American Journal of Humanities and Social Sciences Research (AJHSSR)
e-ISSN :2378-703X
Volume-6, Issue-2, pp-263-270
www.ajhssr.com
Research Paper Open Access

The impact of self-service technologies on the profitability of the banking sector: Evidence from an African country

[1]Disney Leite Ramos, [2]Ahmed Rabeeu, [3]Abdul Basit Abdul Rahim,
[1](Ph.D. student, School of Economics and Management, Tongji University_Shanghai,
[2] (Ph.D. student, School of Economics and Management, Tongji University_Shanghai
[3] (Ph.D. student, School of Economics and Management, Tongji University_Shanghai,
Corresponding Author, Disney Leite Ramos,

ABSTRACT: This article seeks to understand how the innovation provided byself-service payment in developing country influence financial performance, using sample banks in Sao Tome and Principe. Central Bank and Commercial Banks annual reports, payment systems reports, service orders, and internal regulations related to the automatic payment system and electronic product sheets wereour data resources as well as information on self-service payment. Return on assets (ROA) and return on equity (ROE)were used to assess financial performance. Regression analyses were used for data processing. We found evidence that the automatic payment system is not statistically significant for the bank profitability decision. Although it translates benefits to the banking system, both in terms of reducing personnel costs, as well as reducing the opening of new branches to meet customer demands.

KEYWORDS: *Self-service technologies, banking sector, Africa, Sao Tome &Principe, profitability*

I. INTRODUCTION

Self-service has grown rapidly over the last decade, allowing customers to take on the conventional role of a service worker in providing a service. Self-service has been around for a long time, but due to substantial advantages in efficiency and convenience, its relevance has expanded with technological advancements. The banking industry has been transformed by self-service technology, which has resulted in significant financial gains for banks as well as lower costs and better service for clients. While self-service technology has provided numerous benefits to the banking industry, it also has the potential to be a significant driver of productivity development and improved quality of life. It is anticipated that if self-service technologies were more commonly used, the US economy would grow by $130 billion per year, or to an additional $1,100 in yearly household income (Castro, Atkinson, & Ezell, 2010). Sao Tome and Principe (STP) is an island country in the Gulf of Guinea, off the western equatorial coast of Central Africa. It consists of two archipelagos around the two main islands of Sao Tome and Principe, about 140 km apart and about 250 and 225 km off the northwestern coast of Gabon. With a population of around 201,800 is the second-smallest and second-least populous African sovereign state after Seychelles as well as the smallest and least populous Portuguese-speaking country in the world. The Central Bank is responsible for monetary policy and bank supervision. Five banks are in the country, the largest and oldest is the International Bank of Sao Tome e Principe, which is a subsidiary of Portugal's government-owned Caixa Geral de Depositos. It had a monopoly on commercial banking until a change in the banking law in 2003 led to the entry of several other banks. The structure of the banking system consists of 20 bank branches distributed by 96,094 customers, 125,715 bank accounts, and with a growth rate of -1% in the number of customers (Central Bank of Sao Tome and Principe, 2019). According to the Central Bank of Sao Tome and Principe (CBSTP), the banking rate in S. Tome and Principe has been showing an upward trajectory since 2008, reaching a maximum value of (52.9%) in 2015. However, this rate has been declining throughout of years having reached (45.7%) in 2019, a reduction of 7 percentage points, contrary to the trend initially registered until 2015. Due to the suspension of licenses decreed by the CBSTP to two banking institutions due to the incapacity registered in complying with the indicators essential for the continuation of the businesses in the National Financial Market in 2016 and 2019 respectively. The automatic payment system (self-service) is an essential element of the financial system in STP, and its useful functioning contributes decisively to the efficiency of financial and economic transactions, to the good performance of the financial institution and monetary and consequently for the improvement of financial stability. However, it should be noted that, with

innovation and technological development, this system is continually being modified. This study highlights self-service in STP, regarding the Dobra24 network, and its main objective is to assess the financial impacts on the profitability of banks. The local currency is called the Dobra, Dobra24 means Dobra 24 hours. The Dobra24 network is a network that only provides basic automatic banking services, which began operating in 2011. The first test was carried out at the International Bank of Sao Tome and Principe (IBSTP), installing an ATM in the city of Sao Tome, specifically at the head office located in Independence square, offering only three services. And only then did it proliferate in all commercial banks in the country. As of December 31, 2019, 32 ATMs and 128 POS posts were in operation, distributed among banks, commercial establishments, and other companies throughout the national territory. The Dobra24 network is managed by the Automatic Payment Management Company of Sao Tome and Principe (SPAUT), which was founded in 2009, having as majority shareholder the CBSTP (44%), and the Commercial Banks of Country (56%). This operational entity is responsible for managing the interbank automatic payment system (the Dobra24 network), which aims to promote interbank cooperation and the creation of innovative services and solutions in electronic payment systems for banks and other institutions. Developed as a single system common to all existing banks in STP, this network stands out for its excellence, both for its ease of access and use, as well as for its convenience and security, but also the diversity of services and features incorporated in the terminals. With the growth of customer demand for self-service, the main study question is how the existence of self-service affects bank profitability. This research intends to appear as an empirical contribution to the various investigations already carried out in the context of payment systems and bank profitability.

