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# Investigating the relationship between financial technology on financial access in Cameroon: Emperical study

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## ABSTRACT
This empirical study aims to investigate the relationship between financial technology (FinTech) and financial access in Cameroon. With the increasing adoption of financial technology in the financial service sectors, it is essential to determine whether the use of these technologies has a significant impact on financial access. Methodologically, to appraise the link between FinTech and financial access, the study applied the autoregressive distributed lag (ARDL) technique. Data related to financial access were obtained from the Financial Development and Structural Dataset, while bank technological-related data, such as the Depth of Automatic Teller Machines (ATMs), were obtained from the International Monetary Fund (IMF) database. The ARDL Bounds Test results make a substantive contribution to the scholarly discourse by empirically affirming the existence of a long-term cointegration relationship between FinTech and financial access. The outcome shows that in the short run, FinTech has a positive effect on financial access up to the third lag, and the long-run outcome equally confirms a positive and significant effect of FinTech on financial access in Cameroon. In terms of policy recommendations, policymakers should implement programs that incorporate initiatives to promote FinTech, while consumers need to learn about the benefits of FinTech and how to use FinTech services safely.

**Contribution/Originality:** This study contributes to the already extensive literature on the topic. It further provides, in the short and long run, dynamics of financial technology on financial access, specifically in the case of Cameroon, where little has been done.

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## 1. BACKGROUND

Financial access, which has grown to be a progressively significant development parameter that can propel broad economic development, is a prerequisite for the financial performance of small and micro businesses (Cracknell, 2012). It has been observed that small and micro businesses contribute significantly to the employment and economic development of many nations (Liedholm & Mead, 1999). In the majority of industrialized and emerging nations, small and micro businesses are the main drivers of growth and self-employment. According to estimates, small and micro businesses in low-income nations create more than 70% of job opportunities and contribute more than 60% of the GDP (Lukacs & Burnham, 2005). Over the past ten years, technology has changed the way financial services are created, provided, and used. The advent of FinTech, the availability of inexpensive data, the heightened digitalization of mobile and internet usage, blockchain technology, machine learning, and artificial intelligence have all contributed to the rapid digital transformation of economies around the world. The COVID-19 pandemic caused lockdowns, which hastened the digitalization of financial services.

Furthermore, technology is essential to the finance sector. The latter helps banks reduce credit risks, boost performance and efficiency, and lower operating expenses. Additionally, the technologies make it easier for banks to interact with and maintain relationships with their clientele (Cheng & Qu, 2020; Goldstein, Jiang, & Karolyi, 2019; Lee & Shin, 2018; Thakor, 2020). A new type of business has emerged as a result of the development of technologies in the finance sector: the financial technology (FinTech) company. The new term, FinTech, is a combination of the words "financial" and "technology." FinTech and BankTech are sometimes used interchangeably by some writers (Zavolokina, Dolata, & Schwabe, 2016). The technological platform enables FinTech companies to offer financial goods that have the same features as their new products and banking products. Younger generations (millennials, for instance) have become aware of these new items (Jünger & Mietzner, 2020; Pu, Qamruzzaman, Mehta, Naqvi, & Karim, 2021). The way financial service providers perform their duties is being altered by the Internet, which is also radically changing the banking industry. Consequently, it is altering the type of banking services and their delivery methods. As a result, banks need to change to be competitive in the rapidly evolving digital market. The digitalization of financial services, data, trust, competitiveness, and liquidity transformation are issues that future banks, incumbents, and competitors must solve. Bank payment and transfer operations can now be facilitated and even carried out via the Internet. In the past, banks and their borrowers (customers) lived in a world of information asymmetry. A bank's understanding of its customers gives it an edge over the competition. However, as this data can be digitally analyzed, this benefit is diminished with the digital transformation that financial technology delivers (Broby, 2021). Furthermore, because even the nature of deposits is changing, banks will have to accept deposits and handle transactions made in digital form in the days ahead, regardless of whether they are made in cryptocurrencies or central bank digital currencies. This presents a variety of challenges. First of all, it alters the delivery of financial services. Second, it necessitates a conversation about payments' competition, security, and resilience. Finally, it brings up the issue of private and public money issuance. Thirdly, it offers a foundation for improved cross-border money transfers. Braggion, Dwarkasing, and Ongena (2018) examine whether these pose a risk to the stability of the financial system.

## 2. LITERATURE REVIEW

Theoretically, the link between financial access and FinTech can be analyzed using different theories like the Financial Access and Inclusion Theory, the FinTech and Financial Inclusion Theory, Innovation Diffusion Theory, and the Productivity Paradox Theory. The Financial Access and Inclusion Theory suggests that financial inclusion is a key driver of economic development and that increasing access to financial services can help promote financial inclusion. This theory is based on the idea that financial exclusion is a significant barrier to economic development and that promoting financial inclusion can help reduce poverty, increase economic growth, and improve social welfare. The theory assumes that access to financial services is a key determinant of economic well-being, that financial exclusion is a significant barrier to economic development, and finally, it assumes that promoting financial inclusion can help reduce poverty, increase economic growth, and improve social welfare (Demirgüç-Kunt & Klapper, 2012). The theory has been criticized for being overly optimistic and not adequately accounting for the challenges of financial exclusion, such as limited access to physical infrastructure, limited financial literacy, and lack of trust in financial institutions. More recent research on the theory has been conducted by scholars such as Rajan (2012), who have used experimental methods to test the effectiveness of financial inclusion programs. Other authors have criticized the theory for being overly focused on the potential benefits of financial inclusion and not paying enough attention to the challenges of financial exclusion.

