.

Table 2: Explaining the propensity to use fintech in Kenya, 2021

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. In parentheses are robust standard errors clustered by county.

	(1)	(2)	(3)	(4)	(5)	(6)
History of transactions	0.171 *** (0.06)				0.201*** (0.05)	0.136 *** (0.05)
Time to nearest bank		-0.414 *** (0.12)			-0.346*** (0.13)	-0.350 *** (0.12)
Product appropriateness			0.678 *** (0.18)		0.656*** (0.18)	0.572 *** (0.19)
Cost to nearest bank				-0.542*** (0.09)	-0.387*** (0.09)	-0.312*** (0.08)

15. In columns (5) and (6), the results remain qualitatively similar if we include "distance" and "cost" alternately.

	(1)	(2)	(3)	(4)	(5)	(6)
Rural dwelling						-0.434*** (0.06)
Gender: Female						-0.119*** (0.04)
Language: English						-0.078 (0.09)
Age						-0.020*** (0.00)
ID document						1.376 *** (0.08)
Vulnerability: least						0.247 *** (0.05)
Vulnerability: most						-0.096 (0.10)
Northern Kenya	-0.456*** (0.12)	-0.422*** (0.11)	-0.457*** (0.12)	-0.419*** (0.09)	-0.287** (0.13)	-0.462*** (0.12)
Constant	-0.289*** (0.05)	-0.228*** (0.05)	-0.247*** (0.05)	0.108** (0.05)	-0.234*** (0.05)	-0.355*** (0.12)
Pseudo R-square	0.0149	0.0159	0.0134	0.0335	0.0294	0.1441
Wald [p-value]	18.72 [0.00]	48.30 [0.00]	32.78 [0.00]	93.24 [0.00]	78.79 [0.00]	741.25 [0.00]
Log pseudo-likelihood	-3443	-3439	-3448	-4841	-3392	-2989
No. of observations	5272	5272	5272	7230	5272	5269

Regarding the key obstacles faced by residents of all regions of the country, findings suggest that "history of transactions" at a financial institution, and "appropriateness of financial products" to individuals' needs positively determine whether individuals use the fintech ecosystem to meet their financial needs. That is, the fintech ecosystem possibly appeals to the population through its proclivity to offer products that more closely respond to

individuals' needs and preferences[16] as well as due to its inbuilt capacity to leave a trail of evidence (history) that service providers can rely on to understand users' financial behavior (e.g., ability to meet obligations) and needs. However, unlike Osoro & Muriithi (2018), who document no relationship between distance and mobile financial services usage, our results here show that "distance to the nearest bank", like "cost to nearest bank", is negatively and significantly related to the use of the fintech ecosystem. This means that, contrary to expectations informed by some recent studies in other contexts (Dupas et al., 2018; Jack & Suri, 2014), distance/cost to a financial institution appears to disincentivize the enjoyment of fintech services in much the same way that it discourages access to branches/agents of financial institutions.

The latter finding may be explained by the fact that digital money (e.g., transactions use such as withdrawals) necessarily involves the user interacting with digital money agents, who are typically found in commercial centers (local shopping centers). Where those are the same locations in which agents and branches of financial institutions are situated, distance entails similar disincentives (e.g., travel costs and opportunity costs of foregone earnings) to the utilization of fintech services as it would to physical access to financial institutions.[17] Thus, the overriding implication of these findings is that the fintech ecosystem is a possible important alternative avenue for promoting effective financial inclusion that can productively complement the traditional financial infrastructure in Kenya. We examine this possibility in the subsequent sections.

4.2 Does the fintech ecosystem explain effective financial inclusion?

Having established possible reasons for using the fintech ecosystem by Kenyans, we next run tests to ascertain the effect of fintech ecosystem on the usage of formal financial institutions products, defined in this study as effective financial inclusion. The results for various forms of usage of financial institutions such as commercial banks or microfinance banks ("savings at a financial institution" and "loan/credit from a financial institution") and financial markets (investment in securities such as shares/stocks; bills and bonds including M-Akiba (retail-investor-focused infrastructure bonds traded online by the Kenyan government); and investment companies such as unit trusts and hedge funds) are reported in Table 3. For comparison, we include two common uses of mobile/digital micro-banking platforms (savings and credit), which include digital savings and digital loan products

16 That is, due to its application of big data technology, which can, via algorithms that use behavioral patterns, digital finance can model personal behavior and offer individuals products or advise that are consistent with their preferences.

17 Researchers from CGAP and Busara Center for Behavioral Economics recently surveyed 400 m-pesa users in Nairobi. The survey shows that m-pesa is primarily a payment tool, with the bulk (64%) of its users holding an average monthly balance less than KES 1000 (USD 8) and net balance (inflows minus outflows) of only KES 250 (USD 2), the results being robust to income levels and employment types. The data are available here. Since withdrawals (and for many users, even deposits) must be made through an agent or through an automated teller machine (ATM), distance to the agent/ATM is more or less as important as distance to a financial institution, under these circumstances.

such as m-Shwari, KCB m-pesa, M-Coop cash, Eazzy Loan, Timiza, and HF Whizz, offered by various financial institutions in partnership with technology firms, which pioneered and continue to provide digital money services in Kenya.