II. Banking Profitability and its Determinants

Currently, several ratios and indicators make it possible to assess and measure bank profitability. In one of the existing literature, we can present three indicators: Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM). The ROA indicator assesses the gain produced by the use of assets, that is, it serves to assess the efficiency and management capacity of banks' assets according to their results. In turn, ROE is an indicator that provides information to capital holders about the return on invested capital. Finally, the NIM measures the discrepancy between interest collected and interest paid by banks, concerning their assets, in short, this ratio allows an analysis of the success of banking activity. To achieve complete analyses, we must study at least two of these indicators simultaneously. To study which of the factors determine bank profitability and its impact, we must take into account that the bank's performance is not only influenced by the internal and specific characteristics of each bank, as well as the external environment that surrounds it, (Scott & Arias, 2011) considered that some studies do not take into account the importance of the economic environment in which banks are inserted in the current context. Continuing on this point, the authors had to create an econometric model that sought to analyze and understand how profitability is influenced in the five most important banks in the US. This model was created taking into account, on the one hand, the internal aspects of banks and how they are involved with ROA, and on the other hand, the external aspects of their competitiveness, measured by GDP growth. At the end of this work, they concluded that it is very difficult to analyze the determinants of bank profitability, as the results can be biased, due to the inability to get the right and adequate data or even given a weakness in the competitive environment where the banks act. In other words, many causes influence this type of analysis, which are often not taken into account. In the same perspective, (Abreu & Mendes, 2003) carried out a study on the value of macro-financial variables on bank profitability, through an analysis of the econometric model, adding variables exclusive to banks, such as national macroeconomic variables, as well as the macro-financial variables and political situation. Concerning national macroeconomic variables, the authors argue that we must take into account the following: GDP growth; real interest rate, and inflation rate. While the macro-financial and policy variables, they say that we should consider the rate of change in the nominal effective exchange rate; financial liberalization, and the crisis. According to the results obtained by the authors, an unequivocal relationship between GDP growth and banking profitability is considered, that is, positively related. They also consider the importance of the inflation rate for income growth and the importance of the high short-term real interest rate. In turn, (Pasiouras & Kosmidou, 2007) carried out the study on bank profitability through the calculation of ROA, they sought to assess how bank-specific variables, such as total assets and the capital/asset and cost ratio /income, as well as the bank's external variable, such as the inflation rate, influence bank profitability. With this study, they created an econometric model and concluded that the variables presented to explain the model, that is, serve to measure bank profitability. Because of the financial crisis that happened in Europe in 2007, (Dietrich &Wanzenried, 2011) they decided to look for the impact of some determinants on the profitability of Swiss banks, taking into account before and after this occurrence. They built an econometric model based on the same structure line but decided to put some new variables in the model, a variable that relates to the bank's ownership, that is, whether it is public or private, another that measures the market structure, that is, Herfindahl Index is a variable that relates the maturity transformation function, that is, the Term structure of the Interest Rates, as well as others included. The same authors concluded that, before the

crisis, bank ownership was considered irrelevant and that the market structure was significant, with a positive impact. They also concluded that, at the time of the financial crisis, only state banks were more profitable. The Term Structure of Interest Rates disclosed a considerable positive effect, especially at the time of the crisis. In this investigation, it was also found that five factors influence bank profitability, such as total loan growth (+), operational efficiency (+), effective tax rate (-), financing costs (-), as well as the model economic. The economic model determines the variation of income sources (+). In an emerging market environment, (Yilmaz, 2013) followed a line of thought similar to those exposed so far, taking into account 9 emerging countries. The outcomes of this work showed that the management of operating expenses, such as bank risk, credit risk, bank size, and inflation are relevant factors for both NIM and ROA. This investigation also oriented that, to have stable banking profitability, the banking sector must have a robust capital organization and, to have better performance, we must reduce credit risk and increase the quality of service and human resources.