The Financial Access and Inclusion Theory can be linked to the role of financial technology in promoting financial access. If the theory is correct, it suggests that promoting financial inclusion through the use of technology can help to increase access to financial services and promote economic growth and development. If the theory is not correct, it suggests that financial technology may have a limited impact on financial inclusion and that other factors, such as regulatory policies and market conditions, may be more important. The Financial Access and Inclusion Theory provides a useful framework for understanding the potential benefits and challenges of using financial technology to promote financial inclusion and for identifying opportunities to increase access to financial services through the use of technology.

The "FinTech and Financial Inclusion" theory suggests that the use of fintech can promote financial inclusion by increasing access to financial services and reducing the costs and barriers associated with traditional banking services. This theory is based on the idea that fintech can help to increase the efficiency and reach of financial services, making them more accessible to underserved populations. The theory assumes that FinTech can help to increase the efficiency and reach of financial services. It also assumes that FinTech can help to reduce the costs and barriers associated with traditional banking services and finally assumes that financial inclusion is an important goal that can be promoted through the use of FinTech. The theory has been criticized for not adequately accounting for the challenges of digital exclusion, such as limited access to technology, limited digital literacy, and lack of trust in financial institutions. It has also been criticized for not providing clear guidance on how to effectively promote financial inclusion through fintech and for not addressing the potential risks and unintended consequences of FinTech. In the past years, experimental methods have been used to test the effectiveness of fintech in promoting financial inclusion. Some authors have criticized the theory for being overly optimistic and not adequately accounting for the challenges of digital exclusion. The "FinTech and Financial Inclusion" theory can be linked to the role of financial technology in promoting financial access. If the theory is correct, it suggests that the use of FinTech can help to increase access to financial services and promote financial inclusion by reducing the costs and barriers associated with traditional banking services. If the theory is not correct, it suggests that FinTech may have a limited impact on financial inclusion and that other factors such as regulatory policies and market conditions may be more important. The "FinTech and Financial Inclusion" theory provides a useful framework for understanding the potential benefits and challenges of using FinTech to promote financial inclusion and for identifying opportunities to increase access to financial services through the use of FinTech. However, more research is needed to fully understand how this theory applies to the banking industry and the impact of fintech on financial access. The Innovation Diffusion Theory is a theory that explains how new technologies, products, and ideas spread through a population. It was first introduced by Rogers (1962). He assumes that the rate of adoption of an innovation is determined by the relative advantage, compatibility, complexity, trialability, and observability of the innovation. That early adopters play a crucial role in the diffusion process by helping to spread the innovation to others. Finally, the rate of adoption of an innovation is not uniform across all segments of a population. The theory has been criticized for being overly simplistic and failing to take into account the unique characteristics of different innovations and populations. It has also been criticized for not adequately explaining the rate of adoption of some innovations, particularly those that are widely available and have clear benefits. Rogers' theory has been widely cited and applied in a variety of fields, including marketing, education, and public health. The theory has been subject to numerous critiques and refinements over the years, and many authors have suggested ways in which it can be improved. Some authors have argued that the theory is overly focused on the adoption of technological innovations and does not adequately consider the adoption of social and cultural innovations. The Productivity Paradox Theory is a theory that suggests that despite technological advancements and innovations, the productivity of the banking industry has not kept pace with the growth of financial technology. The theory was first introduced by economist Solow (1987) in an article in the New York Times Book Review. The assumptions of the Productivity Paradox Theory are that financial technology has led to significant innovation and growth in the banking industry. Again, despite the growth of financial technology, the productivity of the banking industry has not increased at the same rate. Finally, the lack of productivity growth in the banking industry is due to factors such as inadequate implementation of technology, resistance to change, and a focus on short-term profits over long-term productivity gains. The theory has been criticized for being overly broad and not taking into account the many different factors that can influence productivity in the banking industry. Again, some critics have argued that the theory is based on incomplete or inaccurate data and that more research is needed to fully understand the reasons for the productivity paradox. Roehl's paper on the productivity paradox theory has been widely cited and discussed in the academic literature on financial technology and banking. While some authors have praised the theory for highlighting the need for banks to adopt more effective strategies for implementing financial technology and achieving productivity gains, other authors have criticized the theory for being too narrowly focused on the adoption of technology and not considering other factors that can impact productivity, such as organizational culture and management practices.

## 3. METHODOLOGY

### *3.1. Scope and Area of the Study*

The study in Cameroon aims to investigate the relationship between technological advancements and financial access. It covers a period of 32 years, from 1990 to 2021, and uses a time series methodology. Data for the financial technology measure using the Depth of ATMs is obtained from the Financial Development and Structural Dataset (2023). Meanwhile, data for financial access is built using Principal Component Analysis involving financial access indicators such as liquid liabilities, bank credit, bank credit to bank deposits, broad money, and domestic credit to the private sector. These variables are all sourced from the Financial Development and Structural Dataset (2023). Additionally, data for control variables, including gross domestic product per capita (GDPC), inflation (INFL), stock of external debt (XDEBTS), and gross fixed capital formation (GFCF), are all obtained from the World Development Indicators.

