Adoption of services on mobiles phones by Sub-Saharan micro entrepreneurs

Abstract: This article shows that acquisition pattern analysis is highly suited for research in developing economies. Consumers in such contexts prioritise the adoption of alternative product-services as a result of resource constraints. In the reported acquisition pattern analysis, we provide insights into sequential adoption of services and applications (apps) on mobile phones, e.g., Facebook and mobile money, by micro entrepreneurs in Sub-Saharan Africa. We collected survey data from 169 Zambian food vendors, and through Mokken scale analysis we derived an acquisition pattern for 12 analysed services and apps. Micro entrepreneurs with more employees, tertiary education and who were younger tended to be closer to the hierarchy's apex. These findings imply that the individual's mobile technology maturity and business development drive their adoption of services and apps. After presenting these results, we conclude with a discussion of the theoretical insights, managerial insights and implications for policy makers resulting from the study.

Keywords: Acquisition patterns, micro entrepreneurship, mobile phone technology, innovation adaption, Sub-Saharan Africa.

Introduction

Mobile phone penetration levels in Africa have rapidly increased, resulting in 759 million unique subscriptions in 2017 (International Telecommunications Union, 2018). These developments have triggered academic interest in the continent's mobile phone sector (Dey et al., 2013; Nakata and Antalis, 2015; Suri and Jack, 2016). Previously reported research has often addressed a specific local innovation, "mobile money", which "is a payment system (storing of value, payment instrument and channel) that enables financial services (payments, savings, credit, and insurance) using ubiquitous mobile technology" (David-West et al., 2019: 277). For example, M-Pesa replaces more conventional banking services for many low-income individuals in Kenya and Tanzania (Economides and Jeziorski, 2017); "Pesa" is the Swahili term for money and "M" represents mobile. In 2016, M-Pesa had 614 million monthly transactions and almost 30 million active users (Vodafone, 2018).

Mobile phone owners in Sub-Saharan Africa (SSA) can also use globally available services and applications (apps), such as Facebook, LinkedIn and Twitter (Findlay and van Janse Rensburg, 2018). However, the adoption of mobile money and these other services and apps on mobile phones is understudied. Moreover, academic research about innovation adoption amongst consumers in SSA is sparse. In addition, businesses have often neglected the so-called bottom of the pyramid consumers, which represents an untapped market of approximately 2.7 billion individuals (Rashid and Rahman, 2009). Not only may targeting this large market be commercially profitable, but satisfying the unmet needs of these consumers may also enable them to enhance their economic performance, thereby contributing to poverty alleviation (Rashid and Rahman, 2009), an effect that has been realised through mobile phone technology (Daouda et al., 2019; Suri and Jack, 2016).

In this paper, we will apply acquisition pattern analysis (Kamakura et al., 1991; Paas et al., 2005; Paas and Molenaar, 2005) to gain insights into adoption orders for mobile phone services and apps amongst Zambian micro entrepreneurs, i.e., owner-managers of resource-constrained and mainly informal small enterprises, who employ a few people at most (Khavul et al., 2009). Small, informal entrepreneurship is predominant in developing economies (Amankwah-Amoah et al., 2018), representing 39.9% of the Zambian population aged 18 to 64 (Global Entrepreneurship Monitor, 2018). Micro entrepreneurs actively use mobile phones (Aker and Mbiti, 2010; Porter, 2012), and are therefore likely to be early adopters of services and apps on their mobile phone. In the reported empirical research, micro entrepreneurs were interviewed about their use of services and apps on their mobile phone through a locally developed survey instrument.

Insight into the sequential adoption order of mobile services and apps by micro entrepreneurs supports cross-sell target selection. Consider a hypothetical acquisition pattern in which micro entrepreneurs in SSA first adopt voice calling, then mobile money and last mobile banking, which we define as "the conduct of transactional and informational banking (accessing traditional bank accounts) over mobile channels or devices" and which is a more advanced mobile service than the previously discussed mobile money facility (David-West et al., 2019: 277). Similarly to successive motivations predicted by the need hierarchy of Maslow (1943), this acquisition pattern would imply that voice calling is relevant for the most basic mobile phone technology need, mobile money would fulfil the next need, followed by mobile banking. Under such conditions, marketers could offer a mobile money app to micro entrepreneurs who currently only use voice calling, while mobile banking apps could be cross sold to those individuals who are already using both voice calling and mobile money.

Acquisition pattern analysis and the resulting cross-sell target selection have relevance in SSA. Most firms in the region apply transactional marketing approaches, without distinguishing between existing customers and other consumers (Allo, 2014). Pressey and Tzokas (2006) proposed that relationship marketing requires alignment of product-services to individual needs, which can be realised through new product development and/or appropriate targeting of product-service offers to consumers (Paas et al., 2005). The latter can be facilitated using the information that can be derived by acquisition pattern analysis.