III. Banking Profitability and New Technologies

For there to be economic development and growth, there must be technological development. This situation fits in with the economic reality of various sectors. Regarding the banking sector, we can consider that new information and communication technologies (ICT) are very fundamental, as it allows the transmission of information and storage of data (Consoli, 2008). Given that Banks use financial and information technologies a lot, that is why the evolution is not only made in terms of information systems. According to (Furst, Lang, & Nolle, 1998) critics of the banking sector consider technology as an important factor in the development of the banking structure. This study was certified by (Berger, 2003), who published a study that referred to changes in the banking industry and productivity growth with technological progress. According to him, the banks managed to reduce costs and increase their productivity, about the sale of banking products such as bank credit, with the implementation and improvement of new technologies. About increased productivity, this work refers to the fact that banking services have improved, as well as their quality and diversity. As for the structure of the banking sector, (Berger, 2003) believes that technological advances can reduce the growth of the banks' extension and its spread at the geographic level, as well as, it can help in the consolidation process through mergers and acquisitions. To justify his theses, the author highlights some advantages that can accompany innovation, such as the ability to achieve economy of scale, as well as to monitor and control long-distance risk at the lowest possible cost; sharing information with some ease; that acquired efficiency or reducing efficiency losses that may arise from the mergers and acquisitions strategy. Technological advances, made it focus more on electronic payment instruments and systems. In this juncture, advances were related to the hypothesis of purchases, payments as well as transfers and other operations, through the Internet, email, and mobile phone (Allen, 2003), as well as the progress of automatic payments, particularly with the emergence ATM (Automated Teller Machine) and APT (Automatic Payment Terminals) or POS (Electronic Fund Transfer at Point of Sale), providing different services (Consoli, 2008). Even though there are several investigations in the field of the payment system, there are few studies that talk about the automatic payment instrument and the return on invested capital for the bank. Considering this same failure in the literature, (Hasan, Schmiedel, & Song, 2009) studied the capital connection between automatic payments and bank profitability, analyzing in this perspective whether the service provided by automatic payment generates an increase in bank profitability. Using some of the external and internal variables mentioned above, including payment-specific variables, namely the number of POS, ATM, and branches, as well as the value and number of the main payment method transactions, they concluded that the more the technologically advanced the payment system, the greater the profitability for the bank in that country. Likewise, the increased use of electronic payment means can stimulate bank transactions. In the same order of idea about the impact of technological advances on profitability, (Jalal-Karim & Hamdan, 2010) carried out a study on information technologies in Jordan banks, measuring the number of POS through the investment in hardware and software, and ATM, as well as using the Internet and Phone Banking. In this study, they concluded that the use of new technologies positively influences the financial and operational development of banks, especially concerning market value, generating profits, as well as ROA's. With this work, they found that there is no impact on ROE and they even argue that it can be justified in the increase of investment in information and communication technology. Afterward, (AL-Adwan, AL-Zyood, &Ishfaq, 2013), intended to analyze the advantages of the e-payment system for bank profitability, specifically, a work that would make it possible to discover the impact of the SADAD system on the profitability of banks in Saudi Arabia, demonstrating a model that linked the essence of e-payment with profitability. Considering the essence of e-payment as a convenience, cost reduction, diversity, speed, safety, and accessibility, and taking ROE and ROA as a means of profitability, they concluded that a successful e-payment system conditions the increase and improvements in the bank's profitability. Finally, (Resende& Silva, 2007) carried out their studies on the efficiency and profits of Portuguese banks, and concluded that, between 2000 and 2004, they reached the limit of their production frontiers, having only verified how technically inefficient one or two banks. This leads the authors to believe that the scope for improvements in the technical component of Portuguese banking activity is much reduced.

