Economic Sustainability of Mobile Money Payments in Ghana: Does a Tax on Transactions Matter?

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Abstract

Ghana's mobile money market has been one of the fastest growing in Africa, and among the biggest. However, the recent implementation of an electronic tax on mobile money transactions has created some uncertainty about the expected gains of the promising mobile money industry in Ghana. This study seeks to ascertain the determinants of active mobile money use and to evaluate its sustainability as a payment system in Ghana. Primary data from a probability sample of 400 digital payments subscribers are analyzed using a logistic regression model and cost-effectiveness ratios. The results show that general acceptance, subjective norms and cost of transactions significantly influence the active use of mobile money in Ghana. Also, the mobile money payment system is found to be the most cost-effective payment system among all digital payment systems in Ghana. However, the percentage deterioration in cost-effectiveness of mobile money transactions exceeds the percentage increase in transaction cost for small transactions. Also, the effect of Ghana's 1.5% electronic levy resulted in more than 50% deterioration in cost-effectiveness of mobile money payments for big transactions. Thus, the tax system is inefficient and regressive, leading to worsening economic conditions for low transaction subscribers. It is recommended that the electronic levy tax be withdrawn, to make the mobile money payment system effective enough to deliver the cashless economy, for which its use was conceived.

Keywords: Cost-effectiveness; Debit card; Digital payment systems; Electronic levy; Ghana; Mobile money, Transaction cost.

JEL Classification Codes: D12, D23, E42, H21, H24.

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1. Introduction

Cash still remains a dominant form of payment in most developing countries including Ghana, often exposing holders to high risk and cost. To mitigate the risk and excessive cost of cash transactions and increase financial inclusion, the Bank of Ghana has since 2007 advocated for more use of electronic transactions. This could create a cashless economy to deliver more efficient and greater growth. One way to get that done was by legalizing mobile money services in Ghana.

The success of M-Pesa in Kenya as a driver of financial inclusion popularized mobile money use in Africa. However, the profits accruing to mobile money operators have in recent times drawn African governments attention to the system as an avenue of easy tax revenue. In countries like Cameroon, Uganda and Zimbabwe, the mobile money tax system has been described as regressive, in that the burden has been more on the poor than on the rich (Lees and Mader, 2022). In addition, the recent trend of some African countries raising tax revenues from mobile money transactions could be a significant threat to reaching the expected goal of cashless economies, since it increases the cost of using the system.

Mobile money service users are provided with mobile money accounts linked to their phone numbers which enables them to receive, save and transfer money electronically (Worldremit, 2021). Ghana has a high number of mobile phone users (about 91% of adults), compared to about 70% conventional bank account holders (GSMA, 2015; NCA, 2015), which has contributed to high demand for mobile money in the past five years. This resulted in the creation of about 16.4 million mobile money accounts by June, 2016 (NCA, 2016; Bank of Ghana, 2016). The number of mobile money accounts grew to 32.7 million in 2020 and further to 40.9 million in 2021 (Bank of Ghana, 2021).

Mobile phones officially became the most-used mode of payment by 2019, as a result of mobile banking and mobile money operations in Ghana (Ghana Web, 2019). However, while there were 32.5 million registered accounts, active users of mobile money were only 13 million by the close of 2018 (Ghana Web, 2019). The wide gap between registered mobile money accounts and active users showed that the factors that influenced the adoption of the payment system may not be the same as those determining its active use. Ghana's banking survey in 2016 found that, while some users of mobile money identified low transaction costs as a benefit of using the system, others mentioned high transaction cost as a challenge (PwCIL, 2016). There was however, no empirical analysis to support this assertion.

Ghana's Electronic Transfer Levy (e-levy) was originally to be introduced as a 1.75% levy on the value of a transaction, but was later revised to 1.5% due to protests from the general public. The tax allowed a daily exemption of the first one hundred Ghana cedis for users. However, in its budget statement for 2023, the government cancelled the exemption and reduced the rate to 1%. The government of Ghana has had a disappointing experience trying to achieve tax revenue targets from mobile money transactions so far. From an initial mobile money tax revenue target of 6.9 billion Ghana cedis (GH₵), the value was revised to 4.9 billion Ghana cedis following a delay in the mandatory parliamentary approval of the tax.

After some months of implementation, the budget review for mid-year 2022 indicated that the e-levy tax only generated 93.7 million Ghana cedis instead of the targeted half year budget of 1.46

billion Ghana cedis. This caused yet another revision of the target to 611 million Ghana cedis for 2022. The reduction is about 90% of the stated budget target (Ghanaian Times, 2022). This is against the background that mobile money transaction values did not change significantly over the period, based on the central bank estimates. The failure of Ghana's e-levy to raise significant revenue led to a call by some stakeholders for its abolition, in less than one year of implementation.

The uncertainty surrounding the sustainability of the e-levy tax system could be addressed if there is a solid understanding of the factors that determine the active use of mobile money as well as the potential effect of the tax system on it. Very limited empirical study has been done so far to provide enough basis for a mobile money based tax system in Ghana (Lees and Mader, 2022). This study will therefore be one of the first empirical studies, coming in less than one year after the introduction of Ghana's e-levy.