### *3.2. Model Specification*

To evaluate how Cameroon's financial technology affects financial access, higher levels of financial access may arise from the adoption of improved technologies, according to the study. Autoregressive Distributed Lag (ARDL) was used in the study to assess this. The following functional model is suggested.

$$FAC = f(FINOV, GDPC, GFCF, XDEBTS, INFL) \quad (1)$$

Where FAC denotes financial access, which is a composite index constructed using principal component analysis with components such as financial access indicators like liquid liabilities, bank credit, bank credit to bank deposits, broad money, and domestic credit to the private sector. More specifically, the financial access model is specified in Equation 2 below.

$$\text{FAC}_t = \beta_0 + \beta_1 FINOV_t + \beta_2 \text{GDPC}_t + \beta_3 \text{GFCF}_t + + \beta_4 XDEBTS_t + \beta_5 INFL_t + \varepsilon_t \quad (2)$$

Where $\beta_i$ denotes the parameters to be estimated and denotes the stochastic error term. Note that the variables are transformed into their log form before empirical estimation.

### *3.3. Estimation Technique*

The association between financial technology and financial access is also established by this study. We use the Autoregressive Distributed Lag (ARDL) Approach to examine the dynamic relationship between financial technology and financial access in our study. Because of the several benefits this model offers over alternative estimation methods, it has been embraced. Among the many benefits of the method, the ARDL model is the most statistically significant way to find the cointegration relation in small samples, whereas other methods, such as the Johansen co-integration techniques, need large data samples to be valid (Ghatak & Siddiki, 2001). The ARDL approach has a second advantage in that it is robust when there is only one long-term relationship between the underlying variables in a small sample size, whereas other cointegration techniques require all of the regressors to be integrated of the same order. This is true whether the regressors are I (1), I (0), or a combination of the two. This indicates that the pre-testing issues related to standard cointegration, which necessitates that the variables be previously categorized into I(1) or I(0), are circumvented by the ARDL approach (Pesaran, Shin, & Smith, 2001). The ARDL approach is a more suitable model for empirical work if we are uncertain about the unit root features of the data. Similarly, the (Johansen & Juselius, 1990) co-integration approach is not suitable when there is just one co-integrating vector. Therefore, regardless of whether the underlying variables are I(0), I(1), or a combination of both, Pesaran and Shin (1995) presented the Autoregressive Distributed Lag (ARDL) technique for co-integration or the limits procedure for estimating a long-run connection. The ARDL approach to co-integration should provide effective estimates in such a scenario. The ARDL approach circumvents yet another challenge of the Johansen cointegration technique, which is the numerous decisions that need to be made. These include the number of endogenous and exogenous variables (if any) to be included, how to handle deterministic elements, the order of VAR, and the ideal number of lags to employ. The approach taken to make these selections and choices has a significant impact on the estimating processes (Pesaran & Smith, 1998). Lastly, it is feasible that distinct variables have varying optimal numbers of lags when using the ARDL technique, although this is not allowed in Johansen-type models. The following two steps are necessary for the ARDL technique, according to Pesaran (1997). An F-test is used in the first step to examine whether there is any long-term association between the variables of interest. Estimating the long-term relationship's coefficients and figuring out their values is the second stage of the analysis. The short-term variables are then estimated using the ARDL model's error correction representation. The ECM version of ARDL will be used to calculate the rate of equilibrium adjustment.

## 4. PRESENTATION AND DISCUSSION OF RESULTS

### *4.1. Descriptive Statistics and Preliminary Test*

#### *4.1.1. Descriptive Statistics*

Since we postulate a linear dynamic relationship between the two variables, which are financial technology and financial access, we make use of the autoregressive distributed lag (ARDL) model to estimate the short- and long-run relationship between the two variables. The ARDL requires that we have variables that are integrated of order zero and one. This first condition is respected within the framework of our data since the Phillips-Perron unit root test outcome presented above affirms this. We commence the presentation of the estimated outcome by first presenting the bound test results, which will establish the existence of a long-run relationship between the variables of interest. The results of the unit root and stationary tests depict that the study data sample has a mixture of variables that are either I(0) or I(1), and therefore, the conclusion from these tests was that the appropriate model for the cointegration test is the ARDL. The latter employs bound testing to determine whether the variables have a long-run cointegration (Habanabakize & Muzindutsi, 2017). The result from bound testing, in Table 1, delineates the results of the ARDL Bounds Test, a pivotal econometric tool deployed to scrutinize the presence of a long-run equilibrium relationship among variables. The test's null hypothesis posits that no long-run relationships exist among the variables under study, which are imperative for understanding the intricate dynamics between financial access and financial technology, economic output, and external debts within the context of Cameroon.