In this paper, the literature review and empirical study will provide some of the first insights into sequential forms of innovation adoption by micro entrepreneurs in SSA. Furthermore, because it is not clear whether methodologies that were constructed in developed economies are also relevant for SSA (Allo, 2014; Nailer et al., 2015), we will conceptually and empirically illustrate the applicability of acquisition pattern analysis in SSA. In the concluding discussion section of the paper we will assess the implications of these contributions.

Theory

Frugal innovation adoption in SSA

Traditionally, innovations have their foundations in radical change and creative destruction (Kirzner, 1997; Schumpeter, 1934). Disruptive innovations create new markets and may lead to lower prices. Contrarily, frugal innovations take low prices as the basis, and consequently result in simpler attributes. Basu et al. (2013) summarised the differences between frugal innovations and innovations in Western economies as follows: (1) frugal innovations offer acceptable, but not necessarily perfect, utilities; (2) the adoption process involving frugal innovations is bottom-up, i.e., driven by consumer needs, as opposed to top-down, i.e., triggered by the marketing activities of large corporates; (3) frugal innovations' core capabilities concern functionality, as opposed to

desirability and design; (4) frugal innovations are relevant to low-income consumers in developing economies. Other terms such as "jugaad" and "grass root innovations" (Brem and Wolfram, 2014) emphasise the bottom-up adoption of functional product-services requiring limited resources.

In their seminal paper on the topic, Weyrauch and Herstatt (2017) used the following three criteria to define frugal innovations: (1) cost reductions, (2) the offering of core functionalities, and (3) an optimised performance level. Well-known international examples that fit these criteria are the Tata Nano car in India (https://nano.tatamotors.com/), Moladi housing in South Africa (http://www.moladi.co.za/) and the Trans-African HydroMeteorological Observatory (TAHMO) in Ghana and Kenya (https://tahmo.org/). Also fitting these three criteria is that micro entrepreneurs in SSA use their mobile phones to optimise everyday business activities at low costs, i.e., seeking out information about customers, suppliers and markets, accessing price information, establishing new professional contacts, and business planning (Ingenbleek et al., 2013). Nakata and Antalis (2015) pointed out that mobile phones support micro entrepreneurs by altering supply chain relationships, facilitating information provision, transforming information into power, enabling lead generation and potentially supporting network development.

These functionalities are facilitated by the various services and apps available on mobile phones, e.g., mobile money, Skype, SMS-texting, voice calling, and WhatsApp. In developing economies, mobile money is a typical frugal innovation (Lehner and Gausemeier, 2016; Peša, 2018), fitting the three criteria of Weyrauch and Herstatt (2017), i.e., cost reductions, offering core functionalities, and optimised performance. Mobile money has facilitated financial inclusiveness by providing banking services to millions of unbanked Africans who often did not have enough formal income to become customers of financial institutions (David-West et al., 2019).

Asia has been the region with the highest adoption of mobile phones (Comer and Wikle, 2008). Especially in poor and rural areas, people desire the facilities and knowledge that come along with the latest technology (Jain and Hundal, 2007). The adoption of mobile money in Asia is usually dependent on its perceived ease of use, risk and convenience (Ramayah et al., 2017), but factors such as network availability, complexity and security are also important (Khan et al., 2019). In SSA research has shown that enterprises that use mobile money are more likely to obtain loans and credit, and are more productive (Gosavi, 2018). Moreover, mobile phones, and hence mobile money, are more often adopted in social networks in which information is exchanged (Murendo et al., 2018), 'especially in areas with better physical infrastructure. Yet, mobile phone users who live in areas with poor infrastructure are more likely to rely on mobile phones to make financial transactions than individuals living in areas with better infrastructure' (Mothobi and Grzybowski, 2017: 71). Furthermore, the adoption of mobile money in SSA is influenced by ease of use, perceived applicability, trust and costs (Narteh et al., 2017), which are similar to the previously mentioned drivers for mobile technology adoption in Asia. As such, drivers for adopting mobile phone technology seem to generalize across developing economies.

Other services and apps that were first introduced in developed economies, although not initially intended as frugal innovations, can also be used in frugal ways by micro entrepreneurs in developing economies. Social network-based services and apps such as Facebook, Instagram, LinkedIn and Twitter are ideal "simplified" channels that can facilitate inexpensive advertisement. Additionally, communication-based services and apps such as Skype, SMS-texting, video calling, voice calling, and WhatsApp are economically efficient alternatives for long-distance travelling and face-to-face meetings. Furthermore, mobile banking can be considered as a digital shortcut to physically going to commercial banks. These facilities are not only relevant for micro

entrepreneurs in SSA; in the poor and rural areas of Asia, people also have been found to desire the facilities and knowledge that are provided by the latest technology (Jain and Hundal, 2007).