The few studies on digital financial payments conducted in Ghana (Tobbin and Kuwornu, 2011; Mumin *et al*, 2014; Antwi, Hamza and Bavoh, 2015; Sogbodjor, 2015; Bampoe, 2015) have mainly focused on the adoption of mobile money and use of other electronic payment instruments such as E-Zwich and Automated Teller Machine (ATM) debit cards. Thus, the relationship between the actual cost of active use of mobile money payment system and how it affects usage, as well as comparative cost-effectiveness among retail electronic payment instruments is not known for the Ghanaian economy.

Specifically, this study sought to ascertain the factors that influence the active use of mobile money in Ghana and to estimate the real cost of using mobile money and other digital payment instruments. It also sought to assess the cost-effectiveness of these payment systems in Ghana. Analysis towards sustainability of mobile money transactions were also carried out to ascertain the extent to which government revenue mobilization could be affected through changes in the payment system.

The following section reviews some pertinent literature for the study. The third section explains the methodology employed, leading to a specification of the estimation model. A two-part analytical framework then follows, which leads to the presentation and discussion of the results for the study. The study concludes with some implications and recommendations for economic policy.

2. Literature Review

2.1 Electronic payment systems in Ghana

In 2007, the Bank of Ghana established a subsidiary whose mandate was the implementation and management of infrastructure for financial institutions' interoperability payment systems (GhIPSS, 2022). This subsidiary is the Ghana Interbank Payment and Settlement Systems Limited (GhIPSS). The implementation and management of the National Switch & Biometric Smart Card Payment System called the e-zwich as well as the National Switching and Processing System called the gh-link have been under the supervision of the GhIPSS. These have been part of the effort of the central bank to ensure the achievement of cashless economy (GhIPSS, 2022).

The electronic payment systems in Ghana consist of both retail and wholesale payment systems. Mobile money, National Switch (Debit card, gh-link) and E-Zwich payment systems are the main

retail payments in Ghana for which payments are done through telecommunications and financial institutions. The main instruments used are electronic wallets (mobile money wallet) and payment cards such as debit cards and e-zwich biometric cards. Basic infrastructures such as telecommunication network arrangements through mobile phones, automated teller machines (ATMs) and Point of Sale (POS) terminals are employed in the payments.

Ghana's e-zwich card, introduced in 2008 gives holders the ability to use other financial institutions' outlets linked to the system for retail and banking purposes. It is a smart card system of payment with interoperability and biometric features. The gh-link card (Debit card) was developed in 2012 to provide Ghanaians with a secured local Ghanaian card that reduces the cost of securing and using an ATM card. The card seeks to lower the cost of local transactions and protect transaction data of customers since card transactions are processed in Ghana (GhIPSS, 2022).

2.2 Active use of mobile money

Mobile money as a payment system became operational in 2009, to improve financial services towards a cashless economy in Ghana. Within the past fifty years, various models and theories, which explain the acceptance and use of innovative technology have been used to predict the adoption of electronic money payments. Fishbein and Ajzen (1975) used the Theory of Reasoned Action (TRA) while Davis (1989) employed the Technology Acceptance Model (TAM). Later, Ajzen (2005, 1991) came up with the Theory of Planned Behaviour (TPB) explanation while Rogers (1995) employed the Innovation Diffusion Theory (IDT). Venkatesh *et al*. (2003) also tried to explain the acceptance and use of electronic payments with the Unified Theory of Acceptance and Use of Technology (UTAUT).

This study employs constructs from the Theory of Planned Behaviour (TPB) (Ajzen 2005, 1991) in the context of technology use, to ascertain the determinants of active mobile money use in Ghana. The theory proposes that three main factors lead to the formation of behavioural intentions which eventually results in the performance of actual behaviour such as the adoption and use of technology like mobile money payments systems. These factors are one's attitude (A) toward that technology, that is, favourable or unfavourable feelings towards the use of the system; subjective norms (SN), that is, the perception that people who are important to the individual desire for him or her to use or not to use mobile money; and perceived behavioural control (PBC), that is, internal and external control factors. Thus, factors determining active mobile money use (MM_{USE}) are expressed in equation (1) as

$$MM_{USE} = f(A + SN + PBC) \quad (1)$$

These factors are also believed to be shaped by behavioural, normative and control beliefs respectively which have prior determinants. The study decomposes the 'A' and PBC into specific determinants of the active use of mobile money. According to TPB (Ajzen, 1991), 'A' is determined by the benefits or usefulness and cost of using a technology. Benefits in this study were expressed in terms of the satisfaction derived from making payments (SAT), convenience (CONV) and general acceptance (ACCEPT) of the system by parties in the payment chain. PBC also relates to internal (self-efficacy) and external (facilitating) factors that may impede or facilitate the use of a technology. Self-efficacy conditions were measured by age (AGE) and education level of