Our findings show that fintech ecosystems is strongly positively related to individuals' usage of traditional financial institutions' services for welfare enhancing purposes such as savings and credit. Specifically, the results for 2021 show that the fintech ecosystem increases the probability of usage of traditional products/services of financial institutions by at least 5.2 percentage points after controlling for various individual-level factors such as age, language, education level and ownership of assets and after controlling for locational factors typically associated with access and usage of financial services and products. Similar results are documented for the usage of mobile bank products, whose probability of usage increases by at least 9.6% for individuals with access to the fintech ecosystem. Expectedly, the fintech ecosystem has a weaker relationship (the coefficient is significant at 10%) with the usage of capital markets products such as shares and bonds, and wealth management products/services offered by investment companies such as unit trusts and hedge funds, whose presence in Kenya is still in its infancy, with usage appealing largely to sophisticated and wealthy investors who can access investment advice, usually at a fee.

Several other reasons can explain the finding about securities investments. First, securities investing is not yet popular among Kenyans, majority of whom have only basic knowledge of the functioning of financial markets: the 2021 FinAccess Household Survey data show that only about 2.7% of Kenyans have or have had investments in the securities markets. Second, other than the M-Akiba bond which is offered to retail investors on the mobile platform, the supply-side in the securities market has continued to rely almost exclusively on traditional methods of securities issuances, with marketing efforts (usually via traditional outlets such as stockbrokers, investment banks and the print media) typically targeting sophisticated urban investors and institutions rather than the mass market. Third, there has been a lull in initial public offerings of stocks/shares since mid-2000s and some of the oversubscribed IPOs of yesteryears have recorded poor long-term (e.g., Kengen) performance or got delisted (e.g., Access Kenya). While the dearth of IPOs has denied the stock market the necessary publicity that IPOs engender, the weak performance of previous IPOs has discouraged retail investors, some of whom, due to insufficient advice, employed leverage in their debut IPO acquisitions, from participating in the securities markets.

It is important to note that most of the control variables, when significant, record coefficient estimates with the expected signs. For example, individuals in business are more likely to use capital markets products while women are less likely to seek credit in financial institutions, acquire assets in the financial asset markets and to use mobile banking services. The results also show, interestingly, that the probability of using all the financial services/products increases generally with the level of education as well as with age.

Table 3: Usage of financial products (effective financial inclusion), 2021

This table presents Probit regression results of alternative uses of financial products (representing welfare enhancing or "effective" financial inclusion) against the fintech ecosystem construct and controls. In parentheses are robust standard errors clustered by county. **Note**: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Usage of products for	Financial institutions		Financial markets	Mobile banks	
	Savings	Credit	Investments	Savings	Credit
Fintech ecosystem	0.065 ** (0.026)	0.052 *** (0.018)	0.057 * (0.033)	0.113 *** (0.017)	0.096 *** (0.014)
Rural dwelling	-0.157 (0.122)	0.103 (0.091)	-0.055 (0.099)	-0.061 (0.072)	-0.154 *** (0.055)
Female	0.158 (0.107)	-0.033 (0.083)	-0.167 ** (0.082)	-0.114 ** (0.056)	-0.139 ** (0.066)
Age group (18 – 24)	2.743 *** (0.175)	2.736 *** (0.207)	-0.271 (0.291)	1.169 *** (0.235)	0.805 ** (0.335)
Age group (25 – 34)	2.879 *** (0.183)	3.463 *** (0.093)	0.028 (0.279)	1.341 *** (0.238)	1.337 *** (0.327)
Age group (35 – 44)	3.384 *** (0.171)	3.677 *** (0.115)	0.482 * (0.264)	1.134 *** (0.260)	1.281 *** (0.335)
Age group (45 – 54)	3.281 *** (0.185)	3.705 *** (0.109)	0.418 (0.269)	0.932 *** (0.271)	1.155 *** (0.337)
Age group (55 – 64)	3.487 *** (0.162)	3.831 *** (0.150)	0.887 *** (0.265)	0.697 *** (0.245)	1.069 *** (0.334)
Age group (65 +)	3.379 *** (0.199)	3.826 *** (0.159)	1.026 *** (0.269)	0.869 *** (0.271)	0.984 *** (0.361)
Language: English	0.433 (0.342)	0.392 * (0.207)	0.192 (0.226)	0.237 (0.212)	0.244 (0.196)
Language: Swahili	0.350 (0.335)	0.312 * (0.176)	0.080 (0.167)	0.233 (0.195)	0.277 (0.199)

Usage of products for	Financial institutions		Financial markets	Mobile banks	
	Savings	Credit	Investments	Savings	Credit
Education: Primary	0.254 (0.195)	0.268 (0.173)	0.511 *** (0.156)	0.729 *** (0.142)	0.743 *** (0.142)
Education: Secondary	0.237 (0.215)	0.419 ** (0.176)	0.836 *** (0.179)	0.869 *** (0.137)	0.843 *** (0.151)
Education: Technical	0.415 * (0.214)	0.821 *** (0.186)	0.953 *** (0.243)	0.968 *** (0.172)	1.026 *** (0.142)
Education: University	0.485 * (0.281)	0.887 *** (0.211)	1.469 *** (0.250)	1.017 *** (0.199)	0.812 *** (0.181)
Occupation: Farming	0.107 * (0.130)	0.155 * (0.080)	0.328 *** (0.076)	-0.046 (0.073)	0.038 (0.067)
Occupation: Waged	0.208 (0.150)	0.730 *** (0.104)	0.216 (0.131)	0.203 ** (0.084)	0.105 (0.075)
Occupation: Business	0.995 * (0.559)	0.941 * (0.529)	0.881 ** (0.405)	0.385 (0.436)	0.701 (0.509)
Asset ownership	0.014 (0.035)	0.108 *** (0.030)	0.151 *** (0.029)	0.058 *** (0.016)	0.021 (0.022)
Constant	-6.623 *** (0.404)	-7.023 *** (0.270)	-3.803 *** (0.330)	-4.053 *** (0.325)	-4.087 *** (0.470)
Wald p-value	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R-square	0.1121	0.2590	0.2534	0.1783	0.1452
Log pseudo-likelihood	-317	-638	-672	-1844	-1470
# Observations	7230	7230	7230	7230	7230