In summary, according to recently published theoretical reflections of inclusive growth by using frugal innovations (George et al., 2012; Lim et al., 2013; Mbogo, 2010; Onsongo, 2017), micro entrepreneurs adopting different services and apps – including mobile money – on their mobile phones can be seen as the vehicle to build capacity in developing economies. Although there are some insights into the drivers for adopting mobile phone technology in developing economies of Asia and SSA, it is largely unknown which, and in what order, services and apps are adopted by micro entrepreneurs, and what latent trait drives the acquisition pattern of multiple services and apps. This can be researched using acquisition pattern analysis.

Behavioural rationale of acquisition pattern analysis

Acquisition pattern analysis assumes that consumers have needs for various product-service offerings. Such product-services may require substantial investments, and consequently consumers will first allocate assets towards acquiring products that are relevant for their more basic or high priority needs (Paas and Molenaar, 2005; Paroush, 1965; Pyatt, 1964). After fulfilling the more basic needs, a consumer may allocate assets towards fulfilling more advanced needs.

Acquisition pattern analysis was initially applied to consumer survey data collected in the United Kingdom (UK) in the late 1950s (Paroush, 1965; Pyatt, 1964). At that time, many UK households lacked the assets to acquire all desired durables at the same time-point. In an empirical study, Paroush (1965) found that households generally acquired cookers before vacuum cleaners, and next dedicated assets towards acquiring a washing machine, while refrigerators were generally acquired last. Currently the penetration levels of these products approach 100% in the UK and

other Western economies. In such saturated markets, acquisition pattern analysis is less relevant. Instead, researchers should concentrate on replacement purchases by consumers.

Nevertheless, acquisition patterns have also been reported in the financial services retail market, where consumers adopt more basic product-services, such as savings accounts and credit cards, before risky investments, such as shares and options (Kamakura et al., 1991; Paas et al., 2005; Paas and Molenaar, 2005). Here, the prioritisation of product-services is assumed to result from the consumer's available financial assets, level of knowledge about financial services and willingness to take financial risks. Consequently, Kamakura et al. (1991) and Paas and Molenaar (2005) labelled the relevant latent trait as financial maturity. More recently, a study by Juhl et al. (2017) reported an acquisition pattern by which consumers adopt green products, which was assumed to be driven by the consumers' financial assets and knowledge about green consumption.

In general, researchers assume that finite financial and/or non-financial resources in conjunction with choices between alternative product-services will lead to a priority structure, which implies that both consumers and product-services can be positioned on the same latent trait (Paas and Molenaar, 2005). This latent trait would represent, on the one hand the ability of consumers, and on the other hand the difficulty involved in adopting a product-service. Consumers that are less developed in terms of for example mobile phone technology maturity, have lower positions on the latent trait and tend to adopt only those services and apps that are found at an even lower latent trait position (Kamakura et al., 1991; Paas and Molenaar, 2005; Paroush, 1965). Consumers with higher latent trait positions will have adopted more services and apps.

Relevance of such a hierarchical latent trait can be assessed using empirical data. Feick (1987, p. 174) suggested that: "If there is a hierarchical pattern of behaviour, researchers should observe only behaviours consistent with this single pattern. That is, if the hierarchy is that A is

acquired before B and B before C, we should find few instances of acquisition of C without A and B, and so on." Under such conditions, product A will have a higher penetration level than B and B will be more commonly owned than C. However, differences across product-services in penetration levels is not a sufficient condition for assuming the relevance of an acquisition pattern. In addition, the occurrence of patterns contradicting the order of acquisition, e.g., an individual owns product B but not A or only C, should occur less often than expected under conditions of independence between acquisitions of the three products in our hypothetical marketplace.

An illustrative comparison can be conducted using an educational setting. Because multiplication is more complicated than addition, it can be expected that more students can perform addition than can perform multiplication. However, addition and multiplication can only be considered as part of the same knowledge acquisition pattern if those students capable of addition have a higher probability of performing multiplication correctly. If multiplication is performed equally well by students capable of addition and those individuals that are incapable of addition, then these two forms of knowledge are not part of the same knowledge acquisition pattern. Therefore, acquisition pattern analysis assesses whether the expected order occurs more often in the analysed empirical data than would be expected under conditions of independence.

The adoption of mobile technology in SSA

We propose that acquisition pattern analysis is applicable to various markets in developing economies. For many consumers and micro entrepreneurs in SSA, conditions of resource constraints and the resulting necessity to prioritize products will apply. Moreover, in an empirical study, Zinn et al. (1992) successfully applied acquisition pattern analysis to measure wealth amongst low-income villagers in Indonesia. Those villagers who were positioned closer to the hierarchy's apex, i.e., owning more products, were categorised as relatively wealthy. Due to the

informal nature of their economic circumstances, this measure was deemed to be a more suitable wealth indicator than the traditional financial asset-based measures that are commonly used in economically developed contexts.

