

## A REGRESSION ANALYSIS OF INFLATION AND CASHLESS TRANSACTIONS IN KENYA, TANZANIA, AND NIGERIA

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### Abstract

This study aimed to assess whether higher Inflation leads to more cashless transactions in Africa. Annual data was collected from the Central banks of Kenya, Tanzania, and Nigeria, including variables for cashless transactions and average inflation rates. The approach consisted of data cleaning and exploration, descriptive analytics, a simple regression model, and correlation testing between the variables to check the magnitude of their relationships. Using the inflation rate as the dependent variable and the cashless transactions as the independent variable, the results from the regression model for the three countries were assessed using the p-value metric, where a p-value below 0.05 was generally considered statistically significant, implying a low probability that the relationship observed is due to chance. Nigeria (p-value = 0.0238) and Tanzania (p-value = 0.00102) revealed p-values all less than 0.05, the usual statistical significance level, thus indicating a statistically significant relationship. On the other hand, Kenya (p-value = 0.167) was statistically insignificant. Thus, there was enough evidence to reject the null hypothesis and accept the claim that higher inflation leads to more cashless payments in Africa. Another finding was that other factors, such as technological advancements, government laws on cashless operations, and changes in consumer preferences affect cashless transactions in Africa. Thus, it is recommended for policymakers to promote cashless transactions and put in place supportive regulations strategically. Further, the use of cashless transactions reduces the impact of inflation. The analysis was conducted using R, Power BI, and Excel.

**Keywords:** Inflation, Cashless Transactions, Regression Analysis, Financial Inclusion, Macroeconomic Indicators.

### INTRODUCTION

Cashless transactions, which involve conducting financial activities without physical currency, have become increasingly common through digital channels and various electronic methods (Kumari & Khanna, 2017). These methods include mobile transactions using mobile devices, enabling users to send and receive money, make purchases, and pay bills conveniently through mobile wallets (Tee & Ong, 2016). Online banking also allows individuals to conduct various transactions such as sending, withdrawing, and transferring money between accounts via the Internet. Additionally, credit and debit cards provide the means to electronically borrow funds for payments and cash withdrawals (Thirupathi *et al.*, 2019). Assessing the relationship between higher inflation and the increased use of cashless payments is crucial for understanding economic efficiency. Higher inflation can enhance efficiency by reducing transaction costs (Mlambo & Msosa, 2020). Evaluating the progress and impact of implementing cashless transactions can help identify areas for improvement and develop policies to encourage their adoption (Chougule *et al.*, 2020). This analysis can also provide insights into the effects of cashless transactions on the economy, including their influence on inflation and tax collection, helping countries formulate effective economic policies to address

the transition to cashless transactions (Chougule *et al.*, 2020). Furthermore, studying cashless transactions can help identify consumer preferences and guide financial institutions in promoting their adoption. In regions where traditional banking services are not widely accessible, such as Kenya, Tanzania, Nigeria, and other parts of Africa, the introduction of mobile wallets like M-Pesa has significantly increased inclusivity and transaction activity, especially in remote areas (Jumba & Wepukhulu, 2019). The convenience of cashless transactions allows individuals to conduct financial activities from their current location, saving time and providing traceable evidence of transactions. Additionally, the adoption of cashless transactions can lead to increased tax revenue and overall development in these countries (Humbani & Wiese, 2018).

The growth of cashless transactions in Africa has been driven by technological advancements, government initiatives, and changing consumer behavior, with countries like Kenya, Tanzania, and Nigeria witnessing a high demand for traditional banking services, particularly in remote areas (Batiz-Lazo *et al.*, 2023). The use of mobile wallets like M-Pesa has enabled anyone with a mobile phone to transact efficiently, leading to increased financial inclusion (Mumtaza *et al.*, 2020). Small businesses have also embraced cashless transactions for their speed and safety, providing them with better financial tracking and increasing their productivity (Rahman *et al.*, 2022). Furthermore, the government has seen increased revenue from taxing cashless transactions, leading to further development in these areas (Mbiti & Weil, 2015). This study aims to assess the relationship between higher inflation and cashless transactions in Africa and analyze the trends in cashless transactions in Kenya, Nigeria, and Tanzania. Using a regression model, the study intends to investigate the statistical relationship between cashless transactions and inflation. The novelty of this research lies in its examination of the relationship between inflation and the development of cashless payments, as well as its analysis of specific trends in three countries. By addressing these gaps, this study provides valuable insights for policymakers and businesses and contributes to the growing knowledge in the field of cashless transactions.