IV. Innovation in the Banking Sector

According to (Harker &Zenios, 1998) the financial sector, where banking is the dominant industry, is currently one of the most important sectors of activity in the most developed economies, and financial services contribute around 5% to GDP in the US, 5.5% in Germany, 3.5% in Italy, and similar amounts in other countries in the world that have relatively developed financial intermediaries.In small economies, especially those seeking greater participation in international markets through offshore banking activities, the contribution of the financial sector may be even higher. Forexample, in Switzerland, the financial sector represents around 9% of GDP (Harker &Zenios, 1998). These statistics signify the direct influence that the financial sector exerts on the economic system. Meanwhile, this sector mobilizes savings, promotes the allocation of financial resources, through the design of credit to finance the economy. Notwithstanding this, it still helps economic agents deal with uncertainty and risk through hedging, pooling, and sharing instruments. Economists consider that Banks are of paramount importance for the proper functioning of the economic/financial system. In the early 1920s, for example, Joseph Schumpeter already drew economists' attention to the crucial role that the banking sector plays in economic growth, highlighting the circumstances in which banks actively promote innovation and future growth through identification and development, financing of productive investments (Schumpeter, 1961).Studies demonstrate that there is a correlation between the level of banking intermediation with the long-term growth rates, capital accumulation, and productivity increase in different countries (King & Levine, 1993) and (Levine &Zervos, 1998). Aware of its unquestionable importance, the global financial sector has been the scene of a process of profound change in the last two decades. Basic services remained constant, but their structure and how these functions were carried out underwent many changes. In this climate of change, the study of innovation was seen as an exceptional opportunity. However, some notable exceptions were omitted, innovation in banking went unnoticed by academics, as the only issue that was thoroughly investigated was innovation in financial products. It is along these lines that science dealt with the study of banking innovation. It is not very convincing, as it is known that banking innovation goes far beyond product innovation, also focusing on the distribution channels, production processes, and organizational systems of banks (Sundbo, 1995) and (Frey, Harker, & Hunter, 1997). The scarce study in the field of banking innovation is not an isolated problem, as it is part of a more general problem resulting from the embryonic state of the innovation economy in the services sector. However, when compared to the literature on innovation and technological change in the industry, the focus on services is practically marginal. This situation is very problematic, especially as services are a very important part of modern economies. Note that currently approximately two-thirds of employment is located in the tertiary sector (Hauknes, 1996) and (Gallouj& Weinstein, 1997).

V. Research Methodology

The method used to carry out this research is secondary data analysis. Banking profitability can be influenced by some factors internal and external to the Bank, according to previous researchers. The study proposed here has as its main object the perception of the financial and non-financial impact of the implementation of self-service services. The time horizon is thirteen years (2006-2018), and the choice of this study period is related to the introduction of this system at the end of 2011. The documents under analysis are the annual report, payment systems report, service order, and the internal regulation related to the automatic payment system and electronic product sheets. The tool used for data analyses is the Excel software, using the functionality of descriptive statistics and linear regression. We initially propose two multiple linear regression models to test the variables under analysis.This research was based on data made available on the website of the Central Bank of Sao Tome and Principe, the National Institutes of Statistics, and the website of commercial banks operating in the country. Attribute bank profitability as a dependent variable, considering ROA, which is calculated using the formula "Net Profit/Total Assets*100" and ROE, which is calculated using the formula "Net Profit/Equity*100". These variables concern the consolidated activity of the banking system. As independent variables, we consider three variables consistent with those used in the literature, which are: real GDP growth –realGDP (change rate relative to the same year of the immediately previous year), the Consumer Price Index – CPI (as a measure of inflation; end value of each year) and the Spread of long-term interest rates to the short-term - SpreadLT_ST (calculated from the difference between the yield of other fixed rates with a maturity of 12 years and the EURIBOR rate per year; year-end value). We also include two variables specific to the banking institution, namely the Effective Tax Rate –EfTxRate (calculated using the Tax on Profits for the Year/Result before Taxes) and the Capital/Total Assets ratio – Cap/TA (as a measure of banking risk), it was also decided to incorporate a variable related to the self-service operation with more relevance, which is the withdrawal at the ATM - ATMwithdv, in value (millions of Dobras - v), to verify whether it influences the model. To verify whether personnel cost explains ROE and ROA, we decided to include the personnel cost variable – cost/staff, which aims to know the impact of the introduction of self-service on the annual personnel cost. We present a summary description of the variables under study in table 1.Concerning the data collected from these variables, it should be noted that most were taken from the annual reports of commercial banks, except real GDP growth, whose data were taken from