respondents (EDU). Facilitating conditions were also measured by the ease of use (EUSE), level of transfers (TR), occupation (OCCUP) and marital status (MARRIED) of the user. Thus:

$$\mathrm{MM}_{USE} = f(SAT + CONV + ACCEPT + COST + SN + AGE + EDU + EUSE + TR + OCCUP + MARRIED) \quad (2)$$

2.3 Cost-effectiveness of electronic payment systems

Cost-effectiveness analysis (CEA) is an economic evaluation technique that relates relative costs to key outcomes or benefits (effectiveness) of two or more courses of action such as the use of different electronic payment systems (Cellini and Kee, 2015). As an economic evaluation technique, CEA examines the cost and effectiveness of alternative means of accomplishing an objective with the aim of selecting the one with the highest effectiveness relative to its cost or lowest cost relative to effectiveness (Husereau *et al*, 2013).

Cost in CEA is measured from the economics perspective and distinction is made between different cost concepts such as fixed and variable cost; opportunity cost; direct, indirect and intangible cost; private and social cost (Segendorf and Jansson, 2012; Hayashi and Keeton, 2012). Effectiveness in CEA measures a single quantified but not monetised outcome or benefit that is central to the objectives of an alternative. In order to ensure that the findings of CEA are not subject to misinterpretation, it is important to clearly specify the nature of cost items and effectiveness included as well as those which are not included in the analysis. The study used the number of electronic payments made in each payment system as a measure of its effectiveness.

Three types of cost – effectiveness ratios are usually used in a CEA. These are average cost – effectiveness ratio (ACER): it is used to assess a single alternative when alternatives are assumed to be independent and it measures the cost per unit of effectiveness of alternatives (Murray *et al*, 2000; Cellini and Kee, 2015); marginal cost – effectiveness ratio (MCER) is also used to assess the specific changes in cost and effectiveness as an alternative is expanded and finally incremental cost – effectiveness ratio (ICER) is described as the additional cost per additional unit of effectiveness and compares the difference in costs and effectiveness of two alternatives that compete for the same resources, thus alternatives are viewed as mutually exclusive.

2.4 Empirical literature

Babatope and Abbyssinia (2020) investigated the factors responsible for the acceptance and use of payments with mobile money in Africa's rural communities. The Africa ICT access survey was the source of data analyzed. They employed a two-in-one model which sought to explain the factors responsible for mobile money use as well as the amount of money received or sent. They found that owning a bank account, employment status, number of years of education and age influenced both how much money was received or sent and whether mobile money would be used or not.

Tobbin and Kuwornu (2011), Domeher, Frimpong and Appiah (2014) and Mumin *et al* (2014) employed structural equations, logistic regression and probit regression models respectively on constructs from TAM and IDT. They identified perceived ease of use, perceived usefulness, risk, education, convenience and charges (cost) as some of the determinants of adoption and use of Mobile Money and other financial innovations such as ATM (Debit) cards in Ghana.

In some other countries, Yu (2012), Hayashi and Keeton (2012), Chayanis *et al* (2013), Jack and Suri (2014) and Koulayev (2015) found cost, acceptance, convenience, subjective norm and age to be significant determinants of the use of mobile money and other electronic payments. In spite of identifying cost as a determinant, none of these studies actually measured the cost of using the payment systems or their cost-effectiveness. Hayashi and Keeton (2012) and Murendo (2015) went to the extent of identifying the key concepts needed to measure cost – effectiveness and hence the efficiency of mobile money and other payment instruments, even though they did not measure cost – effectiveness.

3. Methodology

3.1 Research Design

The study used a quantitative design, providing for quantitative analysis of data and ensuring high reliability and validity of the research. A sample of 400 subscribers of electronic payments systems was obtained, based on a 2-stage sampling procedure, determined by Slovin (1960) sample size estimation procedure. The first stage was based on a probability selection of three out of nine Sub-Metropolitan Areas within the Greater Kumasi Metropolis in Ghana: Oforikrom, Old Tafo and Suame. The Greater Kumasi Metropolis was selected because it had a diverse population, being the best representation of the national diversity required. It is also one of the top 2 commercial centres in Ghana where all kinds of the systems of payments under consideration were accessible to customers. It is worth noting that the transaction fees and rates for all the payment systems are uniform throughout the country.

The second stage sample consisted of 344 mobile money users, 42 Debit card users and 14 E-Zwich users based on the proportions of users for each payment system, as required by the sample size estimation procedure. Thus quota sampling technique was used to identify the number of respondents to be selected for each of the payment instruments whereas random sampling techniques were used to select individual respondents for each group.

Data was collected through face-to-face questionnaire administration with respondents on their demographic characteristics, the factors that influence their use of mobile money and other types of electronic payment systems and finally the costs and benefits of using the payment systems.

Three sets of questionnaire made up of 25, 16 and 14 questions each were administered respectively to mobile money, Debit card and E-Zwich card users over a period of three weeks.