We suggest that acquisition pattern analysis also is applicable to studying the order of adoption of services and apps on mobile phones in SSA. This adoption process requires a time investment, in terms of activating and learning to use services or apps (Rashid and Rahman, 2009), and possibly also financial investments, i.e., Internet surfing time and/or subscription fees. Given the required investments we suggest that micro entrepreneurs in SSA are unlikely to adopt all available services and apps simultaneously. Instead, they may first adopt services and apps that offer utilities that are needed most urgently and may postpone the adoption of services and apps providing higher order utilities.

The route describing business developments in subsistence marketplaces further supports the relevance of a sequential adoption process for services and apps on micro entrepreneurs' mobile phones. Daouda et al. (2019) conducted qualitative research that resulted in the definition of three phases through which (micro) enterprises in SSA develop. In the first phase, relatives and neighbours are the main suppliers. We suggest that in this phase, SMS-texting, voice calls, and mobile money can facilitate the relatively basic financial requirements and communication needs of the micro entrepreneur. Because of this, entrepreneurs require only a basic mobile phone in this stage; the required services and apps can run on such a device.

In the second phase of the enterprise, consumers outside the micro entrepreneur's personal network, who for example pass by the bricks-and-mortar location of the enterprise, can be targeted. Such developments can possibly result in a need for broader communication, which can be realised at low costs through the utilities offered by for example Facebook, Instagram and Twitter. These

options are used instead of costly conventional marketing channels, e.g., billboards, newspaper advertising. In this phase, owning a smartphone becomes relevant for the micro entrepreneur.

Daouda et al. (2019) found that in the third and final phase the micro entrepreneur interacts directly with other, sometimes larger, enterprises, to provide for example food catering services. This development is likely to result in a need for formal financial services, such as mobile banking, and the more complicated communication requirements may lead to the adoption of facilities such as Skype and video calling, which replace the costly travel involved in face-to-face contacts.

In sum, the limited resources of micro entrepreneurs in conjunction with differing priorities for services and apps on mobile phones may result in a priority pattern. Therefore, we formulate the two following research questions, which will be addressed next in the reported empirical study:

RQ1: Which services and apps are adopted on mobile phones in a sequential acquisition order by micro entrepreneurs in SSA?

RQ2: What latent trait drives the adoption of mobile phone services and apps by micro entrepreneurs in SSA?

Method

Research setting

The data were collected in February 2018 in Kitwe, the second largest city in Zambia. With 520,000 inhabits and a geographical location in an economically emerging copper mining region, this city attracts much entrepreneurial activity (Choongo et al., 2016). Zambia is a developing economy in SSA that experienced rapid growth until 2014. In 2016, the gross national income per capita was US$3850 and 57.5% of the population lived below the poverty mark of US$1.90 a day (World Bank, 2018). Developing economies are characterised by government and market failures

that constrain micro entrepreneurs from starting up an enterprise, but that also enable them to exploit the institutional voids that these characteristics create (McDade and Spring, 2005).

In Zambia, eight major mobile money providers dominate the market. CelPay was among Zambia's first telecom service providers that introduced mobile money in 2002. Only since 2015 has mobile money gained much popularity in Zambia, and this was due to cooperation between M-Pesa and MTN. In 2019, Zoona was the market leader in mobile money. Although most of the mobile money adopters are centred in and around urban areas, the providers are increasingly targeting rural dwellers. A detailed and comprehensive overview of the Zambian mobile money industry has been provided by David-West et al. (2019: 289).

Survey instrument development

The survey instrument was developed following the "qual → QUAN" research approach (Molina-Azorín et al., 2012, p. 442). This approach has often been used in SSA and has shown to be effective to contextualise research methods including surveys (Eijdenberg et al., 2015; Eijdenberg, 2016). In this research approach, a qualitative pre-study, i.e., a capacity building workshop, was conducted to justify the quantitative main study. Two of this paper's authors led the qualitative workshop as instructors, after which they coordinated the quantitative main study.

The workshop took place at Copperbelt University (CBU) in Kitwe with CBU-faculty. Seven female and nine male middle-level or senior professionals at CBU were involved as participants. At the time of the data collection, all participants had lived in the Kitwe-region over a long period. They were associated with local entrepreneurship in different ways, e.g., educating local micro entrepreneurs, teaching entrepreneurship to university students or being entrepreneurs themselves. The participants were affiliated with different schools and departments; six were from the School of Business, while others were from for example the School of Natural Resources, the

School of Engineering and the Dag Hammarskjöld Institute for Peace and Conflict Studies. Involving local participants in the qualitative pre-study ensured that the developed measurement instrument reflected context-specific circumstances (Eijdenberg, 2016; Ingenbleek et al., 2013).