Table 3b: Usage of financial products (effective financial inclusion), 2016

This table presents Probit regression results of alternative uses of financial products (representing welfare enhancing or "effective" financial inclusion) against the fintech ecosystem construct and controls. In parentheses are robust standard errors clustered by county. **Note**: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Usage of products	Financial institutions		Financial markets	Mobile banks	
	Savings	Credit	Investments	Saving	Credit
Fintech ecosystem	0.045 *** (0.013)	0.069 *** (0.012)	0.018 (0.018)	0.066 *** (0.015)	0.110 *** (0.012)
Rural dwelling	-0.100 (0.070)	-0.111 ** (0.044)	-0.186 * (0.107)	-0.042 (0.047)	-0.096 (0.065)
Female	0.003 (0.057)	-0.174 ** (0.084)	-0.059 (0.099)	-0.028 (0.075)	0.020 (0.070)
Age group (18 – 24)	0.283 (0.310)	3.678 *** (0.119)	2.935 *** (0.122)	0.482 *** (0.151)	0.581 *** (0.204)
Age group (25 – 34)	0.434 (0.282)	3.888 *** (0.078)	3.430 *** (0.098)	0.589 *** (0.166)	0.730 *** (0.200)
Age group (35 – 44)	0.524 * (0.308)	3.998 *** (0.100)	3.508 *** (0.135)	0.357 ** (0.166)	0.571 *** (0.200)
Age group (45 – 54)	0.619 (0.306)	4.219 *** (0.100)	3.738 *** (0.128)	0.382 ** (0.170)	0.347 (0.247)
Age group (55 – 64)	0.760 ** (0.305)	4.454 *** (0.124)	3.845 *** (0.114)	0.242 (0.188)	0.218 (0.237)
Age group (65 +)	0.838 *** (0.293)	4.613 *** (0.121)	4.177 *** (0.170)	0.379 ** (0.187)	0.090 (0.272)
Language: English	0.095 (0.117)	0.050 (0.094)	0.136 (0.174)	0.193 ** (0.076)	0.106 (0.077)
Language: Swahili	0.123 (0.110)	0.024 (0.077)	0.084 (0.155)	0.054 (0.060)	0.017 (0.061)
Education: Primary	0.370 *** (0.103)	0.439 *** (0.108)	0.456 ** (0.218)	0.954 *** (0.228)	0.959 *** (0.319)

Usage of products	Financial institutions		Financial markets	Mobile banks	
	Savings	Credit	Investments	Saving	Credit
Education: Secondary	0.348 *** (0.128)	0.605 *** (0.138)	0.657 *** (0.224)	1.132 *** (0.208)	1.222 *** (0.299)
Education: Technical	0.333 ** (0.170)	0.694 *** (0.167)	0.899 *** (0.228)	1.131 *** (0.216)	1.423 *** (0.339)
Education: University	0.191 (0.198)	0.570 *** (0.171)	0.707 ** (0.297)	1.045 *** (0.250)	1.204 *** (0.343)
Occupation: Farming	-0.063 (0.109)	-0.072 (0.106)	-0.317 * (0.169)	-0.014 (0.098)	-0.097 (0.094)
Occupation: Waged	0.000 (0.102)	-0.057 (0.073)	-0.002 (0.080)	0.046 (0.069)	-0.110 (0.070)
Occupation: Business	-0.109 (0.109)	-0.107 (0.107)	-0.113 (0.147)	0.111 (0.080)	-0.123 ** (0.061)
Asset ownership	0.050 (0.031)	0.107 *** (0.021)	0.139 *** (0.032)	0.001 (0.023)	0.090 *** (0.021)
Constant	-2.995 *** (0.302)	-6.691 *** (0.146)	-6.470 *** (0.207)	-3.561 *** (0.287)	-3.934 *** (0.333)
Wald p-value	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R-square	0.0433	0.1162	0.1315	0.0907	0.1669
Log pseudo-likelihood	-1074	-1173	-619	-1284	-1370
# Observations	8665	8665	8665	8665	8665

Finally, we find that investment usage during 2021 is dominated by individuals above the age of 54 years, indicating either that they have achieved a higher level of sophistication than the rest from extended periods of wealth accumulation or that they have a stronger need to carefully manage their wealth using sophisticated capital markets products (e.g., by outsourcing their wealth management to professionals) in old age. In T**able 3b**, where the 2016 results are presented, the key highlight is the "investments" usage, which is statistically insignificantly related to the fintech ecosystem. Thus, the ecosystem was not yet adequately developed at the time to facilitate acquisition of capital markets assets such as shares and bonds.

4.4 Does the fintech ecosystem address barriers to financial inclusion in Kenya?

Following our results in **Table 2**, which show that the fintech ecosystem serves both as a substitute to (as far as history of transactions and appropriateness of products are concerned) and a complement of (in respect to distance to a financial institution) formal financial institutions, we now seek to establish whether the fintech ecosystem enables formal effective financial inclusion by addressing some of the reasons, which many individuals have given in response to the question of why they do not have an account at a bank. We implement these "reasons" by interacting them with the fintech ecosystem in our Probit estimation of Equation (1). We refer to the interaction effects estimated, respectively, as the "distance effect", the "history effect" and the "product appropriateness effect". As explained earlier, the fintech variable is constructed as a score, increasing by a unit for every relevant demand-side input. Thus, higher levels of the fintech variable represent superior enjoyment by individuals/households of the fintech space. We include the usual controls.