**Table 1.** ARDL-bound testing results.

| **Null hypothesis: No long-run relationships exist** | | |
|---|---|---|
| **Test statistics** | **Value** | **K** |
| F statistics | 6.484 | 1 |
| Critical value bounds | | |
| Significance | Lower bounds I(0) | Upper bounds I(1) |
| 10% | 4.040 | 4.780 |
| 5% | 4.940 | 5.730 |
| 2.5% | 5.770 | 6.180 |
| 1% | 6.140 | 6.410 |

The F-statistic value is registered at 6.484425, which is significant at the 1% level when compared against the critical value bounds for significance. Specifically, the F-statistic exceeds the I1 bound value of 6.41 at the 1% significance level, thereby decisively rejecting the null hypothesis. This signals that a long-run cointegration relationship exists among the variables in question. This finding is particularly salient as it lends empirical support to theories advocating that financial systems and economic variables are not isolated phenomena but part of a complex, interconnected web that equilibrates over the long term (Johansen, 1991).

The implication of this cointegration relationship is far-reaching, especially in light of the research questions and hypotheses posed. Primarily, it substantiates the premise that financial access, financial innovation, and other macroeconomic factors are not just spuriously related but share a more profound, long-run equilibrium relationship. This bolsters the underpinnings of the study by confirming that the short-run dynamics, as captured by the ARDL model, are not mere statistical artifacts but reflective of a deeper, long-term economic interplay (Pesaran et al., 2001).

Furthermore, the presence of a long-term cointegration relationship offers a strong foundation for policy implications. For instance, it underscores the necessity for policy interventions aimed at enhancing financial access or encouraging financial innovation to consider the long-term equilibrium states and interconnectedness of various economic sectors. Such policy measures would be more effective and sustainable as they would be rooted in a nuanced understanding of the complex economic ecosystem (Engle & Granger, 1987). In summary, the ARDL Bounds Test results make a substantive contribution to the scholarly discourse by empirically affirming the existence of a long-term cointegration relationship among the key variables studied. This, in turn, enriches the study's theoretical framework and fortifies its empirical rigor, offering not just a snapshot but a longitudinal panorama of the economic dynamics shaping financial access in Cameroon. The results in Table 1 confirmed the existence of a long-run relationship among variables. However, it does not quantify the effect of independent variables on the dependent variables. Thus, we proceed to provide quantitative figures of the impact of explanatory variables on the explained variable and the responsiveness of the latter on the long-term changes in explanatory variables. Considering the results displayed in Table 2.

**Table 2.** ARDL long-run coefficients.

| Variable | Coefficient | Std. error | t-statistic | Probability |
|---|---|---|---|---|
| FINOV | 0.094*** | 0.014 | 6.72 | 0.000 |
| GDPC | 0.089 | 0.08 | 1.15 | 0.267 |
| GFCF | 0.001 | 0.008 | 0.127 | 0.901 |
| XDEBTS | -0.034 | 0.022 | -1.64 | 0.119 |
| INFL | 0.010* | 0.005 | 1.85 | 0.082 |
| C | -1.34 | 2.00 | -0.686 | 0.502 |

**Note:** *** p<0.01, * p<0.1, denote the significance levels at 1% and 10%. FINOV denote financial technology, GDPC stand for gross domestic product per capita, GFCF stand for gross fixed capital formation, XDEBTS stand for external debt stock, INFL stand for inflation and C is a constand.

A long-term association between the variables of interest was confirmed by the results in Table 1 and the preceding section. They did not, however, measure how independent variables affected dependent variables. Quantitative data, the influence of explanatory variables on the explained variable, and the latter's responsiveness to long-term changes in explanatory variables are thus the main goals of this section. In light of the findings presented in Table 2, it can be concluded that the financial technology variable has a long-term favorable impact on financial access, and that this effect is statistically significant at the 1% level of significance. According to the results, if all else is equal, a one percent gain in financial technology will result in an approximate 0.0937 increase in financial access. Inflation, GDP per capita, and gross fixed capital formation are all found to have long-term beneficial effects on financial access. This suggests that long-term financial access is enhanced by GDP per capital, inflation, and domestic fixed capital formation. At the 10% level of significance, however, only inflation is found to be statistically significant. Additionally, there is evidence of a long-term detrimental impact of foreign debt on financial access, however, this effect is not statistically significant. Examining if explanatory factors also have a short-term effect on the dependent variables is important, even though the study demonstrated the long-term relationship between the dependent and independent variables. In a similar vein, determining how long it will take for short-term changes in independent variables to affect dependent variables is crucial. That is how the rate of adjustment on long-term equilibrium is determined. The latter is ascertained by the estimation of the error correction model (ECM) (Brooks, 2014). However, the error term coefficient must be large and negative in order for the ECM to be qualified for estimating the materialization of long-run equilibrium (Mukhtar & Rasheed, 2010). If the error term coefficient is positive, it indicates that the model is explosive; if it is not significant, it has no equilibrating effect.