the database of the Central Bank of Sao Tome and Principe, and the CPI was taken from the database of the National Institute of Statistics.The Bank's macroeconomic and specific variables are consistent with those used in the literature. Taking into account the specific variables of the D24 network and the existing literature, these are expected to be positive in ROA, although in ROE it may show a negative sign, since it represents, from the bank's point of view, an investment in technology. As for real GDP growth, a positive sign is expected, given the positive relationship between bank profitability and economic growth. Considering that banks adopt the interest rate according to the expected result of the inflation rate, that is, the relationship between the inflation rate and profitability can be influenced, with or without anticipation, by the bank to its variations. In this way, the CPI, which is used to measure inflation, may present a positive sign if the bank correctly anticipates changes in the inflation rate and manages to adjust their interest rates in time (which leads to more revenue growth faster than the increase in costs), or a negative sign, if the variation is not prevented in this case, leading the bank to adjust interest rates at a slower pace (giving a faster increase in costs than the increase in revenues). A higher inflation rate is linked to relatively higher price volatility, which can complicate the assessment of market and credit risks. But also, if there is a sudden and significant reduction in inflation, it can influence the bank's liquidity, about the spread of interest rates, but the sign is expected depending on the slope of the curve. A steeper slope may be associated with a higher spread, which positively influences bank profitability. We can consider that this variable (interest rate) is linked to the Bank's corporate purpose, which is the sale of currency, that is, the Bank takes deposits from savers and grants loans to those in need at a rate (cost of money).It is clear that this variable signifies the role of maturity transformation banks, that is, the bank uses the short-term deposit of savers to grant long-term loans to those who need it. Predicting the sign of the Capital/Total Assets ratio - Cap/TA would be a little complicated, as this is understood as a measure of bank risk, that is, it is used to assess financial soundness (financial autonomy). This ratio has two implications, on the one hand, the higher it is, it indicates a lower bank risk, or better, a bank with a higher Cap/TA is considered relatively safer with those with the lower ratio. Therefore, those with a higher ratio convey greater credit credibility and a decrease in financing costs, however, it has a positive impact on profitability. On the other hand, according to financial theory, the greater the risk (the lower the ratio), the greater the expected returns, which reveals an inverse relationship between Cap/TA and bank profitability. According to the contradiction between these two implications, the sign for this variable cannot be subjectively anticipated. As far as the Effective Tax Rate is concerned, it reflects the taxes paid by the bank, therefore, the more the tax, the greater the decrease in bank profitability.

VI. Linear Regression Model

The linear regression model, according to (Krajewski, Ritzman, & Malhotra, 2009), consists of a variable called dependent relating to one or more independent variables in a linear equation. The relationship between the variables is estimated using the least-squares method and the resulting regression line minimizes the squared deviations of the differences between actual data and those estimated by the model.

The generic equation of the linear regression model can be represented as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_K X_{Ki} + \mu_i$$

"Y" refers to the dependent variable, "X" the independent variable, the "β`s" give the relationship between the explanatory variables and the dependent variable, and "μ" represents the error term, containing the other explanatory factors of Y that were not included in the template.

For this study, several linear regression models were used, where several variable lags were taken into account to understand the time horizon of influence on the variables.

For example, after several experiences with different lags (see the results part) Cap/TA is the only explanatory variable for ROA, that is, it was where statistical significance was found and models like:

Equation (A): $ROAt = \beta 0 + \beta 1\text{realGDP}t + \beta 2\text{CPI}t + \beta 3\text{SpreadLT_ST}t + \beta 4\text{EfTxRate} + \beta 5\text{Cap/TA} + \beta 6\text{ATMwithdv} + \beta 7\text{Cost/staff} + \varepsilon t$

Equation (B): $ROEt = \beta 0 + \beta 1\text{realGDP}t + \beta 2\text{CPI}t + \beta 3\text{SpreadLT_ST}t + \beta 4\text{EfTxRate} + \beta 5\text{Cap/TA} + \beta 6\text{ATMwithdv} + \beta 7\text{Cost/staff} + \varepsilon t$

The least-squares method was used to estimate the regression models.

VII. Regression Model Hypothesis Tests

Hypothesis testing is a principle used to decide whether a statistical hypothesis is likely to be rejected or not based on the results of a sample. According to (Gujarati, 2011), the significance test is a procedure in which sample results are used to verify the fidelity or falsity of a null hypothesis (H0). Based on the value of the statistical test, a decision can be made whether or not to reject H0. The hypothesis test should be seen as the first study to be carried out to verify the validity of the regression model(Gujarati, 2011).In this order of ideas, the purpose of the procedure is to decide whether or not a hypothesis about a certain population characteristic is supported by evidence obtained from sample data.

Hypothesis testing for the significance of the model aims to analyze whether or not there is a relationship between the dependent and independent variables.

H0 : $\beta_1 = \beta_2 = \cdots = \beta_p = 0$

H1 : $\beta_K \neq 0$ for some k

The test statistic has the F distribution with p and (n-p-1) degrees of freedom, under H0, where p represents the number of explanatory variables. The rejection of H0 will indicate the existence of a relationship and the test represents the first step to validate the model.