The results, displayed in **Table 4a** for 2021, show that the "fintech ecosystem" remains strongly positively related to welfare enhancing financial product usage, especially credit usage, whose coefficients are all significant at 1%. Because "cost of travelling" and "walking time" to the nearest bank behaved the same way in **Table 2**, we represent "distance" using only "walking time". The distance variable is therefore defined as a dummy that takes a value of "1" when an individual answers, "3 hours or more" to the question, "If you had to walk to the nearest bank (branch/ATM/headquarter), how long would it take you on average?" and "0" otherwise. As expected, the results indicate that "distance" is negatively, though weakly significantly, related to effective financial inclusion in Kenya. Living at least three hours away from a bank lowers the probability of effective consumption of products of financial institutions by 30% for credit usage and almost 60% for savings usage; however, distance does not appear to explain usage of financial markets products. We argue that the fintech space should help to bridge the constraints to the access and utilization imposed on individuals by barriers such as distance so that the interaction between "fintech ecosystem" and "distance" should be positive and significant. The results support the positive "distance effect" hypothesis but the coefficients are largely insignificant. Thus, except for the consumption of credit, for which we find a weakly significant distance effect, we can surmise that the fintech ecosystem does not effectively address the distance barrier.

Table 4a: Channels through which fintech ecosystems work, 2021

	Savings			Credit			Investments		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fintech ecosystem	0.064** (0.03)	0.068 * (0.04)	0.074** (0.03)	0.068*** (0.02)	0.112*** (0.03)	0.106*** (0.03)	0.087** (0.04)	0.104** (0.05)	0.095** (0.05)
Distance	-0.588 * (0.33)			-0.307 * (0.17)			-0.413 (0.28)		
History		-0.180 (0.31)			-0.069 (0.31)			0.199 (0.29)	
Product appropriateness			2.842*** (0.79)			2.556*** (0.85)			2.086 ** (0.91)
	0.069 (0.05)			0.050 * (0.03)			0.040 (0.04)		
		0.019 (0.05)			-0.096*** (0.03)			-0.046 (0.05)	
			-0.427*** (0.12)			-0.362*** (0.12)			-0.393*** (0.13)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R-square	0.1105	0.1428	0.1548	0.2467	0.1366	0.1308	0.2263	0.1524	0.1418
Log pseudo-likelihood	-317	-122	-120	-648	-99	-100	-697	-255	-258
# Observations	7230	5272	5272	7230	5272	5272	7230	5272	5272

Table 4b: Channels through which fintech ecosystems work, 2016

	Savings			Credit			Investments		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fintech ecosystem	0.051 *** (0.01)	0.052 *** (0.01)	0.052 *** (0.01)	0.087 *** (0.01)	0.084 *** (0.01)	0.084 *** (0.01)	0.038 ** (0.02)	0.037 ** (0.02)	0.040 ** (0.02)
Distance	-0.140 (0.21)			0.379 (0.31)			-1.001*** (0.30)		
History		-0.043 (0.25)			-0.291 (0.43)			-1.178 ** (0.58)	
Product appropriateness			-0.170 (0.49)			-1.172*** (0.27)			-0.498 * (0.31)
	0.071 ** (0.03)			-0.294*** (0.08)			0.210 *** (0.07)		
		-0.012nm (0.06)			-0.016 (0.09)			0.177 * (0.11)	
			0.003 (0.11)			0.109 ** (0.05)			0.077 * (0.05)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R-square	0.0411	0.0408	0.0409	0.1087	0.1085	0.1083	0.1163	0.1177	0.1154
Log pseudo-likelihood	-1076	-1076	-1076	-1182	-1183	-1183	-629	-628	-630
# Observations	8665	8665	8665	8665	8665	8665	8665	8665	8665

The "history" dummy as defined earlier, takes the value of "1" when the individual answers, "I do not have a regular income" to the question, "Why don't you have your own bank account?". We interpret this response to mean that the individual's lack of consistent flow of income may make them ineligible for credit, for example, if credit scoring systems used by financial institutions emphasize history of financial transactions as an indicator of "willingness to pay". Like "distance to bank", and as expected, "lack of financial history" has a negative effect on effective financial inclusion, which is, however, not significant. In this regard, it is not reasonable to expect that the fintech ecosystem can mediate the relationship between history and welfare enhancing inclusion. Despite this observation, the results show, interestingly, that the interaction between fintech ecosystem and "history" has a negative and significant effect on the consumption of credit of financial institutions. We attribute this finding to the fact that telcos, the largest single supplier of digital money services, often include short-term credit (e.g., Safaricom's Fuliza) in their digital money packages, which may encourage digital borrowing at the expense of borrowing from financial institutions. Since digital loans are typically short-term in nature[18], we do not believe that they promote effective financial inclusion. Thus, one may conclude that in the case of credit usage, the fintech ecosystem, as a substitute for financial institutions credit provision, does not effectively serve the welfare enhancement purposes that financial inclusion should perform.