In addition to participating in other workshop activities, the participants were paired and requested to think about survey items, particularly in terms of services and apps used on mobile phones by micro entrepreneurs in Kitwe. They discussed each other's item suggestions until consensus was reached. The final survey instrument is reported in Table 1.

<INSERT TABLE 1>

Survey procedure and sample

Besides providing input for developing a survey instrument, the workshop participants were also the data collectors for the survey; in the remainder of the methods section they are therefore referred to in their role as data collectors. Additionally, two experienced local students surveyed micro entrepreneurs. Such data collectors are required in developing country contexts, as their knowledge of local circumstances will reduce interviewer bias and other complications (Ingenbleek et al., 2013).

Each data collector was encouraged to conduct at least ten surveys, using the random walk procedure which is commonly applied in SSA (Frese et al., 2007). Data collectors were directed to food vendors, the so-called "Tuntemba" businesses, who were considered prototypical micro entrepreneurs in the Zambian context during the workshop. Food vendors operate on streets or through small, self-built restaurants or kiosks across SSA. In many cases, they are not registered. Such food vendors form a substantial part of the economic activity in SSA (Asiedu and Agyei-Mensah, 2008; Eijdenberg, 2016). For less-educated individuals, street vending may provide the only available employment option (Lyons et al., 2014).

The data collectors reached 170 micro entrepreneurs, but a filter question indicates one respondent was not active in food vending and this individual was excluded from the analyses. The resulting sample of n=169 consisted of 88 women (52.35%) and 141 respondents were aged 20 to 50 years (82.94%). Furthermore, 39 respondents (23.07%) had not completed any formal education beyond primary school, 70 respondents (41.42%) indicated secondary school as their highest educational level, and 60 respondents (35.50%) had completed tertiary education of which 11 respondents (6.51%) had a Bachelor and/or Master's degree. These sociodemographic sample characteristics are similar to those that were reported in previously conducted empirical studies on food vending in Zambia and other SSA countries (Choongo et al., 2020; Eijdenberg, 2016).

Analysis

We conducted acquisition pattern analysis to the data obtained from the questions about the use of the 12 services and apps on mobile phones amongst the 169 respondents. The answers to the 12 questions consisted of the following five categories on usage of the focal service or app: (1) never; (2) rarely; (3) sometimes; (4) often (5) always. We considered usage intensity rather than adoption (yes/no) because these can be considered as two separate behaviours, particularly amongst low income consumers in economically developing contexts (Dey et al., 2013). In the conducted acquisition pattern analysis, values of three or higher, implying the services or app is used at least sometimes, are given the positive value one, and if the app or service is used rarely or never, the value zero is allocated. We applied Mokken Scale Analysis (MSA) to the resulting 12 binary variables.

Paas and Molenaar (2005) found that Mokken Scale Analysis (MSA) is particularly well suited for conducting acquisition pattern analysis; they reported mathematical and empirical support for this application. MSA is an established technique that has been used for many purposes

in the academic literature: the Sijtsma and Molenaar (2002) book in the renowned SAGE series about measurement methods provides an extensive overview of MSA applications. Various applications of acquisition pattern analysis for practical marketing purposes have also been reported in the literature targeting practitioners (Paas et al., 2005; Paas and Kuijlen, 2001). Terpstra et al. (2012, 2014) present some other examples of MSA applications that were conducted in a corporate context. Due to these extensive applications, procedures for conducting MSA are available in R (Ark, 2012), Stata (Hardouin et al., 2011) and SPSS (Kingma and Taerum, 1989).

Applying MSA for acquisition pattern analysis (Coromina and Camprubí, 2016; Paas and Molenaar, 2005) is based on cross sectional product ownership patterns derived from consumer surveys. In some studies latent Markov models have been applied to longitudinal data (Juhl et al., 2017; Paas et al., 2007; Schweidel et al., 2011). Longitudinal data provide additional insights, such as indications about the time passing between the adoptions of consecutive product-services in the acquisition pattern. However, gathering longitudinal data amongst micro entrepreneurs in SSA is less feasible, as they often move from one location to another without formally registering the enterprise (Lyons et al., 2014).

MSA is based on three assumptions stemming from latent trait theory (Sijtsma and Molenaar, 2002): (1) local stochastic independence: overt correlations between respondents' values on the 12 services and apps variables are explained by the respondent's latent trait value, $\boldsymbol{\theta}$, i.e., mobile technology maturity; (2) monotonicity: respondents with higher $\boldsymbol{\theta}$-values are more likely to score one, instead of zero, on the 12 analysed variables; (3) unidimensionality: each of the 12 binary variables represents a different manifestation of $\boldsymbol{\theta}$.