**Table 3.** Short-run dynamics and ECM results.

| Variable | Coefficient | Std. error | t-statistic | Probability |
|---|---|---|---|---|
| D(FAC(-1)) | 0.220** | 0.082 | 2.693 | 0.015 |
| D(FAC(-2)) | 0.127 | 0.094 | 1.348 | 0.195 |
| D(FAC(-3)) | 0.119*** | 0.028 | 4.202 | 0.000 |
| D(FINOV) | 0.087*** | 0.013 | 6.832 | 0.000 |
| D(FINOV(-1)) | -0.034** | 0.015 | -2.328 | 0.033 |
| D(GDPC) | 0.032 | 0.030 | 1.046 | 0.310 |
| D(GFCF) | 0.000 | 0.003 | 0.130 | 0.898 |
| D(XDEBTS) | -0.013* | 0.006 | -2.095 | 0.051 |
| D(INFL) | 0.004* | 0.002 | 2.057 | 0.055 |
| CointEq(-1) | -0.355*** | 0.088 | -4.044 | 0.000 |

**Note:** *** p<0.01, ** p<0.05, * p<0.1, denote the significance levels at 1%, 5% and 10%.

The results in Table 3 depict an error correction term (ECT) of -0.355431 that satisfies the aforementioned conditions. The ECT is negative and significant, with values indicating about 35.5 percent model change corrections yearly, and it takes approximately two years and about eight months for the model to reach full equilibrium (1/0.355431). In the short-run dynamics, the coefficients for D(FAC(-1)), D(FAC(-3)), D(FINOV), D(FINOV(-1)), D(XDEBTS), and D(INFL) are statistically significant at various confidence levels. For instance, D(FINOV) has a coefficient of 0.086929 with a p-value of 0.0000, implying that financial technology has an immediate impact on financial access. This corroborates theories that posit financial technology as a crucial enabler for financial inclusion (Frame, Srinivasan, & Woosley, 2001). The results further affirm that in the short run, past levels of financial access have a positive effect on the current level of financial access.

After presenting the short- and long-run outcomes, we proceed to present the post-estimation outcomes and validation results.

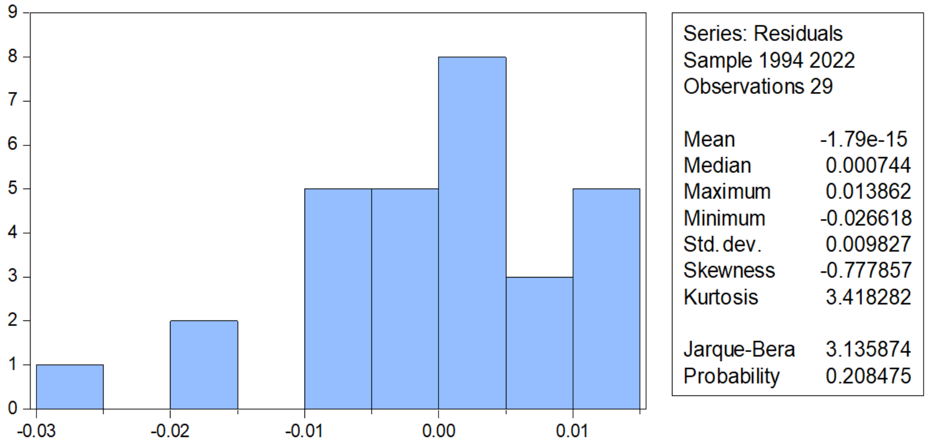


**Figure 1.** Normality test outcome.

In examining the normality test depicted by the histogram (Figure 1), it is seen that the distribution pattern of the residuals, which plays a pivotal role in ascertaining if the residuals align with the normal distribution, is a foundational assumption for a multitude of statistical tests. The Jarque-Bera test value obtained, 0.208475, indicates that the distribution of the residuals gravitates towards normality, leading us to conclude that we fail to reject the null hypothesis concerning the normal distribution of the residuals. Tables 4, 5, and 6 present diagnostic tests for the econometric model focusing on financial access in Cameroon, specifically the Breusch-Godfrey test for serial correlation, the Harvey test for heteroskedasticity, and the Ramsey RESET test for model specification.

**Table 4.** Serial correlation.

| **Breusch-Godfrey serial correlation LM test:** | | | |
|---|---|---|---|
| F-statistic | 2.558 | Prob. F(2,10) | 0.127 |
| Obs*R-squared | 9.816 | Prob. Chi-square(2) | 0.007 |

Starting with the Breusch-Godfrey Serial Correlation LM Test, the F-statistic is 2.558311 with a probability of 0.1267, and the observed R-squared is 9.815819 with a Chi-Square probability of 0.0074. The F-statistic suggests that the null hypothesis of no serial correlation cannot be rejected at conventional levels of significance. This shows that the estimated model does not suffer from the problem of serial correlation (Breusch, 1978; Godfrey, 1978).

**Table 5.** Heteroscedasticity.

| **Heteroskedasticity test: Harvey** | | | |
|---|---|---|---|
| F-statistic | 1.515 | Prob. F(11,17) | 0.214 |
| Obs R-squared | 14.357 | Prob. Chi-Square(11) | 0.214 |
| Scaled explained SS | 12.721 | Prob. Chi-Square(11) | 0.312 |

**Note:** SS denote sum of square.

For the Harvey test for heteroskedasticity, the F-statistic is 1.515360 with a probability of 0.2136. This implies that the null hypothesis of constant variance, or homoscedasticity, cannot be rejected. The implication is that the model's estimates can be considered BLUE (Best Linear Unbiased Estimators), reinforcing the model's robustness (Harvey, 1976).