As defined earlier, product appropriateness is proxied by the response to the question posed to respondent currently not using banking services, "I can do all the transactions I need using a different kind of institution". Individuals with this attitude tend to prefer alternative, usually informal financial service providers such as Chamas or registered, but non-prudential, formal financial service providers such as savings and credit cooperative organizations (Saccos). However, since individuals with this attitude are not necessarily averse to, or unable to afford, the use of services or products offered by prudential financial institutions (e.g., MFIs and banks), the variable, on its own, is (also) positively related to usage of financial services of prudential financial institutions just as they are to similar service offerings of alternative institutions. Interacting it with the fintech ecosystem yields a negative result, suggesting that in the presence of digital financial services, individuals with this "attitude" would prefer them (digital/fintech financial services) to physical branches of financial institutions (or their appendages such as agents and ATMs).

Results for 2016, shown in **Table 4b**, indicate the presence of the "distance effect" (significant coefficient of the interaction between distance and the fintech ecosystem). For example, distance was an important factor inhibiting the consumption of investment products offered by the capital markets; with the introduction of the fintech services, however, a positive relationship emerges, which shows that fintech mitigated the distance barrier. It is interesting to note that while distance was not an important

18. To illustrate, Fuliza was designed to enable Mpesa users, whose outward remittances were unsuccessful, to meet their need for sending money at the time of such failure and to repay the money within a few days thereafter. See the explanation on Fuliza's webpage (accessed 24.07.2022).

factor for credit access (insignificant coefficient estimate), introducing the fintech ecosystem appears to worsen the consumption of credit services of financial institutions. A plausible explanation for this puzzling finding could be the digital credit services (loan apps) that mushroomed the country following the digitalization of finance, and which were greeted with enthusiastic uptake (e.g., Wamalwa et al., 2019). The digital lenders, long accused of predatory lending practices, had operated in the country largely unregulated until late 2021, when *The Central Bank of Kenya Amendment Act of 2021: Regulation of Digital Lenders* was signed into law. Their unregulated proliferation had the potential to erode any welfare gains that digital finance could offer.

4.5 Who benefits from the fintech ecosystem?

Thus far, our findings seem to suggest that the fintech ecosystem has promoted the consumption of formal financial services (see Table 3 and Table 4). The findings in Section 4.3 broadly suggest that the fintech ecosystem does not impact financial inclusion by acting as a catalyst for distance or (lack of) history and that fintech services act as a substitute for traditional financial services probably by offering products that are more appropriate for individuals than those offered by financial institutions or that it is more convenient given that fintech services are available on hand-held devices. Thus, it is important to ask the question of who benefits, in the context of financial inclusion, from the fintech ecosystem. To respond to this question, we run a Probit estimation of Equation (1) including an interaction between fintech ecosystem and the following demographic characteristics: (1) primary or secondary education level; (2) age groups 18 – 34 years; (3) ownership of assets; and (4) female. A positive and significant interaction effect indicates that the fintech system has benefitted individuals of the demographic characteristics represented by "1"; a negative effect shows that the demographic characteristics represented by "0" are the key beneficiaries.

We estimate Equation (5):

$$\text{Effinincl}_{it}=\gamma_0+\gamma_1\,\text{Fintecosys}_{it}+\gamma_3'\,\text{Demogristic}_{ijt}+\gamma_4'\,\text{Fintecosys}_{it}\times\text{Demogristic}_{ijt}+\Gamma'\,\text{Controls}_{it}+\varepsilon_{it} \quad \ldots\ldots (5)$$

where **Demogristic** is the demographic characteristic of interest for our tests: we use the demographic profiles of individuals most likely to use digital technologies such as the youth (people aged between 18 and 34 years), the better educated (secondary and tertiary education), the upper income groups and males (see e.g., Das & Das, 2020; Gulamhuseinwala et al., 2015). Our analysis focuses on effective usages of traditional services offered by financial institutions (savings and credit), and capital markets instruments (i.e., we exclude mobile bank usages, which are ordinarily available to everyone with a mobile gadget and a GSM connection). Results are in **Tables 5a** and **5b**. We begin our analysis from the 2016 findings, reported in **Table 5b**.

First, the fintech ecosystem hardly has any effect on the savings appetites of Kenyans of all demographics during 2016 except for a weak positive influence on lower income groups. Similarly, the effect of the fintech ecosystem on capital markets activities is muted except for a weak positive effect on the uptake of securities investing amongst the relatively more educated. We attribute both effects to greater awareness of savings/investments opportunities that has been enabled by digital financial services. For example, by 2016, many Kenyan banks already had internet and mobile banking products (Wamalwa et al., 2019), allowing their clients to perform varied financial services including making deposits into their savings accounts from remote locations. Similarly, Kenya's policy environment, in an effort to promote capital formation, has encouraged the financial sector to offer innovative savings and investment solutions, which has invariably been actualized through partnerships with telcos to avail products such as M-Shwari. Like remote access, these digital platforms likely intensified awareness of the need to save in general, which the beneficiary groups exploited.

Further, as of 2016, the benefits of fintech ecosystems to credit utilization had been extended to individuals of varied demographic characteristics. We report strong evidence that the fintech ecosystem had fostered access to and usage of financial institutions' credit facilities among females, people in the upper income groups, older individuals (people aged above 34 years) and individuals with superior education (secondary school or better). With the exception of females, these effects are largely anticipated. Focusing on women, we argue the fintech ecosystem may have played a role in capacitating women and improved their ability to access and use formal credit, for example, by addressing "history".[19] This is consistent with the observation in **Figure 4**, which indicates reduced disparity between males and females on access to financial services.