The questions were structured into sub-sections and included closed- and open-ended questions which could be easily analysed statistically. This approach according to Jackson (2009) makes it easier to extrapolate the significance of the results to represent the entire population under study. Semi-structured interviews were also conducted to verify information on some cost components from commercial banks and mobile money service providers.

3.2 Model specification

The study employed the binary logistic regression model to ascertain the determinants of active use of mobile money, since the dependent variable (y_i) was dichotomous. The two categories of dependent variable that is 'active' and 'non-active' use were coded as "1" and "0" with probabilities of π_i and 1 - π_i respectively. If y_i takes the value of 1, it is equated to π_i and if it takes the value of 0, it is equated to 1 - π_i. Thus the variable of interest referred to is "active use" and therefore coded as 1. The econometric model adopted for the study was then specified as in equation (3):

$$logit\,(\pi_i) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots\cdots\cdots + \beta_n X_n + \mu \quad (3)$$

Where π_i = the probability of a respondent actively using mobile money system.
X_1, X_2, X_3…, X_n = independent variables, β_0= coefficient of the constant term
$\beta_1, \beta_2, \beta_3 \ldots, \beta_n$ = coefficients of the independent variables. The error term was μ.
The logit transformation was then defined in equation (4) as logged odds:

$$\text{Odds}_i = \frac{\pi_i}{1-\pi_i} \quad (4)$$

The natural logarithms of the odds of the unknown binomial properties were therefore specified as a linear function of X_i as:

$$logit\,(\pi_i) = Ln\left(\frac{\pi_i}{1-\pi_i}\right) - \beta_0 + \sum_{j=1}^{n} \beta_j X_j$$

Thus, the $logit\,(\pi_i)$ is assumed to be a random variable predicting the likelihood that mobile money is actively used as a payment system in Ghana. The likelihood of active use can then be stated as:

$$\pi_i = \frac{1}{1 + e^{-logit\,(\pi_i)}} = \frac{e^{logit\,(\pi_i)}}{1 + e^{logit\,(\pi_i)}}$$

The functional form of the regression model predicting the factors that influence active use of mobile money as a payment system in Ghana is equation (2), as earlier stated and defined in section 2.2:

$$\text{MM}_{USE} = f(SAT + CONV + ACCEPT + COST + SN + AGE + EDU + EUSE + TR + OCCUP + MARRIED) \quad (2)$$

The independent variables, their descriptions and a priori expectations for the model are presented in Table 1. The dependent variable, active use of mobile money (MM_{USE}), is a binary value defined as the practice of making payments with mobile money at least once every 90 days. It takes the value 1 for active use and 0 for inactive use.

Table 1: Description of variables and a priori expectations for mobile money (MM) model

Variable	Description	Expected sign
Satisfaction (SAT)	Feeling of fulfillment after making retail payments with MM. Dummy: 1 for satisfied; 0 for not satisfied.	+
Convenience (CONV)	Comfort of making payments with MM at any time and place. Dummy: 1 for comfortable; 0 for not comfortable.	+
Acceptance (ACCEPT)	Willingness of parties in the payment chain to use MM as a payment system. Dummy: 1 for accept; 0 for reject.	+
Cost (COST)	Expense incurred or the price respondents paid directly or indirectly in the use of the payment system.	-
Subjective Norms (SUB)	Decision to use MM because some people have and expect respondent to use it too. Dummy: 1 for yes; 0 for no.	+
Transfer (TR)	Amount of money received and/or sent by respondents	+
Marital Status (MARRIED)	Whether respondent is married (1) or not married (0).	+
Occupation (OCCU)	Whether respondent was employed in formal or informal sector. Dummy: 1 for formal sector; 0 for informal.	+
Educational Status (EDU)	Whether respondent had formal education or not. Dummy: 1 for formal education; 0 for no formal education.	+
Age (AGE)	Continuous numerical variable value of respondents' age.	-
Ease of Use (EUSE)	User-friendliness of MM use and respondents' ability to independently execute transaction. Dummy: 1 for yes; 0 for no.	+

Source: Authors' construct

3.3 Estimation Techniques

The study employed logistic regression model to determine the factors responsible for active use of mobile money. The cost measure was related to the cost of using mobile money wallet, E-Zwich card and Debit card for payment systems respectively. The costs associated with each electronic payment instrument were categorized into fixed cost (FC) and variable cost (VC) as indicated in Table 2.

Table 2: Cost components for electronic payment instruments.

Type of cost	Payment instruments		
	Mobile Money	**E – Zwich**	**Debit Card**
Fixed Cost	• Registration cost • Cost of phone if any • Cost of sim card	• Cost of opening an account if any • Cost of E – zwich card	• Cost of opening an account if any • Cost of debit card • Fixed monthly charges for debit card use
Variable Cost	• Transaction fee • Transport cost • Time cost	• Transaction fee • Transport cost • Time cost	• Transaction fee • Service fee • Transport cost • Time cost

Source: Authors' construct.