Hypothesis testing for an individual parameter serves to test the significance of each parameter β_k (k=1,...,p) using t Student statistic with (n-p-1) degrees of freedom,b_k estimator and respective standard deviation S (b_k) and according to the hypotheses:

$$H_0 : \beta_k = 0$$

$$H_1 : \beta_K \neq 0$$

The test statistic is:

$$t^* = \frac{b\kappa}{S\,(b\kappa)}$$

If $|t^*| \leq t_{(1-\alpha/2;n-p-1)}$ H_0 is not rejected, otherwise, H_0 is rejected (indicating that there is a significant contribution of the independent variable X_k in the model).

VIII. Results and Discussions

ROA

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.010651242	0.025831767	0.412331	0.701237727
ATMwithdv	1.99711E-11	1.22767E-11	1.626746	0.179119449
Cost/staff	-1.11122E-11	2.79326E-10	-0.03978	0.970173311
EfTxRate	-0.006120386	0.044579822	-0.13729	0.897434468
Cap/TA	0.15459495	0.045697122	3.383035	0.027707636
SpreadLT_ST	0.002251473	0.00160936	1.398986	0.234381312
realGDP	0.011233992	0.008495425	1.322358	0.25659177
CPI	-0.000157083	0.000311325	-0.50456	0.640394299

ROE

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.183907142	0.233969792	0.786029	0.475800532
ATMwithdv	1.36035E-10	1.11196E-10	1.223384	0.288324706
Cost/staff	-9.75549E-10	2.52998E-09	-0.3856	0.719425314
EfTxRate	-0.379306492	0.403779261	-0.93939	0.400716557
Cap/TA	0.467239416	0.413899136	1.128873	0.322068981
SpreadLT_ST	0.011028138	0.014576689	0.75656	0.49142822
realGDP	0.115654831	0.076946839	1.503048	0.20725217
CPI	-0.000348303	0.002819811	-0.12352	0.907653244

These results were not consistent with the expected results, as found in the revised literature, however, as expected, the Cap/TA ratio showed a positive relationship with bank profitability, so that a positive variation or an increase in it has a positive impact on ROA, "ceteris paribus". It is important to highlight the importance of the Cap/TA ratio, which presents itself as the regressor with the greatest impact on ROA, which confirms the conclusion of (Yilmaz, 2013), which exposes bank risk as an extremely relevant factor for indicators for both the ROA, as well as for ROE (although, in the present paper, only significance for ROA is demonstrated). Although it does not have a statistically significant positive relationship for ROE, the regressor realGDP was the one with the best result for profitability. Although (Abreu & Mendes, 2003) argued that this variable explains profitability, in this study, it was not verified.The remaining explanatory variables, on the other hand, did not prove to be statistically significant in explaining the ROE and ROA, thus, the proposed models will be of no use in this study because they show a negative relationship with bank profitability, therefore, ROA and ROE vary

inversely with these regressors.There was no statistical significance for the only variable introduced in the model, ATMwithdv, which has to do with the main operation carried out in the Dobra24 network. This suggests that other more important variables, whose variations can cause more robust impacts, maybe more important for bank profitability decisions.Furthermore, its coefficient had a very low value, which could explain the existing cost-benefit connection that this network exhibits. It is possible to assume that the Dobra24 network provides benefits to the banking system through the ostensible cost savings it generates, both in terms of personnel costs and the establishment of new branches to fulfill consumer demand, among other indirect benefits.However, this approach comes with a cost in terms of terminal installation and maintenance. Despite the slight positive values reached in the estimations, the benefits of this network more than offset the expenditures it entails in general terms, albeit in a relatively minor proportion. Despite these problematic tendencies, this type of system will likely continue to be seen as a requirement for the banking industry in general, and for Sao Tome and Principe in particular, to make certain transactions easier and safer.As (Hasan, Schmiedel, & Song, 2009) pointed out, the more technologically advanced the retail payment system, the higher the Bank's profitability. As a result, the lack of this network would call into doubt some of the improvements made by the banking industry in Sao Tome and Principe during that time, and the outcomes would most likely be inferior to those validated.

Considering the results of the variables of not having a statistically significant positive relationship for ROE and having only one explanation for ROA, which is CAP/TA, which has a positive coefficient. Therefore, this model (ROA), globally statistically significant, but with the other variables not significant, we propose a more robust final model with only explanatory variable, that is, a simple regression model, which will be presented as follows:

Equation (C): $d_ROAt = \beta 0 + \beta 1 \mathrm{d}_Cap/\mathrm{TA}t + \varepsilon t$

Based on the data we had, we tried to estimate a new model (simple regression model) as proposed above.