From the 2021 analysis, first, we find that the fintech ecosystem had no effect on the propensity to save in financial institutions amongst Kenyans of various demographic characteristics. Second, and more interesting, fintech has no effect on the propensity to borrow among females and among individuals of various educational achievements. A plausible interpretation of the latter finding is that people of various educational achievements and men and women probably already achieved equitable access and use of credit services by the time the survey was conducted during 2021 so that the fintech ecosystem could not make a difference. For example, Safaricom's premier digital savings platform M-Shwari, was launched in January 2013 and had over 9 million unique accounts by the end of 2014.[20] We also find that the use of credit services was substantially better amongst older Kenyans and amongst the upper income echelons of the Kenyan society in the presence of the fintech ecosystem. This is expected given upper hand traditionally enjoyed by these individuals in financial access.

19. The bulk of Kenya's excluded women has traditionally resorted to informal products such as table banking and chamas to meet their credit needs. These products do not qualify as part of "credit history" when a credit application is the subject of evaluation by formal financial outlets.
20. Historical information about the performance of M-Shwari information can be obtained here.

Table 5a: Beneficiaries of the fintech ecosystems, 2021

	Savings				Credit				Investments			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	12)
Fintech ecosystem	0.081 ***	0.088 ***	0.082 ***	0.071 ***	0.094 ***	0.113 ***	0.079 ***	0.080 ***	0.112 ***	0.120 ***	0.093 ***	0.121 ***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)
	0.001				-0.026				-0.029 *			
	(0.02)				(0.02)				(0.02)			
		-0.026				-0.091***				-0.078		
		(0.03)				(0.02)				*** (0.03)		
			0.000				0.034 **				0.044	
			(0.02)				(0.02)				***(0.02)	
				0.028				0.008				-0.037 *
				(0.04)				(0.02)				(0.02)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R-square	0.1075	0.1079	0.1075	0.1082	0.2482	0.2515	0.2495	0.2476	0.2256	0.2268	0.2279	0.2248
Log pseudo-likelihood	-318	-318	-318	-318	-647	-644	-646	-648	-697	-696	-695	-698
# Observations	7230	7230	7230	7230	7230	7230	7230	7230	7230	7230	7230	7230

Table 5b: Beneficiaries of the fintech ecosystems, 2016

	Savings				Credit				Investments			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	12)
Fintech ecosystem	0.053 *** (0.02)	0.056 *** (0.02)	0.059 *** (0.01)	0.059 *** (0.02)	0.058 *** (0.02)	0.106 *** (0.01)	0.071 *** (0.01)	0.070 *** (0.01)	0.008 (0.02)	0.034 * (0.02)	0.045 ** (0.02)	0.029 (0.02)
	-0.001 (0.02)				0.044 ** (0.02)				0.048 * (0.03)			
		-0.010 (0.02)				-0.048 ** (0.02)				0.015 (0.02)		
			-0.030 * (0.02)				0.039 *** (0.04)				-0.014 (0.02)	
				0.025 (0.03)				-0.071*** (0.02)				-0.048 (0.03)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R-square	0.0412	0.0413	0.0429	0.0417	0.1097	0.1093	0.1119	0.1104	0.1182	0.1159	0.1163	0.1172
Log pseudo-likelihood	-1076	-1077	-1074	-1075	-1181	-1182	-1178	-1180	-628	-630	-629	-629
# Observations	8665	8665	8665	8665	8665	8665	8665	8665	8665	8665	8665	8665

More interesting is the role of fintech ecosystem in the enjoyment of investment opportunities available in the capital assets. Our findings show that the uptake of capital markets investments improved, interestingly, for women, the low-income earners, and the less educated (primary school or less). Thus, here we see a case where the fintech ecosystem has played a facilitation role in enabling traditionally disadvantaged segments of the population to enjoy formal financial services in ways that are potentially welfare enhancing – e.g., the capital markets serve the important function of enabling smoothing of income through assets such as equities and bonds. In this regard, Kenya's premier retail infrastructure bond, offered exclusively through a mobile platform may have played a critical role. We also find, expectedly, that, through fintech services, the use of investment products improved amongst older people (individuals over 34 years of age).

5.0 Conclusions and policy implications

Kenya has the reputation as a leader of fintech in Africa, with high growth in mobile money transactions in recent years. Data from the Central Bank of Kenya show that mobile money transactions increased by 17.5% from KES 3.26 trillion (USD 21.12 billion) to KES 3.8 trillion (USD 31.6 billion) in the first half of 2022. This represents about 32% of the country's gross domestic product (GDP), estimated at KES 12 trillion (USD 99.8 billion) in current money. Similarly, the country has made big strides in financial inclusion with usage of services such as credit growing from about 66.4% of the population in 2016 to about 74.0% in 2021 and savings rising from about 34.2% to 60.8% during the same period. These developments make it likely that the expansion of the fintech ecosystem and usage of fintech services has played a role in the growth in financial inclusion. This study sought answers to this question. Employing the Kenya Household Survey data for 2016 and 2021, we have documented several interesting findings.

First, we demonstrate empirically that by provisioning transactions data of its users, the fintech ecosystem facilitates its (clients') evaluation which fosters utilization of credit services by applicants who would ordinarily be denied access due to insufficient credit history. We also ascertain that the fintech ecosystem has superior ability to offer financial products and services that respond better to the preferences of their users thereby fostering their usage of those services. Further, we establish that fintech services are complements of traditional financial institutions services as they do not seem to effectively address distance to service points as a barrier to access and usage. Interestingly, we also document that the probability of an individual enjoying services available in the fintech ecosystem falls by at least 19% if the individual resides in Northern Kenya.