## MATERIALS AND METHODS

This study utilize a simple linear regression model to examine the relationship between annual inflation rates and cashless payment amounts in Kenya, Tanzania, and Nigeria. The methodology involved data collection, cleaning, exploration, and analysis to uncover patterns and insights in the data, culminating in fitting the regression model for all three countries and drawing conclusions based on the model results. The analysis was conducted using R, Excel, and Power BI statistical software.

### Data

The cashless payments datasets for Kenya, Nigeria, and Tanzania were collected from the respective countries' central banks, while the inflation rates were obtained from the central banks, Statista, and The World Bank. For Tanzania, the study obtained data from 2013 to 2022, including the cashless payment amounts and annual average inflation rates for each year (see Table 1).

**Table 1: Tanzania Data**

Year	The sum of the Annual Amount (Tzs Trillions)	Annual Average Inflation Rate
2013	28.85	7.87
2014	40.81	6.13
2015	47.22	5.59
2016	57.64	5.17
2017	67.79	5.32
2018	81.38	3.49
2019	94.60	3.46
2020	109.21	3.29
2021	115.23	3.69
2022	114.32	4.35

For Nigeria, the study obtained data from 2012 to 2022, as shown in Table 2, including the cashless payment amounts and Annual average Inflation rates for each Year as shown below:

**Table 2: Obtained Data from 2012 To 2022**

Year	The sum of Annual Value (Trillions)	Annual Average Inflation Rate
2012	4.11	12.2
2013	4.71	8.5
2014	3.27	8
2015	6.20	9
2016	5.83	15.7
2017	4.10	16.5
2018	7.04	12.1
2019	5.08	11.4
2020	19.38	13.2
2021	53.21	17
2022	111.12	18.8

For Kenya, the study obtained data from 2007 to 2023, including the Cashless payment amounts and average Inflation rates. The study obtained the monthly data and then aggregated it by Year and the sum of cashless payments and Average Inflation rates for each Year as shown below:

**Table 3: Kenya Data collected over years**

Year	The sum of Annual Value (Millions)	Annual Average Inflation Rate
2007	2.47847	4.555
2008	39.10682	10.28666667
2009	87.17171	14.11166667
2010	152.27306	5.614166667
2011	218.5496	7.991666667
2012	235.8853	14.2775
2013	282.5545	5.5625
2014	311.0154	6.810833333
2015	320.9951	6.5375
2016	385.2056	6.575833333
2017	418.4482	7.670833333
2018	510.0073	5.5875
2019	628.7952	5.054166667
2020	743.8544	5.791666667
2021	808.73	5.471666667
2022	846.79	6.624166667
2023	760.25	8.472

### Variables:

The study employed three variables for this research: the year, the sum of annual cashless payment amounts, and the average annual inflation rates for Kenya, Tanzania, and Nigeria.

- **Dependent Variable:** The average inflation rate was used as the dependent variable.
- **Independent Variables:** The sum of annual cashless payment amounts was used as the independent variable.

### Independent Variable:

For the Year, the study considered data from the past ten to fifteen years for the three countries. For Kenya, the study obtained data from 2007 to 2023. For Tanzania, the study obtained data from 2013 to 2022. Finally, for Nigeria, the study obtained data from 2012 to 2022.

### Data Cleaning:

The data was cleaned to make it easier to read and use during analysis and modeling. The process consisted of handling missing values, removing duplicate values, checking for outliers, and scaling the cashless payment column for consistency.

### Descriptive Statistics:

The study calculated the Minimum, Mean, Median, and maximum values for the cashless payments amount column and the Inflation rate column for Kenya, Nigeria, and Tanzania to understand the data and gain hidden insights. Correlation analysis was also conducted to check the relationship between Cashless Payment amounts and the Inflation rate.

### Regression Model:

A simple Linear regression statistical model was employed to check the relationship between Cashless Payment amounts and the Inflation rate, with the Inflation rate being the dependent variable and the Cashless Payment amounts being the independent variable (Zou *et al.*, 2003).