To compare the cost-effectiveness of the mobile money payment system to E-zwich and National Switch payment systems, effectiveness was measured by the number of electronic payments that respondents made with each of the payment instruments. The cost estimated for each payment instrument represented the cost of the corresponding payment system. Two main assumptions were made for the CEA. First, the alternative payment systems were considered to be independent; that is the cost and effectiveness of one does not affect the other. Based on this assumption, average cost – effectiveness ratio (ACER) for each independent payment system was calculated as:

$$ACER = \frac{Cost\ of\ payment\ instrument}{Total\ effectiveness}$$

The second assumption was that the payment systems were mutually exclusive; that is the cost and effectiveness of one affects the other since they compete for resources and as a result the incremental cost – effectiveness ratio (ICER) was calculated as:

$$ICER = \frac{cost\ of\ an\ effective\ payment\ system - cost\ of\ NLE\ payment\ system}{benefit\ of an\ effective\ system - \ the\ \ benefit\ of\ NLE\ system}$$

where NLE is the next less effective payment system. The strongly dominated payment system was eliminated and the ICER was recalculated for the most cost-effective system for confirmation.

4. Analysis and Discussion of Results

4.1 Descriptive statistics of respondents

Two hundred and sixty (51.5%) of the total number of respondents were females, while the others (48.5%) were males. The respondents' age ranged between 17 and 79 years with about 99% between 17 and 55 years old. Majority of the respondents had at least basic education; majority (74.5%) had tertiary education whereas only 1% had no education. About 63% (251) were engaged in formal employment, 20.8% were involved in informal occupations and 16.5% were

unemployed. Monthly transfers of respondents ranged from GH₵ 50.00 (US$11.36) to GH₵5, 200.00 (US$1,181.81).

4.2 Determinants of active mobile money use

A logistic regression was employed to isolate the effects of independent variables on the likelihood that a respondent actively uses mobile money system for payments. The Wald statistics and significance level was used to examine the contribution of each independent variable to the model. Table 3 presents a summary of the results for the regression.

Table 3: Logistic Regression Results of the Active Use of Mobile Money

Independent Variables	Coefficient	Std. Error	Wald Test	*p*– value	Odds Ratio (Exp(B))
Constant	-2.475	2.852	0.753	0.386	0.084
SAT**	1.487	0.701	4.502	0.034	4.424
ACCEPT***	4.088	1.139	12.888	0.000	59.650
CONV**	1.788	0.867	4.252	0.039	5.977
COST**	-2.224	0.864	6.631	0.010	0.108
SN***	2.145	0.815	6.924	0.009	8.545
AGE**	-0.078	0.036	4.539	0.033	0.925
BASIC	4.527	2.603	3.024	0.082	92.481
SECOND	1.377	2.443	0.318	0.573	3.964
TERT	1.691	2.638	0.411	0.521	5.426
FORMAL	1.247	1.073	1.351	0.245	3.481
UNEMP	1.173	1.046	1.259	0.262	3.233
MARRIED	0.054	0.765	0.005	0.943	1.056
EUSE	-0.562	0.974	0.333	0.564	0.570
TR	0.000	0.001	0.720	0.396	1.000
Chi – square	176.206	$p = 0.000$	Specificity Rate	78%	
-2 Log likelihood	90.690		False Positive	3%	
Nagelkerke R^2	0.743		False Negative	26%	
Sensitivity Rate	96%		Overall success	94%	

Source: Authors' computation from field data.
Note: *** and ** show 1% and 5% significant levels respectively.

The model chi-square was 176.206 and highly significant at one percent level of significance ($\chi 2 = 176.206$, $p = 0.000$). This implies that the independent variables together significantly explain the dependent variable, that is, the active use of mobile money. The Nagelkerke R Square was also high at 74.3% implying a good fit of the model. Thus the independent variables explain 74% of the likelihood of actively using mobile money. In addition, 287 (83%) respondents were correctly classified by the model as active users of mobile money giving a sensitivity rate of 96%.

As presented in Table 3, six (6) independent variables were statistically significant at 1% and 5% significance levels. Acceptance (p = 0.000) and subjective norms (p = 0.009) were significant at 1% level each with positive coefficients of 4.008 and 2.145 respectively. This indicates that an increase in the acceptance level of mobile money as a payment system and higher subjective norm

increase the likelihood of actively using mobile money for payments. The result for acceptance confirms the assertion by Hayashi and Keeton (2012) and findings of Koulayev *et al* (2016) whereas that of subjective norm supports Sripalawat, Thongmak and Ngramyarn (2011), Yu (2012) and Chayanis *et al* (2013). In addition, the model predicts odds ratios of 59.650 and 8.545 respectively for acceptance and subjective norm which shows that the odds of actively using mobile money for payments were 59.650 and 8.545 times higher for subscribers who are influenced by general acceptance and subjective norm respectively than for those who are not.