In MSA, the homogeneity coefficient H_j quantifies the strength by which service or app j fulfils these three assumptions (Mokken and Lewis, 1982; Sijtsma and Molenaar, 2002). In terms

of acquisition pattern analysis, a higher H_j–value implies a stronger indication of service j's acquisition pattern position (Paas and Molenaar, 2005), i.e., j is more often adopted after services and apps with higher penetrations and before services and apps with lower penetrations. The statistic H is an overall indication of the extent to which services with higher penetrations (more basic needs) are adopted before less frequently owned services and apps (higher order needs).

Mokken and Lewis (1982) and Sijtsma and Molenaar (2002) present equations for calculating H and H_j. Under empirical conditions of positive correlations between all possible $J^*(J-1)$ item pairs i,j in the set of J items, H and H_j will take on values ranging from 0 to 1. If H=0, the order of adopting services and apps with higher penetrations before less commonly owned services and apps occurs as often as expected under conditions of independence. H=1 would imply a perfect adoption order, which is a theoretical ideal that is not found in practice (Paas and Molenaar, 2005).

Based on extensive empirical research experience, commonly applied rules of thumb are available for determining the extent of scalability under empirical conditions. H and H_j values below 0.30 imply insufficiently strong empirical relationships in the sample for assuming the relevance of a latent trait $\boldsymbol{\theta}$; values ranging from 0.30 and 0.39 imply weak scalability, values from 0.40 and 0.49 imply reasonable scalability and values of at least 0.50 imply strong scalability (Mokken and Lewis, 1982; Paas and Molenaar, 2005; Sijtsma and Molenaar, 2002). We used the R-procedure "Mokken" for applying MSA to the obtained dataset (Ark, 2012). As mentioned above, the same analysis can be conducted in Stata or SPSS.

Results

Findings of acquisition pattern analysis

Based on the 12 relevant five-point polytomous variables we find that 11.76% of the respondents did not use any mobile phone services and apps at all for business purposes, not even rarely. We

expect that such individuals are predominantly subsistence-oriented food vendors. Furthermore, we find that the penetration levels of the services and apps differ extensively, ranging from 76.47% for voice calling to only 5.89% for Skype and LinkedIn. However, as mentioned in the methods section of this paper differences in product penetrations are not a sufficient condition for assuming an acquisition pattern.

In support of assuming that respondents adopted the services and apps according to the relative penetration levels, Table 2 shows that reasonable to strong MSA scalability applies for all 12 analysed mobile phone services and apps (see the second last column); all $H_j \geq 0.40$ and that $H=0.48$. Note that the mean values on the items representing services and apps do not correlate with the *Hj*-values. This is comparable with the situation in exploratory factor analysis, in which the mean values on item-scores are independent from their factor loadings.

< INSERT TABLE 2 >

We note that the found acquisition pattern could possibly result from the mobile phone that different respondents own or have access to, via friends or relatives. The less commonly adopted services and apps, e.g., Facebook, LinkedIn and video calling, run on smartphones, whereas voice calling, SMS-texting and mobile money can run on basic mobile phones. Therefore, we conducted a robustness check. For this purpose, we excluded those respondents who did not use any of the services and apps that can only be used on the more advanced smartphones, i.e., Instagram, Internet Browsing, Facebook, LinkedIn, mobile banking, Skype, Twitter, video calling or WhatsApp.

In the resulting dataset, with $n=116$, each individual respondent used one or more of these nine services at least sometimes, which suggests that they either own or have access to a smartphone. The MSA results showed that scalability is not applicable for three of the 12 apps and services, i.e., voice calling, mobile money and mobile banking (see the last column in Table 2).

Thus, for these three services the order of adoption probably results from the types of mobile phones to which respondents have access.

In terms of *RQ1*, we conclude that the respondents adopted the 12 analysed services and apps in a hierarchical order according to the relative penetration levels, i.e., from most frequently owned service or app to the least frequently owned. The MSA results reported in Table 2 imply that this pattern occurs more often than would be expected under conditions of independence, implying that a latent trait can be assumed to drive the adoption of the analysed services and apps. However, for three of these products this adoption order probably results from the type of mobile phone that respondents have access to, smartphone or basic mobile phone.

Explaining acquisition pattern positions

To address *RQ2* we conducted a linear regression analysis. For this purpose, we calculated, for each of the 169 respondents, a disaggregate sum-score of the number of times that the value one occurs on each of the 12 variables in Table 2. For example, a respondent having value one on voice calling, mobile money and mobile banking, and the value zero on the nine other variables, will receive a sum score of three. The MSA scalability we found, see Table 2, in conjunction with a Cronbach's α of 0.82, implies that this sum-score validly and reliably measures the latent trait value Θ_i for each respondent i (Sijtsma and Molenaar, 2002). Note that we use all 12 items for this analysis, because scalability of some items resulting from owning or not owning a smartphone is not an issue for the linear regression analysis; ownership of a smartphone will also relate to the mobile phone maturity latent trait and the conducted linear regression analysis aims to assess the drives of this latent trait.