### Model Specification

$$\text{Inflation rate} = B_0 + B_1 * \text{Cash less Payment Amount} + e$$

Where:

The study is trying to explain the inflation rate dependent variable.

$B_0$  – The inflation rate-intercept

$B_1$  – is the slope of the Cashless Payment Amount.

Cashless Payment Amount- This is the explanatory variable the study associated with the inflation rate.

$e$  – is the regression error term

**RESULTS AND DISCUSSION**

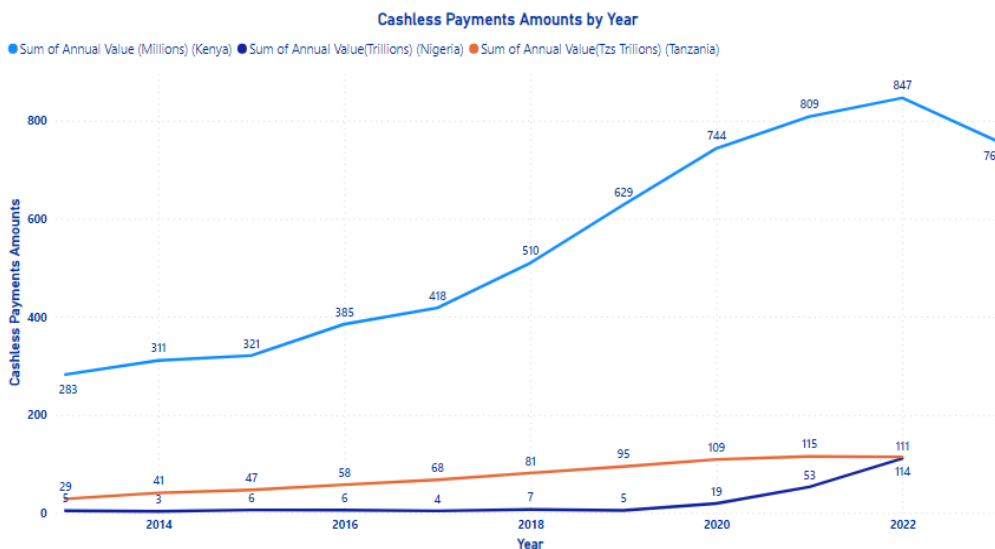
**Descriptive Statistics of the Data**

The descriptive statistics of the data encompassing the Minimum, Mean, and Maximum of the variables Total Cashless Payments amount and Average Inflation rate (%) for Kenya, Tanzania, and Nigeria are shown in the table below:

**Table 4: Mean of Inflation**

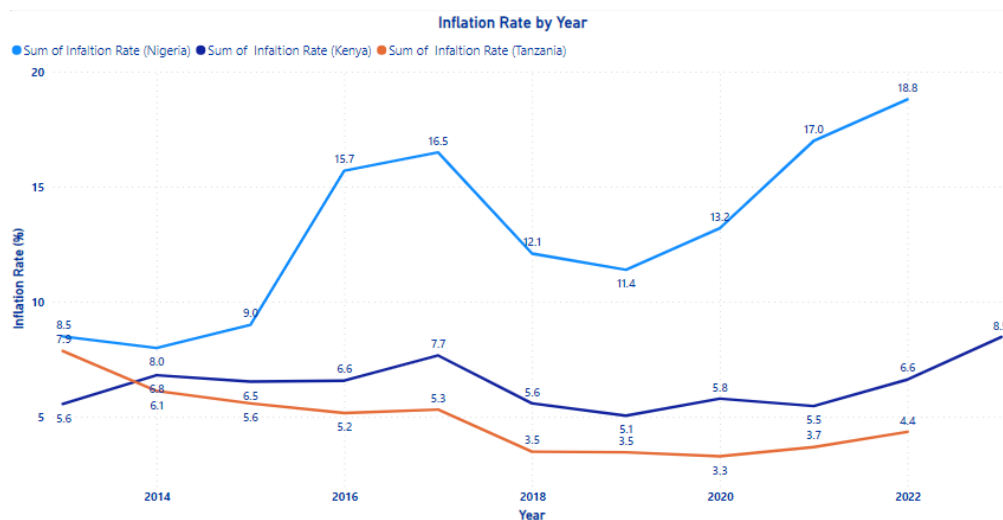
	Kenya		Tanzania		Nigeria	
	Inflation Rate	amount of online transactions	Inflation Rate	amount of online transactions	Inflation Rate	amount of online transactions
Minimum	4.55	2.478	3.29	28.85	8	3.269
Mean	7.47	320.995	4.836	75.7	12.95	20.367
Maximum	14.277	846.79	7.87	115.23	18.8	111.122