**Table 6.** Ramsey reset test result.

| **Ramsey RESET test** | | | |
|---|---|---|---|
| Equation: UNTITLED | | | |
| Specification: FAC FAC(-1) FAC(-2) FAC(-3) FAC(-4) FINOV FINOV(-1) FINOV(-2) GDPC GFCF XDEBTS INFL C | | | |
| Omitted variables: Squares of fitted values | | | |
| | Value | Df | Probability |
| t-statistic | 0.866 | 16 | 0.400 |
| F-statistic | 0.749 | (1, 16) | 0.400 |
| F-test summary: | | | |
| | Sum of sq. | Df | Mean squares |
| Test SSR | 0.000 | 1 | 0.000 |
| Restricted SSR | 0.004 | 17 | 0.000 |
| Unrestricted SSR | 0.004 | 16 | 0.000 |

Lastly, the Ramsey RESET test yielded an F-statistic of 0.749269 with a probability of 0.3995. This suggests that the null hypothesis, which posits that the model has no omitted variables, cannot be rejected. This is a crucial finding as it enhances the model's validity by confirming that it is well-specified (Ramsey, 1969). The diagnostic tests provide critical insights into the model's properties and, by extension, the robustness of the study's findings. While the serial correlation test suggests no serial correlation of residuals, the tests for heteroskedasticity and model specification largely confirm the model's soundness. These results contribute to the scholarly rigor of the study, offering a model that is largely free from specification errors and heteroskedasticity. Hence, the tests lend substantive empirical credence to the examination of how financial technology and various macroeconomic variables interact to shape financial access in Cameroon, a subject of increasing academic and policy importance.

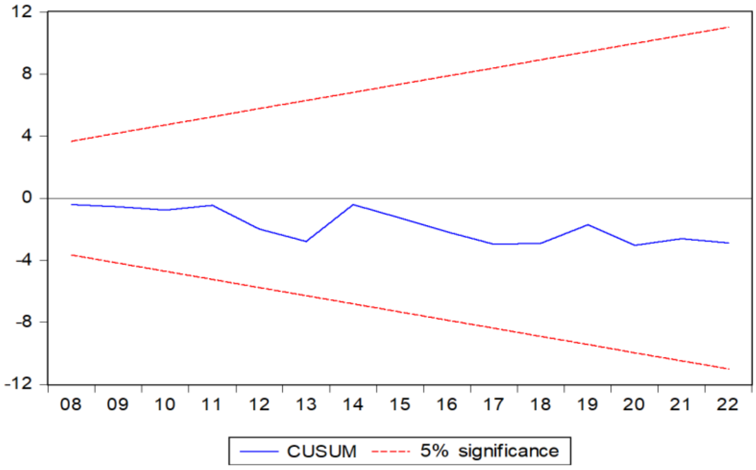


**Figure 2.** CUSUM test.

Figure 2 illustrates the CUSUM (Cumulative Sum) stability test graph. The purpose of the CUSUM test is to assess the stability of the parameters of a linear regression model over time. The blue line represents the CUSUM statistic, while the two dashed red lines represent the 5% significance bounds. For a model to be stable, the CUSUM statistic should lie within these bounds throughout the entire period. From the graph, we observe that the CUSUM line remains between the 5% significance bounds for the entire period from 2008 to 2022. This indicates that the parameters of the model are stable over the period under consideration.

Moving on to the Ramsey RESET test, this test is employed to detect the presence of specification errors in a regression model, particularly the omission of important variables or the incorrect functional form. The "omitted variables" here are the squares of the fitted values, suggesting that the RESET test is examining whether the inclusion of these squared terms might lead to a better-fitting model. The t-statistic value for the RESET test is 0.865603, and its associated probability is 0.3995. Similarly, the F-statistic is 0.749269, with the same probability of 0.3995. Given that the p-value (probability) is notably above conventional significance levels (e.g., 0.05 or 5%), we fail to reject the null hypothesis of the Ramsey RESET test. This implies that there is no evidence of specification errors in the model, and the model appears to be correctly specified. In summary, the CUSUM stability test indicates that the model's parameters have been stable over the period from 2008 to 2022. Concurrently, the Ramsey RESET test suggests that the model is correctly specified and does not suffer from significant specification errors, such as omitted variables or incorrect functional forms, at least within the context of the tested specification.