Second, which is at the heart of this inquiry, we document a robust positive relationship between the use of financial services such as credit, savings and investments and the fintech ecosystem. The fintech ecosystem increases the probability of usage of traditional products/services of financial institutions by

at least 5.2 percentage points after controlling for various individual-level factors and after controlling for locational bottlenecks. Expectedly, the fintech ecosystem has a weaker relationship (the coefficient is significant at 10%) with the usage of capital markets products such as securities (e.g., shares, bonds) and wealth management products/services. Third, we find that the benefits of the fintech ecosystem are not uniform across all user categories. For example, the uptake of capital markets investments improved, interestingly, for women, the low-income earners, and the less educated (primary school or less) during 2021 but fell for men and the more educated (tertiary and secondary education).

Several policy implications can be drawn from our findings. First, the distance bottleneck in the access and use of financial services needs special attention. There is the possibility (which we have not investigated in this paper) that provisioning physical infrastructure may help address this barrier. For example, mobile money agents, like bank agents, would naturally prefer locations with electricity for them to charge their phones. In remote areas that are poorly served by electricity, the distance to the nearest mobile money agent may be as much of a hinderance to transactions as the distance to the nearest bank. Thus, provisioning electricity may help address the issue of access in such locations. Secondly, "savings in financial institutions" does not appear to respond as well to the fintech intervention as the other uses of financial services. This could mean either that the level of savings in Kenya is generally low (e.g., Dupas & Robinson, 2013) to the extent that such interventions may not effectively address it, or that fiscal policy interventions (e.g. greater tax reliefs) may need to be strengthened to work alongside the fintech sector in incentivizing savings, or that mobile savings (the likes of M-Shwari) are crowding out traditional financial institutions savings in which case regulations should explore ways of enhancing it to maximize welfare gains. Third, targeted interventions may be required to make digital financial inclusion attractive to the traditionally marginalized populations (e.g., affirmative action for low-income earners). This should be in response to our finding here that the fintech ecosystem has largely benefitted traditionally favored demographics such as the upper income group, more educated individuals and individuals aged above 34 years.

References

1. Allen, F., Carletti, E., Cull, R., Qian, J. Q. J., Senbet, L., & Valenzuela, P. (2021). Improving access to banking: evidence from Kenya. *Review of Finance, 25*(2), 403–447. https://doi.org/10.1093/rof/rfaa024
2. Arner, D. W., Buckley, R. P., Zetzsche, D. A., & Veidt, R. (2020). Sustainability, fintech and financial inclusion. *European Business Organization Law Review, 21*(1), 7–35. https://doi.org/10.1007/s40804-020-00183-y
3. Bachas, P., Gertler, P., Higgins, S., & Seira, E. (2018). Digital financial services go a long way: Transaction costs and financial inclusion. *AEA Papers and Proceedings, 108*(May), 444–448. https://doi.org/10.1257/pandp.20181013
4. Barykin, S. Y., Kapustina, I. V., Kirillova, T. V., Yadykin, V. K., & Konnikov, Y. A. (2020). Economics of digital ecosystems. *Journal of Open Innovation: Technology, Market, and Complexity, 6*(4), 1–16. https://doi.org/10.3390/joitmc6040124
5. Cherotich, J., Sibiko, K. W., & Ayuya, O. I. (2022). Analysis of extent of credit access among women farm-entrepreneurs based on membership in table banking (TB). *Agricultural Finance Review, 82*(1), 89–112. https://doi.org/10.1108/AFR-08-2020-0125
6. Daniel, B., & Grissen, D. (2015). *Behavior revealed in mobile phone usage predict loan repayment* (Department of Economics, Brown University, Working Paper Series).
7. Das, A., & Das, D. (2020). Perception, adoption, and pattern of usage of fintech services by bank customers: Evidences from Hojai District of Assam. *Emerging Economy Studies, 6*(1), 7–22. https://doi.org/10.1177/2394901520907728
8. Demirguc-Kunt, A., Klapper, L., Ansar, S., & Jagati, A. (2017). *Making it easier to apply for a bank account: A study of the Indian market* (No. WPS8205; World Bank Policy Research Working Papers, Issue September). https://doi.org/book/10.1596/1813-9450-8205
9. Dupas, P., Karlan, D., Robinson, J., & Ubfal, D. (2018). Banking the unbanked? Evidence from three countries. *American Economic Journal: Applied Economics, 10*(2), 257–297. https://doi.org/10.1257/app.20160597
10. Dupas, P., & Robinson, J. (2013). Savings constraints and microenterprise development: Evidence from a field experiment in Kenya. *American Economic Journal: Applied Economics, 5*(1), 163-92. https://doi.org/10.1257/app.5.1.163
11. Gabor, D., & Brooks, S. (2017). The digital revolution in financial inclusion: International development in the fintech era. *New Political Economy, 22*(4), 423–436. https://doi.org/10.1080/13563467.2017.1259298
12. Gichuki, C. N., Mutuku, M. M., & Kinuthia, L. N. (2015). Influence of participation in "table banking" on the size of women-owned micro and small enterprises in Kenya. *Journal of*

*Enterprising Communities, 9(*4), 315–326. https://doi.org/10.1108/JEC-11-2013-0036

13. Gulamhuseinwala, I., Bull, T., & Lewis, S. (2015). FinTech is gaining traction and young, high-income users are the early adopters. *Journal of Financial Perspectives, 3(3). https://ssrn.com*/abstract=3083976

14. Jack, W., & Suri, T. (2014). Risk sharing and transactions costs: Evidence from Kenya's mobile money revolution. *American Economic Review, 104*(1), 183–223. http://www.jstor.com/stable/42920692

15. Jagtiani, J., & Lemieux, C. (2018). *Do fintech lenders penetrate areas that are undeserved by traditional banks?* (Federal Reserve Bank of Philadelphia Working Paper Series).