Furthermore, payment satisfaction ($p = 0.034$), convenience ($p = 0.039$), cost ($p = 0.010$) and age ($p = 0.033$) were statistically significant at the 5% level each. Payment satisfaction and convenience had positive coefficients (1.487 and 1.788 respectively) which indicate that active users of mobile money are more satisfied and also find it more convenient to use the system than inactive users. The result empirically confirms the assertion by Hayashi and Keeton (2012). Also, the model predicts the odds of satisfied subscribers and those who find the system to be convenient actively using mobile money for payments to be 4.424 and 5.977 times higher than non-satisfied subscribers and those who do not find it convenient to use the system respectively.

The cost and age factors on the other hand, had negative coefficients (-2.224 and -0.078 respectively) implying that individual subscribers who find the use of mobile money for payments costly are less likely to actively use the system and also older mobile money subscribers are less likely to actively use the system for payments. Both results support the findings of Koulayev *et al* (2016).

In addition, the finding concerning cost of mobile money transactions confirms results by Yu (2012), Chayanis *et al* (2013) and Jack and Suri (2014) whereas the finding regarding age is further supported by Bounie, Francois and Van Hove (2014) but in contrast to the finding of Domeher, Frimpong and Appiah (2014). The model also predicted odds ratio of 0.108 and 0.925 which suggests that the odds of actively using mobile money for payments are 0.108 and 0.925 times lower for subscribers who find the system costly and elderly people respectively than for those who do not find the system costly and younger people. Thus the probability that a subscriber could stop using the payment system due to increasing cost was 10.8%.

The remaining variables included in the model; educational level of users, occupation and marital status of users as well as ease of use and transaction value were not statistically significant at any of the conventional levels.

4.3 Cost of use of payment instruments

Cost was estimated for the use of three payment instruments, namely; mobile money, Debit card and E-zwich for retail payments by respondents. For each payment instrument, transaction sizes were classified into two groups for easy comparison. Respondents with total transaction size of GH₵ 1,000. 00 (US$227.27) or less were classified as small transactions whereas those with payments above GH₵ 1,000. 00 were classified as big transactions. All costs were computed in Ghana cedis (GH₵). At the time of collecting the data, the exchange rate between the Ghana cedi and the US dollar was 4.4 Ghana cedis (GH₵) to the US$. Details of costs for the payment instruments are presented in Table 4.

Table 4: Values of cost items for each sample and monthly cost of using payment instruments

Cost Items (monthly cost for all respondents in sample)	**Mobile Money (GH₵)**	**Debit Card (GH₵)**	**E-Zwich Card (GH₵)**
Fixed cost			
Cost of account	0	100.00	10.00
Cost of device (phone, sim card, debit card, e-zwich card)	36.90	9.65	0
Fixed monthly charge	0	93.20	0
Variable cost			
Transaction fee	2,578.22	3.60	56.88
Service fee (for use of ATM from other Banks)	0	73.60	0
Cost of time lost	610.75	296.73	35.49
Transport cost	854.00	240.40	64.40
Overall cost (TC)	**4079.87**	**817.18**	**166.77**
Average cost (AC)	11.86	19.46	11.91
Small transactions TC	1872.85	522.86	95.74
Small transactions AC	6.60	16.34	7.98
Big transactions TC	2207.02	294.32	71.03
Big transactions AC	36.78	29.43	35.52

Source: Authors' computation from field data.

As presented in Table 4, the most significant cost component for mobile money usage is transaction fee showing the highest value. However, for Debit card and E-Zwich card, the costs components with the highest values are transport and time costs respectively. In all, variable cost formed greater percentage of the total cost for each of the payment instruments. For overall total cost and small transactions, mobile money had the lowest AC per user followed by E-Zwich and then Debit card. For big transactions however, Debit card had the lowest AC per user whereas mobile money had the highest AC. All things being equal, the results could mean that the use of mobile money is relatively cheaper for lower transaction sizes than for higher transaction values.

4.4 Cost-effectiveness analysis (CEA) of alternative payment systems

CEA for the alternative payment systems involve the costs and effectiveness of each payment system as discussed in section 3.3. The estimated cost for payment instruments as presented in Table 4 were used as costs of using the corresponding payment systems.

In addition, the effectiveness or outcome of each payment method was measured by the total number of electronic retail payments made with each of the payment systems monthly. Mobile money and E-Zwich were the most effective and least effective systems respectively. The total effectiveness of each payment system is presented in Table 5.

Table 5: Effectiveness of alternative payment methods monthly

Effectiveness (monthly)	Mobile Money	National Switch (gh-link™) (Debit Card)	E-Zwich
Small transactions	643	43	14
Big transactions	267	18	2
Overall Effectiveness	910	61	16

Source: Authors' computation from field data.

Under the assumption that payment systems are independent, average cost – effectiveness ratios (ACERs) were calculated for the alternative payment systems. In reality however, payment systems compete for resources. Also, based on the assumption that the alternative payment systems are mutually exclusive, they were ordered from the least to the most effective and incremental cost – effectiveness ratios (ICERs) were calculated for them. Table 6 shows the results of the ACERs and ICERs.