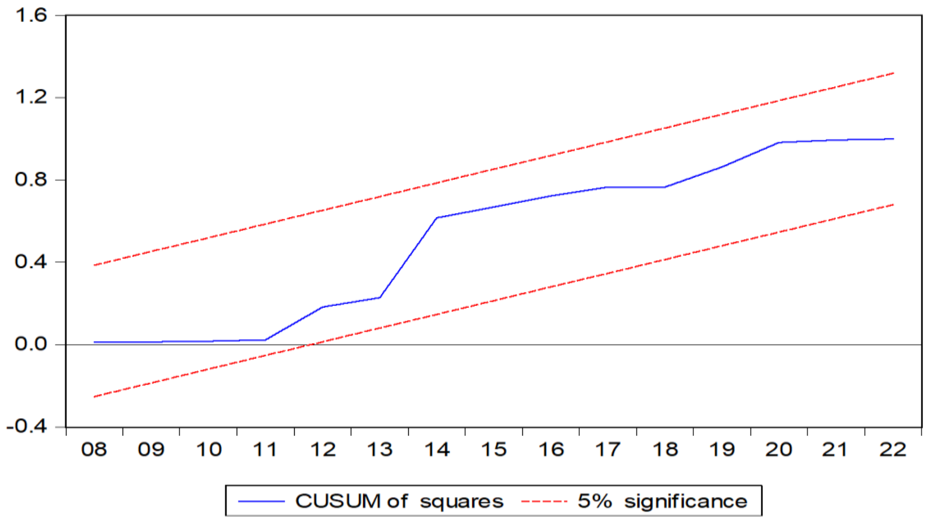


**Figure 3.** CUSUM of squre test.

In recent research endeavors exploring the stability of econometric models, scholars have employed various diagnostic tests to ascertain the validity and robustness of their analytical constructs. Central to these diagnostic endeavors is the CUSUM of Squares test, a nuanced variation of the Cumulative Sum (CUSUM) stability test. This advanced test specifically assesses the stability of the variances of the residuals over time. Figure 3 illustrates the CUSUM of Squares test result. Within the context of the graph, the horizontal axis represents the time series from 2008 to 2022, while the vertical axis delineates the cumulative sum of the squares of the standardized residuals. The trajectory of the blue line, representing the CUSUM of Squares, is juxtaposed against the 5% significance bounds, depicted as two dashed red lines. When the CUSUM of Squares line remains within these bounds, it can be inferred that the variances of the residuals are stable, thus validating the homoscedasticity assumption inherent in most linear regression models.

In the case at hand, the CUSUM of Squares line begins at the zero mark, consistent with theoretical expectations. As we move chronologically, a noticeable deviation emerges around the year 2013, wherein the CUSUM of Squares line starts to ascend and continues its upward trajectory until 2022. Notably, this ascending line does not breach the upper 5% significance boundary, suggesting that while there might be some fluctuations in the variances of the residuals, they are not statistically significant enough to violate the homoscedasticity assumption. This is congruent with the works of Brown, Durbin, and Evans (1975), who postulated that minor deviations within the significance bounds are tolerable and do not necessarily compromise the validity of the model. To further accentuate the findings, drawing parallels with prior research becomes imperative. Earlier studies have underscored the pivotal role of variance stability in ensuring unbiased and efficient parameter estimates. Given that the current model appears to fulfill the homoscedasticity criteria, based on the CUSUM of Squares test, the results contribute substantively to the existing body of knowledge. It corroborates the findings of other scholars who have achieved similar stability in their models, reinforcing the notion that with diligent model specification and data preprocessing, stable variances can be achieved. In summation, the presented CUSUM of Squares test serves as a testament to the model's adherence to the homoscedasticity assumption, a cornerstone of regression analysis. The visual evidence, coupled with statistical underpinnings, furnishes a compelling argument for the model's validity and robustness, thus cementing its place in the academic discourse on econometric model stability.

## 5. CONCLUSION

The study in Cameroon aims to investigate the relationship between technological advancements and financial access. It covers a period of 32 years, from 1990 to 2021, and uses a time series methodology. FinTech can have a positive impact on financial access by providing financial products and services to underserved populations. FinTech can achieve this by reducing the costs of delivering financial services and by making financial services more accessible and convenient. In Cameroon, FinTech is still in its early stages of development, but it is already having a positive impact on financial access. For example, a number of FinTech companies in Cameroon are providing mobile banking services to people in rural areas who do not have access to traditional banking services. In terms of policy recommendations, policymakers should implement policies and programs that promote the adoption of FinTech, while financial institutions should invest in FinTech solutions to improve efficiency, reach new markets and customers, and offer new products and services. Finally, consumers have to learn about the benefits of FinTech and also how to use FinTech services safely.

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## REFERENCES

Braggion, F., Dwarkasing, M., & Ongena, S. (2018). Household wealth inequality, entrepreneurs' financial constraints, and the great recession: Evidence from the Kauffman Firm survey. *Small Business Economics, 50*(3), 533–543. https://doi.org/10.1007/s11187-017-9906-2

Breusch, T. (1978). Testing for autocorrelation in dynamic linear models. *Australian Economic Papers, 17*(31), 334-355. https://doi.org/10.1111/j.1467-8454.1978.tb00635.x

Broby, D. (2021). Financial technology and the future of banking. *Financial Innovation, 7*(1), 1-19. https://doi.org/10.1186/s40854-021-00264-y

Brooks, C. (2014). Modelling long-run relationships in finance. In Introductory Econometrics for Finance. In (pp. 353–414): Cambridge University Press. https://doi.org/10.1017/CBO9781139029247.009.

Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society: Series B (Methodological), 37*(2), 149–163. https://doi.org/10.1111/j.2517-6161.1975.tb01532.x

Cheng, M., & Qu, Y. (2020). Does bank FinTech reduce credit risk? Evidence from China. *Pacific-Basin Finance Journal, 63*, 101398. https://doi.org/10.1016/j.pacfin.2020.101398

Cracknell, D. (2012). Policy innovations to improve access to financial services in developing countries: Learning from case studies in Kenya. *Centre for Global Development*, 1-75.