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.010756448	0.001420115	7.574351	1.89E-05
Cap/AT	0.078574652	0.018188052	4.320125	0.001513

$d_ROAt = \beta 0 + \beta 1 \mathrm{d}_Cap/\mathrm{TA}t + \varepsilon t$

ROA= 0,011+0,079 $Cap/\mathrm{TA}t$

Analyzing the Inclination

Based on the above data, the hypothesis that the slope is equal to zero was rejected.The value of $\beta 1$=0.079 (CAP/TA – Variable X1) indicates that, for each growth corresponding to one unit in X, it is estimated that Y will grow at an average of 0.079 units.That is, for each corresponding CAP/TA growth, the adjusted model predicts the estimate that the ROA will grow by 0.079 currency units.It follows that, if the CAT/TA increases by 10 units, it is expected that the ROA will increase by 0.79 units.The intercept, the value of $\beta 0$ = 0.011 represents the mean value of Y when X equals (0) zero. That is, it indicates that the ROA is 0.011 for a zero (0) CAT/AT (X) reference.

ROA= 0.011+0.079*0

ROA=0.011

IX. Conclusion

Using sample banks in So Tomé and Prncipe, this article aims to examine how self-service payment innovation effects financial performance in emerging nations. The following are the key findings.

There is a positive relationship between financial performance with self-service payment and the results confirm the idea that the more technologically advanced the retail payment system, the greater the bank's profitability (Hasan, Schmiedel, & Song, 2009).Personnel costs negatively influence the relationship between financial performance and investment in self-service.Real GDP growth has a positive relationship with the banks financial performance.The self-service system is necessary for the development and sustainability of the banking sector for the Sao Tome e Principe, it provides several benefits to the country, both in terms of minimizing transaction costs, as well as reducing expenses with staff and service agencies.In short, these studies reveal that customers (traders) do not have any direct cost for joining the self-service system, on the contrary, it provides and encourages them to join the system, because it saves time when traveling to branches and avoids the long queue for service, as well, reduces the risk of theft of money before depositing it.Concerning limitations, this research lacks satisfactory temporal data to draw all conclusions about the behavior of the ROA and ROE variables for profitability. As a result, the regression models' results (Equation A and B) were not homogeneous, indicating that they were unable to effectively capture the ROA and ROE.This was because the process is still in its early stages in Sao Tome and Principe, and the sample size is somewhat tiny, so concluding may require more observation. Other questions or clues emerge as a result of these findings, which can be

investigated further in future research:a) Conducting a broader sampling is likely to result in divergent conclusions; b) Include a qualitative research approach, diversifying the sampling panel and covering all types of Dobra24 network services; c) Conduct similar research for other African countries, compare the results, and extrapolate the findings to the continent.

References

[1]. Abreu, M., & Mendes, V. (2003). Do macro-financial variables matter for European bank interest margins and profitability? *2nd CIEF Workshop European Integration and Banking Efficiency*. Lisboa.

[2]. AL-Adwan, M., AL-Zyood, M., & Ishfaq, M. (2013). The Impact of Electronic Payment on Saudi Banks Profitability: Case Study of SADAD Payment System. *International Journal of Research and Reviews in Applied Science*, 14-1, 100-113.

[3]. Allen, H. (2003). Innovations in retail payments: e-payments. *Bank of England Quarterly Bulletin: Winter*, 2003, 428-438.

[4]. Berger, A. (2003). The Economic Effects on Technological Progress: Evidence from the Banking Industry. *Journal of Money, Credit, and Banking*, 35.

[5]. Castro, D., Atkinson, R., & Ezell, S. (2010). *Embracing the Self-Service Economy.* Washington: THE INFORMATION TECHNOLOGY & INNOVATION FOUNDATION (ITIF).

[6]. Central Bank of Sao Tome and Principe. (2021, November 4). Retrieved from: http://www.bcstp.st/

[7]. Consoli, D. (2008). Systems of Innovation and Industry Evolution: The Case of Retail Banking in UK. *Industry and Innovation*, 15-6, 579-600.

[8]. Dietrich, A., & Wanzenried, G. (2011). Determinants of bank profitability before and during the crisis: Evidence from Switzerland. *Journal of International Financial Markets, Institutions & Money*, 21, 307-327.

[9]. Ferreira, S. (2016). Princípios de Econometria, 2a edição,. *Reis dos Livros*. (2a Edicão).

[10]. Frey, F., Harker, P., & Hunter, L. (1997). Innovation in Retail Banking, Wharton Financial Institutions Center. *The Wharton School, University of Pennsylvania*. Filadélfia.