The results in Table 6 indicate that assuming the three payment systems are independent of each other, mobile money offers the lowest cost per retail payment with the lowest ACER of GH₵ 4.48 (overall), GH₵ 2.91 (small transactions) and GH₵ 8.27 (big transactions) respectively. The ICER

Table 6: Results of ACERs and ICERs of alternative payment systems

Results	**E-Zwich (GH₵)**	**Debit Card (GH₵)**	**Mobile Money (GH₵)**
ACER			
Overall	10.42	13.40	4.48
Small transactions	6.84	12.16	2.91
Big transactions	35.51	16.35	8.27
ICER			
Overall	10.42	14.45	3.84 (4.38)
Small transactions	6.84	14.73	2.25 (2.83)
Big transactions	35.52	13.96	7.68 (7.68)

Note: ICERs in brackets are the recalculated ICERs for mobile money.
Source: Authors' computation from field data.

results also showed that mobile money is the most cost-effective payment system before and after the strongly dominated system was removed with the lowest ICER for overall ICER (GH₵ 4.38) as well as for small transactions (GH₵ 2.83) and big transactions (GH₵ 7.68). This implies that the additional cost incurred per additional benefit is lower for mobile money payment system than for

the other payment systems. For both ACERs and ICERs, E-Zwich payment system was the second most cost-effective payment system for the overall and small transactions. Debit card (National switch) payment system was however the second most cost-effective for big transactions.

The above results show that whether the alternative payment systems are evaluated as independent or mutually exclusive, mobile money is the most cost-effective. The results empirically confirm the claim by Hayashi and Keeton (2012). Compared to E-Zwich and National Switch (Debit card) payment methods, mobile money has additional benefits such as convenience in terms of time and place of payments, general acceptability, proximity to merchants and control over finance apart from the number of payments it can be used for. These features give users more flexibility and control thereby encouraging them to increase their frequency of use and the different types of electronic payments they can make with the system. This increases the system's effectiveness and hence makes it more cost-effective, with all other factors constant.

4.5 Sensitivity Analysis

To check the robustness of the CEA results, sensitivity analysis was conducted. The most significant cost item for the estimation of cost of using mobile money, as presented in Table 4 was transaction fee.

Table 7: ACER and ICER for 1%, 2% and 3% changes in transaction fee of mobile money

% Changes	E-Zwich			Debit Card			Mobile Money		
	Transaction cost-effectiveness (GH₵)			Transaction cost-effectiveness (GH₵)			Transaction cost-effectiveness(GH₵)		
1% Change	Small	Big	Overall	Small	Big	Overall	Small	Big	Overall
ACER (Increase)	6.84	35.51	10.42	12.16	16.35	13.40	2.94	8.30	4.51
ACER (Decrease)	6.84	35.51	10.42	12.16	16.35	13.40	2.90	8.12	4.46
ICER (Increase)	6.84	35.52	10.42	14.73	13.96	14.45	2.85	7.72	4.41
ICER (Decrease)	6.84	35.52	10.42	14.73	13.96	14.45	2.81	7.61	4.35
2% Change									
ACER (Increase)	6.84	35.51	10.42	12.16	16.35	13.40	2.96	8.36	4.54
ACER (Decrease)	6.84	35.51	10.42	12.16	16.35	13.40	2.88	8.15	4.43
ICER (Increase)	6.84	35.52	10.42	14.73	13.96	14.45	2.87	7.78	4.43
ICER (Decrease)	6.84	35.52	10.42	14.73	13.96	14.45	2.79	7.55	4.32
3% Change									
ACER (Increase)	6.84	35.51	10.42	12.16	16.35	13.40	2.97	8.41	4.57
ACER (Decrease)	6.84	35.51	10.42	12.16	16.35	13.40	2.86	8.09	4.40
ICER (Increase)	6.84	35.52	10.42	14.73	13.96	14.45	2.89	7.83	4.46
ICER (Decrease)	6.84	35.52	10.42	14.73	13.96	14.45	2.77	7.49	4.29

Source: Authors' computation from field data.

Holding every other factor constant, and allowing only the transactions fees for using mobile money to change, 1%, 2% and 3% changes in the cost of using mobile money was used to check if mobile money remained the most cost-effective payment system. The results of the sensitivity analysis are shown in Table 7.

Thus at all the levels of 1%, 2% and 3% changes in transaction fees for the use of mobile money, both average cost – effectiveness ratios (ACERs) and incremental cost – effectiveness ratios (ICERs) confirmed that mobile money was the most cost-effective retail payment system in Ghana, showing the least ACER and ICER for all transaction sizes. The results obtained for the cost-effectiveness analysis for the study is thus robust. This implies even with a 3% increase in transaction fee, mobile money transactions will still be preferable to other forms of electronic money payment systems in Ghana.