Demirgüç-Kunt, A., & Klapper, L. F. (2012). *Measuring financial inclusion: The global findex database.* World Bank Policy Research Working Paper, No. 6025.
Development and Structural Dataset. (2023). *World bank group, data catalog.* Retrieved from https://datacatalog.worldbank.org/search/dataset/0039687
Engle, R. F., & Granger, C. (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrica, 55*(2), 251-276. https://doi.org/10.2307/1913236
Frame, W., Srinivasan, A., & Woosley, L. (2001). The effect of credit scoring on small-business lending. *Journal of Money, Credit and Banking, 33*(3), 813-825. https://doi.org/10.2307/2673896
Ghatak, S., & Siddiki, J. U. (2001). The use of the ARDL approach in estimating virtual exchange rates in India. *Journal of Applied Statistics, 28*(5), 573–583. https://doi.org/10.1080/02664760120047906
Godfrey, L. G. (1978). Testing against general autoregressive and moving average error models when the regressors include lagged dependent variables. *Econometrica: Journal of the Econometric Society, 46*(6), 1293–1301. https://doi.org/10.2307/1913829
Goldstein, I., Jiang, W., & Karolyi, G. A. (2019). To FinTech and beyond. *The Review of Financial Studies, 32*(5), 1647–1661. https://doi.org/10.1093/rfs/hhz025
Habanabakize, T., & Muzindutsi, P. F. (2017). Analysis of government expenditure and sectoral employment in the post-apartheid South Africa: Application of ARDL model. *Journal of Economics and Behavioral Studies, 9*(2), 224–233. https://doi.org/10.22610/jebs.v9i2(J).1663
Harvey, A. (1976). Estimating regression models with multiplicative heteroscedasticity. *Econometrica, 44*(3), 461-465. https://doi.org/10.2307/1913974
Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica: Journal of the Econometric Society, 59*(6), 1551-1580. https://doi.org/10.2307/2938278
Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with appucations to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*(2), 169-210. https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x
Jünger, M., & Mietzner, M. (2020). Banking goes digital: The adoption of FinTech services by German households. *Finance Research Letters, 34*, 101260. https://doi.org/10.1016/j.frl.2019.08.008
Lee, I., & Shin, Y. J. (2018). Fintech: Ecosystem, business models, investment decisions, and challenges. *Business Horizons, 61*(1), 35–46. https://doi.org/10.1016/j.bushor.2017.09.003
Liedholm, C., & Mead, D. (1999). *Small enterprises and economic development: The dynamics of micro and small enterprises.* London: Routledge.
Lukacs, P. M., & Burnham, K. P. (2005). Review of capture–recapture methods applicable to noninvasive genetic sampling. *Molecular Ecology, 14*(13), 3909-3919. https://doi.org/10.1111/j.1365-294x.2005.02717.x
Mukhtar, T., & Rasheed, S. (2010). Testing long run relationship between exports and imports: Evidence from Pakistan. *Journal of Economic Cooperation and Development, 31*(1), 41–58. https://doi.org/10.37879/jecd.v31i1.1663
Pesaran, M. H. (1997). The role of economic theory in modelling the long run. *The Economic Journal, 107*(440), 178–191. https://doi.org/10.1111/1468-0297.00151
Pesaran, M. H., & Shin, Y. (1995). An autoregressive distributed lag modelling approach to cointegration analysis. In (Vol. 9514, pp. 371-413). Cambridge, UK: Department of Applied Economics, University of Cambridge.
Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289-326. https://doi.org/10.1002/jae.616
Pesaran, M. H., & Smith, R. (1998). Structural analysis of cointegrating VARs. *Journal of Economic Surveys, 12*(5), 471-505.
Pu, G., Qamruzzaman, M. D., Mehta, A. M., Naqvi, F. N., & Karim, S. (2021). Innovative finance, technological adaptation and SMEs sustainability: The mediating role of government support during COVID-19 pandemic. *Sustainability, 13*(16), 9218. https://doi.org/10.3390/su13169218
Rajan, R. (2012). *The corporation in finance (No. w17760).* National Bureau of Economic Research.
Ramsey, J. B. (1969). Tests for specification errors in classical linear least-squares regression analysis. *Journal of the Royal Statistical Society Series B: Statistical Methodology, 31*(2), 350-371. https://doi.org/10.1111/j.2517-6161.1969.tb00796.x
Rogers, E. M. (1962). *Diffusion of innovations* (1st ed.). New York: Free Press.
Solow, R. M. (1987). We'd better watch out. *New York Times Book Review, 12*, 36.
Thakor, A. V. (2020). Fintech and banking: What do we know? *Journal of Financial Intermediation, 41*, 100833. https://doi.org/10.1016/j.jfi.2019.100833
Zavolokina, L., Dolata, M., & Schwabe, G. (2016). The FinTech phenomenon: Antecedents of financial innovation perceived by the popular press. *Financial Innovation, 2*, 1-16. https://doi.org/10.1186/s40854-016-0036-7