The results that are reported in Table 3 imply that respondents with more employees and who had completed tertiary education were more likely to have progressed towards the apex of the

acquisition pattern that is reported in Table 2; $p<0.05$ for both effects. In addition, in Table 3 we report that age has a marginally significant negative effect ($p<0.10$); older micro entrepreneurs were more likely to be found in the relatively basic stages of Table 3. Interestingly, previously reported qualitative research findings suggested that younger and more educated individuals tend to be more mobile phone technology savvy and also tend to make more use of such innovations (Dey et al., 2013). Furthermore, a larger number of employees has a significant positive effect on the number of mobile phone services and apps that are used. The r-square of 0.16 suggests that future research could assess other explanatory variables in terms of their relevance for the adoption of mobile phone services and apps, next to the predictors that are reported in Table 3.

< INSERT TABLE 3 HERE >

Concluding discussion

In this paper, we have conceptually and empirically illustrated the applicability of acquisition pattern analysis for assessing the sequential adoption order of innovations in contexts where consumers have limited assets, financial and otherwise, and where they consequently need to prioritise the adoption of product-services (*RQ1*). We proposed that such conditions are relatively likely to occur in developing economies and we empirically assessed the specific case of the adoption of services and apps on mobile phones by micro entrepreneurs in SSA. We have also provided insights into the drivers underlying mobile phone technology maturity (*RQ2*).

In terms of *RQ1*, the paper has extended the academic knowledge about the adoption of mobile phone services and apps in SSA. As discussed in the Theory section, the adoption of mobile phones, mobile money and various other services and apps involves different individual and contextual drivers. However, most of the previously published studies only addressed the adoption of mobile phones or alternatively mobile money and have for example confirmed the relevance of

regional differences in the adoption of mobile phones and/or mobile money in developing economical contexts (Comer and Wikle, 2008; Gosavi, 2018; Khan et al., 2019; Mothobi and Grzybowski, 2017; Murendo et al., 2018; Narteh et al., 2017).

In addition to this knowledge, the MSA results in our paper support the existence of a latent trait that drives the adoption of various services and apps on mobile phones of micro entrepreneurs in SSA. When assessing for example regional differences in mobile phone technology maturity in future studies, the researchers could aim to quantify the differences in average acquisition pattern positions of consumers across regions, instead of only exploring differences in the adoption of a single service, such as mobile money, or the adoption of mobile phones.

In terms of *RQ2*, the reported regression analysis showed that the latent trait underlying the found acquisition pattern relates to mobile phone technology maturity and the size of micro entrepreneur's enterprise, see Table 3. This extends the previous literature which addressed mobile phone technology adoption in Asian and SSA contexts (Comer and Wikle, 2008; David-West et al., 2019; Jain and Hundal, 2007; Khan et al., 2019; Ramayah et al., 2017) by showing how the adoption of various mobile phone apps and services are interrelated and driven by various antecedents, next to the type of mobile phone that is owned by the micro entrepreneur, a basic model or a smartphone.

Nevertheless, we found that the three services and apps that can also be used on basic mobile phones, voice calling, SMS-texting and mobile money, to have the highest penetration levels. This finding suggests that some micro entrepreneurs only have access to more basic mobile phones, allowing them to use only the most basic services and apps for running their businesses. Interestingly, the finding that mobile money is one of the basic mobile phone services for Zambian micro entrepreneurs implies that in SSA mobile money probably is a key motivator for adopting

mobile phone technology in general, just as SMS-texting and voice calling formed key motivators for the initial adoption of mobile phone technology by consumers in Western economies. This suggests that mobile service providers aiming for a substantial share of the market in SSA should aim to offer a mobile money app, next to voice calling and SMS-texting facilities.

Another managerial marketing perspective is that the findings in Table 2 suggest that a Zambian telecom service provider could inform micro entrepreneurs using voice calls, mobile money and SMS-texting about Facebook, Internet browsing and WhatsApp, which are found in the next steps of the acquisition pattern, whereas for example LinkedIn and Skype, with lower penetration levels, would, at this stage of the micro entrepreneur's mobile phone technology maturity development, be a bridge too far. If Zambian telecom service providers enhance consumer awareness about services and apps which have not yet been adopted, this information may motivate micro entrepreneurs to adopt or cross-buy such offerings, but they may also consider purchasing a smartphone, where such a mobile phone is not already owned.