[11]. Furst, K., Lang, W., & Nolle, D. (1998). Technological Innovation in Banking and Payments:Industry Trends and Implications for Banks. *Quarterly Journal, Office of the Comptroller of theCurrency*, 23.

[12]. Gallouj, F., & Weinstein, O. (1997). Innovation in Services. *Research Policy*, 26, 537-556

[13]. Gujarati, N. (2011). Econometria Básica (5a Edição ed.). (M. R. tradução de Denise Durante, Trad.) AMGH Editora Ltda.

[14]. Harker, P., & Zenios, A. (1998). What Drives the Performance of Financial Institutions? *Wharton Financial Institutions Center, The Wharton School, University of Pennsylvania, Working Paper*, 98-21. Filadélfia.

[15]. Hasan, I., Schmiedel, H., & Song, L. (2009). Return to Retail Banking and Payments. *European Central Bank Working Paper Series*, 1135.

[16]. Hauknes, J. (1996). Innovation in the Service Economy, Studies in Technology, Innovation and Economic Policy. *Step Group, SI4S Report No. 7-96*. Noruega.

[17]. Instituto Nacional de Estatísticas STP. (2021, November 2). Retrieved from: https://www.ine.st/

[18]. International Bank of Sao Tome and Principe. (2021, November 4). Retrieved from: http://www.bistp.st/

[19]. International Bank ok Sao Tome and Principe. (2010). *Report & Accounts 2009*. Edição e Comunicação, Lda.

[20]. International Bank ok Sao Tome and Principe. (2008). *Report & Accounts 2007*. Edição e Comunicação, Lda.

[21]. International Bank ok Sao Tome and Principe. (2012). *Report & Accounts 2011*. Edição e Comunicação, Lda.

[22]. International Bank ok Sao Tome and Principe. (2014). *Report & Accounts 2013*. Edição e Comunicação, Lda.

[23]. International Bank ok Sao Tome and Principe. (2016). *Report & Accounts 2015*. Edição e Comunicação, Lda.

[24]. International Bank ok Sao Tome and Principe (2018). *Report & Accounts 2017*. Edição e Comunicação, Lda.

[25]. Jalal-Karim, A., & Hamdan, A. M. (2010). The Impact of Information Technology on Improving Banking Performance Matrix: Jordanian Banks as Case Study. *Abu Dhabi, European, Mediterranean & Middle Eastern Conference on Information Systems*, 2010.

[26]. King, R., & Levine, R. (1993). Finance and Growth: Schumpeter Might Be Right, *Quarterly Journal of Economics*, 108-3, 717-42.

[27]. Krajewski, L., Ritzman, P., & Malhotra, M. (2009). *Administração da produção e operações* (8a ed. ed.). São Paulo: Pearson Prentice Hall.

[28]. Levine, R., & Zervos, S. (1998). Stockmarkets, Banks and Economic Growth,*American Economic Review*, 88-3, 537-558.

[29]. Milone, G. (2004*). Estatística Geral e Aplicada*. São Paulo: Pioneira Thomson Learning.

[30]. Morettin, A., & Toloi, M. (1987). *Séries Temporais* (2a ed. ed.). São Paulo: Atual Editora.

[31]. Pasiouras, F., & Kosmidou, K. (2007). Factors Influencing the profitability of domestic and foreign commercial banks in the European Union. *Research in International Business and Finance*, 21, 222-237.

[32]. Resende, J., & Silva, E. (2007). A Profit Efficiency Perspective on the Future Strategic Positioning of the Portuguese Banks. *Centro de Estudos de Economia Industrial, do Trabalho e da Empresa, Faculdade de Economia da Universidade do Porto*.

[33]. Schumpeter, J. (1961). *The Theory of Economic Development*, Oxford: Oxford University Press.

[34]. Scott, J., & Arias, J. (2011). *Banking Profitability Determinants*, Business Intelligence Journal. 4-2, 209-230.

[35]. Silveira, M. (2016). *Palavras de Ex. Governadora do Banco Central de São Tomé e Príncipe.*

[36]. Sundbo, J. (12-14 de Junho de 1995). Managing and Organizing Innovation in Banking: a Strategic Task. *Workshop on Risk Management in Banks, Stockholm*.

[37]. White, W. (1998). The Coming Transformation of Continental European Banking. *Bank for International Settlements, Monetary and Economic Department, Working Paper No. 54*, Basle.

[38]. Yilmaz, A. (2013). Profitability of Banking System: Evidence from Emerging Markets. *WEI International Academic Conference Proceedings*. Antalya, Turquia.