4.6 Effect of electronic tax on mobile money transactions

Even though mobile money is more cost-effective than the E-zwich and debit card payments, increases in transaction fees as shown in the sensitivity analysis, leads to consistent deterioration in the cost–effectiveness of mobile money transactions. Thus as the value of transaction cost increases, mobile money payments get less cost-effective for all transactions.

From Table 6, the average cost-effectiveness ratio (ACER) for small transactions of mobile money is 2.91. This deteriorates to 2.94 following a 1% increase in transaction cost (Table 7) and then to 2.96 with a 2% increase in transaction cost and further to 2.97 with a 3% increase in transaction cost. At the first instance, a 1% increase in transaction cost leads to a 1.02% deterioration in cost-effectiveness for small transactions. Thus the percentage of deterioration in cost-effectiveness exceeds the percentage change in transaction cost for small transactions.

For big transactions, ACER for mobile money payments also deteriorates from 8.27 (Table 6) to 8.30 due to 1% increase in transaction cost, then to 8.36 for a 2% increase in transaction cost and further to 8.41 with a 3% increase in transaction cost. This means while transaction costs increase from 1% to 3%, the deterioration in cost-effectiveness is from 8.27 to 8.41, a percentage deterioration of 1.7%.

Thus considering Ghana's e-levy for big transactions means that the 1.5% tax rate would cause 0.85% deterioration in cost-effectiveness of mobile money payments. This is a more than 50% deterioration in the cost-effectiveness of mobile money payments for big transactions. The deterioration in ICER is consistent with the deterioration in ACER for both small and big transactions. This shows the tax is not efficient.

The results have serious implications for taxing mobile money transactions as Ghana has done. This means subscribers will find the deteriorating cost-effectiveness of mobile money payments unacceptable and seek alternative ways of avoiding the increase in transaction cost, if they will continue to use the payment system. The current dilemma Ghana has regarding failures to meet expected revenue targets from the tax testifies to this effect.

Again, given the percentage changes in cost-effectiveness, it is observed that the percentage deterioration in cost-effectiveness for a 1% increase in small transactions is greater than the percentage deterioration of the same increase in transaction cost for big transactions. This means the tax system is regressive, leading to worsening welfare conditions for low transaction subscribers.

5. Conclusion and Policy Implications

To protect the economy from unnecessary risk and cost of engaging in excessive cash transactions, the Bank of Ghana like many other central banks in Africa, embarked on a cashless economy agenda. This saw the introduction of a number of electronic payment systems into the Ghanaian economy. Among them, the mobile money payment system had been very successful in providing high rates of financial inclusiveness as well as a promising drive towards cashless economy. However, the desire of government to raise tax revenue from the booming mobile money transactions through electronic taxes has posed some challenges in most African countries, including Ghana.

The study employed logistic regression to analyze factors that determine the active use of mobile money in Ghana. It also estimated the cost incurred in using mobile money, Debit card and E-Zwich card as payment instruments for their respective payment systems. Transaction sizes were grouped into big transactions and small transactions for easy comparison and to assess their response to increasing costs.

The study found that the major factors that determine the active use of mobile money are general acceptance of mobile money as a payment system, influence of family and friends (subjective norm), costs incurred in the use of mobile money, age of the user, satisfaction derived from making payments, and the convenience with which payments are made. Educational level of users, occupation, marital status and ease of use did not significantly influence active mobile money use at any acceptable statistical significance level.

Generally, mobile money had the lowest average monthly cost per user for all levels of transaction sizes. Mobile money had the lowest average cost – effectiveness ratios (ACERs) and incremental cost – effectiveness ratios (ICERs) for all levels of transaction and was therefore found to be the most cost-effective payment system for retail payments for all the transaction sizes in Ghana.

Holding all other factors constant, even up to 3% change in transaction fees for mobile money did not alter it being more cost-effective than E-zwich and the National Switch (debit card) payment systems. The second most cost-effective payment system for the overall cost-effectiveness and small transactions was E-zwich. For big transactions, National Switch payment system was found to be the second most cost-effective payment system.

However, increasing transaction costs render mobile money transactions consistently less cost-effective. Thus, as transaction fees increased, mobile money transactions became less cost-effective. The implication is that taxing mobile money transactions render them less cost-effective, encouraging users to employ strategies to avoid the tax.

The finding that general acceptance and subjective norm determine active use of mobile money implies that if more people get to know, understand and accept the usefulness of mobile money, they are more likely to actively use the system and influence other people to also use it. It is therefore recommended that mobile money providers focus more on creating awareness and making the system more attractive as well as useful to end users in order to promote its active use. Cost of mobile money transaction was found to have a significant negative impact on the active use of mobile money. This is confirmed by the importance of transaction fee as the major cost component in the estimation of the cost of using mobile money and the sensitivity analysis results for different levels of transaction costs. While pursuing the cashless economy agenda, it will be prudent if the Bank of Ghana would work to reduce transaction fees and hence the cost of using mobile money. It is therefore recommended that the electronic levy tax be withdrawn to make the mobile money payment system effective enough to deliver the cashless economy for which its use was conceived.

Declaration of conflicting interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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