The reported acquisition pattern also supports the cross-selling of services and apps to micro entrepreneurs who already own a smartphone, as eight of the nine services and apps that are only available on the smartphone also had sufficient MSA scalability in the robustness check that is reported in Table 2. Such cross-selling could be profitable for mobile phone services providers, because if the targeted micro entrepreneur indeed starts using for example Facebook, then more Internet surfing time will be sold. Moreover, acquisition pattern based targeting of existing customers would be a step towards relationship marketing approaches, which are currently applied sporadically by marketers in the SSA region (Allo, 2014).

Our findings are also relevant to the entrepreneurship literature and models on frugal innovation adoption. Current frugal innovation models explore how products and services add

value, generate revenues and create new international markets (Rosca et al., 2017). Previous papers in the entrepreneurship literature have not assessed interconnectedness in the adoption of different innovations (George et al., 2012; Rosca et al., 2017). Considering multiple product-service adoptions as a sequential consumer-driven need-based process, through the application of acquisition pattern analysis, may provide new conceptual perspectives and enhanced empirical precision for frugal business models.

From a societal perspective, the results provide relevant input for development of entrepreneurship courses in SSA. The acquisition pattern of the services and apps in Table 2 represents the most common order of adoption. Individual micro entrepreneurs who deviate from this adoption order should be encouraged to consider whether this divergence is prudent and, if so, why a deviation is appropriate for their specific enterprise. During workshops for micro entrepreneurs in SSA the higher order apps and services in Table 2 can also be assessed in terms of the utilities required by their enterprise, and micro entrepreneurs can consider whether investing in a smartphone is prudent or, in the case of micro entrepreneurs without any mobile phone, whether a basic mobile phone can enhance their enterprise outcomes.

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Table 1. Final survey instrument.

Variable	Scale
Age	Number
Gender	1 = Male; 2 = Female
Highest completed education	1 = Less than primary school; 2 = Primary school; 3 = Secondary school; 4 = College/University diploma; 5 = Bachelor's degree; 6 = Master's degree; 7 = Doctorate; 8 = Other.
Current number of employees of the enterprise	Number
Food sector	1 = Yes; 2 = No
Formal/informal	1 = Yes; 2 = No
Enterprise founded in less than five years	1 = Yes; 2 = No
To what extent do you make use …	
LinkedIn	1 = Never; 2 = Rarely; 3 = Sometimes; 4 = Often; 5 = Always
Skype	
Instagram	
Video calling	
Twitter	
Facebook	
Internet browsing	
WhatsApp	
Mobile banking (e.g., the Barclays mobile banking app in Zambia)	
SMS-texting	
Mobile money (e.g., MTN Zambia mobile money)	
Voice calling	

Table 2. MSA results.

Mobile phone service and app	Service used at least sometimes – Binary (*n*=169)	MSA results - H-values (*n*=169)	MSA robustness check (*n*=116)*
LinkedIn	5.89%	0.46	0.37
Skype	5.89%	0.49	0.37
Instagram	8.23%	0.50	0.42
Video calling	9.41%	0.53	0.40
Twitter	10.00%	0.50	0.45
Facebook	31.76%	0.69	0.64
Internet	36.47%	0.59	0.52
WhatsApp	42.94%	0.62	0.60
Mob. Banking	49.41%	0.49	Not scalable
SMS-texting	60.00%	0.58	0.45
Mob. Money	61.76%	0.52	Not scalable
Voice calling	76.47%	0.50	Not scalable
Scale		0.56	0.47

* To assess whether access to a Smartphone may have influenced the MSA results we conducted an additional analysis on those respondents who have access to a smartphone, their own or borrowed from someone else. The 116 respondents with such access were found by selecting only those respondents who had used a service that can only be run on a smartphone at least sometimes, i.e., Mobile banking. WhatsApp, Internet browsing, Facebook, Twitter, Video calling, Instagram, Skype or LinkedIn. The results reported in the table were attained after excluding the three non-scalable items from the MSA, which is a standard approach in MSA (Sijtsma and Molenaar, 2002).

Table 3. Regression results for explaining the number of mobile phone services and apps used

Variable	Beta	Standardised Beta	*p*-value
Constant	3.60	-	0.01
Age (in years)	-0.38	-0.14	0.08
Current number of employees of the enterprise	0.13	0.19	0.02
Gender = female	0.56	0.10	0.18
Being a formal business	-0.04	-0.01	0.94
Enterprise founded in the last five years	0.08	0.01	0.86
Having high school	-0.22	-0.04	0.70
Having tertiary education	1.28	0.22	0.04

* Age and the number of employees are metric variables, all other independents are binary. Furthermore, the non-metric variable education is represented by two binary variables, high school and tertiary. The dependent variable is the number of mobile services and apps that are at last used sometimes by the respondent. In this analysis r^2=0.16 (df=7, F=4.27, p<0.01).