Table 4 above shows that Kenya has the highest mean Inflation, followed by Nigeria and Tanzania. Similarly, the study can also observe that Kenya has the highest substantial Inflation rate compared to Tanzania and Nigeria. Kenya exhibits the highest mean and maximum cashless transaction volume for online transaction amounts compared to Nigeria and Tanzania. It can also be observed that Tanzania has the smallest mean and foremost cashless transactions among the three countries.



**Figure 1: The relationship between cashless payment amounts by Year and country (Kenya, Nigeria, and Tanzania)**

Figure 1 above shows the relationship between cashless payment amounts by Year and country (Kenya, Nigeria, and Tanzania). The study can observe an upward trend in the number of cashless payments by Year, indicating the rise in usage over the years.



**Figure 2: The above shows the relationship between the Inflation rate in percentage by Year and country (Kenya, Nigeria, and Tanzania)**

Figure 2 above shows the relationship between the Inflation rate in percentage by Year and country (Kenya, Nigeria, and Tanzania). The study can also observe an upward trend in the annual inflation rate, indicating the rise of Inflation over the years for all three countries.

### Correlation Analysis Results

This study calculated the correlation between the variables' total cashless amounts and the average inflation to determine if there is any relationship between them.

**Table 5: The correlation coefficient between Inflation and Cashless transactions in Kenya**

Country	Correlation coefficient
Kenya	-0.3511
Tanzania	-0.8716
Nigeria	0.6709

From the data presented in Table 5, the correlation coefficient for Kenya was calculated as -0.3511, indicating a weak inverse relationship between inflation and cashless transactions. This implies that as inflation rates rise, cashless transactions in Kenya tend to decrease. Similarly, the correlation coefficient for Tanzania was determined to be -0.8716, indicating a weak inverse relationship between inflation and cashless transactions in Tanzania.

This suggests that as inflation rates escalate in Tanzania, the volume of cashless transactions typically decreases. In contrast, Nigeria exhibited a positive correlation coefficient of 0.6709, indicating that in Nigeria, as inflation rates increase, there is a tendency for cashless transactions to increase as well.

## Regression Analysis Results

The study fitted a simple linear regression model to quantify the relationship between the Inflation rate as the dependent variable and the Cashless transaction as the independent variable.

**Table 6: The relationship between the inflation rate and the total cashless**

Category	Details
Call	lm(formula = 'Annual Average Inflation Rate' ~ 'Sum of Annual Value (Millions)', data = Kenya)
Residuals Min	-4.3724
Residuals 1Q	-1.4663
Residuals Median	-0.4794
Residuals 3Q	0.8136
Residuals Max	6.2117
Coefficients (Intercept) Estimate	8.936573
Coefficients (Intercept) Std. Error	1.216934
Coefficients (Intercept) t value	7.344
**Coefficients (Intercept) (Pr(> t ))	
(Sum of Annual Value (Millions)) Estimate	-0.003692
(Sum of Annual Value (Millions)) Std. Error	0.002542
(Sum of Annual Value (Millions)) t value	-1.452
** (Sum of Annual Value (Pr(> t ))	
RSE: Residual Standard Error	2.802 on 15 degrees of freedom
MRE: Multiple R-squared	0.1233, Adjusted R-squared: 0.06484
F-statistic: F-statistic	2.109 on 1 and 15 DF, p-value: 0.167

Based on the findings presented in Table 6, the study demonstrates that the relationship between the inflation rate and the total cash payments is statistically significant, albeit weak. The R-squared value of 0.1233 indicates that the model accounts for 12.33% of the variation in the total annual cashless payments. However, with a p-value of 0.167, which exceeds 0.05, the study cannot reject the null hypothesis that the coefficient for the inflation rate is zero. This suggests that for Kenya, cashless transactions have a detrimental effect on the inflation rate.