16. Kangwa, D., Mwale, J. T., & Junaid, S. M. (2020). Co-evolutionary dynamics of financial inclusion of generation Z in a Sub-Saharan digital financial ecosystem. *Copernican Journal of Finance & Accounting, 9*(4), 27–50. https://doi.org/10.12775/CJFA.2020.020

17. Kim, K. H. (2020). The role of mobile money in improving the financial inclusion of Nairobi's urban poor. *African Journal of Science, Technology, Innovation and Development, 12*(7), 855–865. https://doi.org/10.1080/20421338.2020.1733281

18. Kodongo, O. (2018). Financial regulations, financial literacy, and financial inclusion: Insights from Kenya. *Emerging Markets Finance and Trade, 54*(12), 2851–2873. https://doi.org/10.1080/1540496X.2017.1418318

19. Lashitew, A. A., van Tulder, R., & Liasse, Y. (2019). Mobile phones for financial inclusion: What explains the diffusion of mobile money innovations? *Research Policy, 48*(5), 1201–1215. https://doi.org/10.1016/j.respol.2018.12.010

20. Lee, I., & Shin, Y. J. (2018). Fintech: Ecosystem, business models, investment decisions, and challenges. *Business Horizons, 61*(1), 35–46. https://doi.org/10.1016/j.bushor.2017.09.003

21. Mallinguh, E., Zoltan, Z., & Kecskes, H. (2017). Innovative financial digital ecosystem: an evaluative study of Kenya. In K. Cebeci, A. Pawlicz, & A. Altaher (Eds.), *MIRDEC - 6th International Academic Conference on Social Sciences, Multidisciplinary, Economics, Business and Finance Studies (Global Meeting of Social Science Community)*. MIRDEC. www.mirdec.com

22. N'dri, L. M., & Kakinaka, M. (2020). Financial inclusion, mobile money, and individual welfare: The case of Burkina Faso. *Telecommunications Policy, 44(*3), 101926. https://doi.org/10.1016/j.telpol.2020.101926

23. Natile, S. (2020). Digital finance, inclusion and the mobile money "social " enterprise. *Historical Social Research, 45*(3), 74–94. https://doi.org/10.12759/hsr.45.2020.3.74-94

24. Ntwiga, D. B. (2019). *Can fintech shape the dynamics of consumer credit usage among the un(der)banked?* (WPS/04/19; KBA Centre for Research on Financial Markets and Policy

Working Paper Series).

25. Oborn, E., Barrett, M., Orlikowski, W., & Kim, A. (2019). Trajectory dynamics in innovation: developing and transforming a mobile money service across time and place. *Management Science, 30*(5), 869–1123. https://doi.org/10.1287/orsc.2018.1281

26. Ojah, K., & Kodongo, O. (2022). *Effective financial inclusion and the need to put the horse before the cart: Saving!* (Unpublished Working Paper).

27. Osoro, B. J., & Muriithi, D. (2018). *Financial inclusion: how do you know that you are there?* (WPS/03/18; KBA Centre for Research on Financial Markets and Policy Working Paper Series).

28. Ozili, P. K. (2020). Theories of financial inclusion. In E. Özen & S. Grima (Eds.), *Uncertainty and Challenges in Contemporary Economic Behaviour (Emerald Studies in Finance, Insurance, and Risk Management)* (pp. 89–115). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80043-095-220201008

29. Rauniyar, K., Komal, R., & Kumar, S. D. (2021). Role of fintech and innovations for improvising digital financial inclusion. *International Journal of Innovative Science and Research Technology, 6*(5). https://ijisrt.com/assets/upload/files/IJISRT21MAY1089.pdf%0Awww.ijisrt.com

30. Senyo, P. K., Karanasios, S., Gozman, D., & Baba, M. (2022). Fintech ecosystem practices shaping financial inclusion: The case of mobile money in Ghana. *European Journal of Information Systems, 31*(1), 112–127. https://doi.org/10.1080/0960085X.2021.1978342

31. SKOLKOVO. (2015). *Digital platforms and the ecosystems of financial inclusion: The Russian experience.* The Moscow School of Management, SKOLKOVO. https://ssrn.com/abstract=3104644

32. Subramaniam, M. (2020). Digital ecosystems and their implications for competitive strategy. *Journal of Organization Design, 9(1)*. https://doi.org/10.1186/s41469-020-00073-0

33. Wamalwa, P., Rugiri, I., & Lauler, J. (2019). *Digital credit, financial literacy and household indebtedness* (No. 38; KBA Centre for Research on Financial Markets and Policy Working Paper Series).

34. World Bank. (2014). *Financial inclusion* (Global Financial Development Report). The World Bank Group, Washington DC.

35. Yue, P., Korkmaz, A. G., Yin, Z., & Zhou, H. (2022). The rise of digital finance: Financial inclusion or debt trap? *Finance Research Letters,* 102604. https://doi.org/10.1016/j.frl.2021.102604

Kenya Bankers Association
13th Floor, International House, Mama Ngina Street
P.O. Box 73100– 00200 NAIROBI
Telephone: 254 20 2221704/2217757/2224014/5
Cell: 0733 812770/0711 562910
Fax: 254 20 2221792
Email: research@kba.co.ke
Website: www.kba.co.ke

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