**Table 7: Regression Results for Nigeria**

Category	Details
Call	lm(formula = Annual Average Inflation Rate ~ Sum of Annual Value(Trillions), data = Nigeria)
Residuals Min	-3.6891
Residuals 1Q	-1.8592
Residuals Median	0.1342
Residuals 3Q	1.0452
Residuals Max	4.7501
Coefficients (Intercept) Estimate	11.44887
Coefficients (Intercept) Std. Error	1.02516
Coefficients (Intercept) t value	11.168
**Coefficients (Intercept) (Pr(> t ))	
(Sum of Annual Value (Trillions)) Estimate	0.07348

(Sum of Annual Value (Trillions)) Std. Error	0.02708
(Sum of Annual Value (Trillions)) t value	2.714
** (Sum of Annual Value (Pr(> t)))	
RSE: Residual Standard Error	On 9 degrees of freedom is equal to 2.866
MRE: Multiple R-squared	0.4501, Adjusted R-squared: 0.3889
F-statistic: F-statistic	7.365 on 1 and 9 DF, p-value: 0.02384

The results from Table 7 reveal that the regression model shows a coefficient of 0.07348 for inflation, accompanied by a p-value of 0.0238, which falls below the threshold of 0.05. This suggests that the study rejects the null hypothesis stating that the coefficient for inflation is zero. Hence, there is a significant relationship between the inflation rate and cashless payments in Nigeria.

**Table 8: Relationship between the inflation rate and the total cashless payments**

Category	Details
Call	lm(formula = 'Annual Average Inflation Rate ~ Sum of Annual Value(TZs Trillions)', data = Tanzania)
Residuals Min	-1.1184
Residuals 1Q	-0.3901
Residuals Median	-0.1538
Residuals 3Q	0.3711
Residuals Max	1.1547
Coefficients (Intercept) Estimate	7.872612
Coefficients (Intercept) Std. Error	0.650436
Coefficients (Intercept) t value	12.104
**Coefficients (Intercept) (Pr(> t))	
(Sum of Annual Value(TZs Trillions)) Estimate	-0.040111
(Sum of Annual Value(TZs Trillions)) Std. Error	0.007977
(Sum of Annual Value(TZs Trillions)) t value	-5.029
** (Sum of Annual Value(TZs Trillions)) (Pr(> t))	
RSE: Residual Standard Error	On 9 degrees of freedom is equal to 2.866
MRE: Multiple R-squared	0.4501, Adjusted R-squared: 0.3889
F-statistic: F-statistic	7.365 on 1 and 9 DF, p-value: 0.02384

Based on the results presented in Table 8, it is evident that the relationship between the inflation rate and the total cashless payments is statistically significant. With a p-value of 0.00102, which is less than 0.05, the study can reject the null hypothesis that the coefficient for the inflation rate is zero, thus indicating a statistically significant relationship between the inflation rate and cashless transactions.

## CONCLUSION

Based on the regression model results provided for Kenya, Tanzania, and Nigeria, it is evident that the p-values for Nigeria (0.0238) and Tanzania (0.00102) indicate a statistically significant relationship between inflation and cashless payments, while Kenya's p-value (0.167) suggests a weaker relationship. Additionally, the F-statistics and adjusted R-squared values illustrate the varying degrees of relationship and explanatory power across the three countries. The study's conclusion aligns with the statistical significance observed in Nigeria and Tanzania, indicating



a relationship between inflation and cashless transactions. However, it is important to recognize that this relationship is country-specific, influenced by various factors, especially notable in the case of Tanzania. The indicated model reflects a trend wherein higher inflation is linked to increased cashless transactions, aligning with global shifts toward electronic payments and tighter regulations around cash transactions. This shift is anticipated to enable better inflation control and regulatory oversight, particularly as cashless transactions become more prevalent. Consequently, the study predicts that elevated inflation rates will drive the adoption of credit-only exchanges, as evidenced by the observed critical p-values in Nigeria and Tanzania. In summary, the findings suggest that as global trends increasingly favor electronic payments and regulatory measures tighten around cash transactions, the reliance on credit-only exchanges is expected to grow, underpinned by improved inflation control and regulatory oversight.

#### **Declaration of competing interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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