Microcredit and Economic Growth in Ecuador from 2013 to 2023

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Abstracts

Microcredit has emerged as an effective instrument for achieving financial inclusion, stimulating productive activities, and with this support, reinforcing economic growth. This study aims to examine the characteristics of microcredit financing in Ecuador and to quantify its impact on economic growth. The study employs quarterly data from 2013 to 2023. An Error Correction (VEC) model was utilized to ascertain the short- and long-term effects of microcredit and investment on GDP. The findings indicate that microcredit and investment do not exert a significant short-term influence on GDP. However, in the long term, a 1% change in investment is associated with a 0.11% positive impact on GDP. Similarly, a 1% shift in microcredit is linked to a 1.17% favorable effect on GDP. Ultimately, there is a unidirectional causal relationship between GDP and microcredit.

Keywords: Microcredit, Economic Growth, Investment, Error Correction.

Introduction

Microfinance can serve as a significant catalyst for local, regional, and national development in a given country. Indeed, in recent years, they have become one of the most frequently utilized instruments incorporated by development promotion policies. On the one hand, microfinance contributes to the reduction of poverty and social exclusion in a given territory. It allows marginalized sectors to generate economic activities and self-employment opportunities. On the other hand, it favors the creation of jobs in small local companies. As Ocaña Mazón (2018) asserts, microfinance has facilitated access to formal financial products for microentrepreneurs, thereby enabling them to secure financing and savings. One of the most notable microfinance products is microcredit, which is designed to support the productive activities of microenterprises. Compared to other informal financial alternatives, microcredit has demonstrated the potential to reduce financial expenses, enhance financial profitability, and bolster the long-term sustainability of microenterprise businesses. In recent decades, microcredit has sought to serve as an instrument that allows access to financial resources for the population strata most in need of them, adapting various methodologies to align with the specific needs of the target population. This is a significant aspect of the situation, as the aforementioned methodologies facilitate credit operations in terms of guarantees, terms, amounts, and amortization.

As posited by authors such as São Paulo, microcredits represent a highly efficacious instrument for the eradication of extreme poverty in developing countries. The provision of resources through the facilitation of easy, rapid, and sustained access to credit enables individuals with limited resources to establish microenterprises that generate wealth. They further assert that microcredits stimulate the economic growth of micro, small, and medium-sized enterprises (MSMEs) in Latin American countries, thereby facilitating structural and productive change. Additionally, they conclude that microcredit enhances the well-being of beneficiaries and fosters entrepreneurship to a greater extent than other policies. However, they also explain that there may be adverse effects on macroeconomic aggregates, as a government policy that increases the demand for capital can lead to a significant increase in the equilibrium interest rate. (Inglada-Galiana, Sastre-Centeno & De Miguel-Bilbao, 2015) (Maldonado, M. y Armijos, L., (Islam & O'Gorman, 2019)

As indicated by the Barometer of the Impact of Finance 2023, the provision of credit to microenterprises is becoming a significant aspect of global finance. In 2022, the global microcredit sector continued to demonstrate consistent growth in line with the preceding year's trends, reaching an estimated gross loan portfolio of 182.7 billion dollars. The average growth of this portfolio in microfinance institutions (MFIs) was 13.7% in 2022, a notable increase from the 9.6% growth observed in 2021. With regard to borrowers, in 2022 MFIs provided services to a total of 173 million individuals, representing an average growth rate of 5%. This is in close proximity to the annual growth rates observed in 2021 and before the pandemic, which ranged from 3.9% to 10.3%. Of the total gross portfolio, 56.9% of borrowers were women, indicating a year-on-year increase of 1.8%. The average loan balance as a proportion of gross national income (GNI) per capita also remained relatively stable, with a median of 48.7% and 44.6% in 2021 and 2022, respectively (Convergences, 2023). The significance of microcredit lies in its role as the primary mechanism for facilitating access to working capital for micro and small enterprises, thereby enabling the creation of productive assets and employment opportunities. Similarly, it permits individuals who have been excluded from formal banking to obtain the resources necessary to finance their projects. Consequently, microcredit has emerged as an effective instrument for alleviating poverty and eradicating financial exclusion, stimulating productive activities, and consequently, reinforcing economic growth. It is therefore important to ascertain whether the provision of microcredit has resulted in increased economic activity in Ecuador, which represents the principal objective of this research.

Literature Review

Although there has been considerable debate about the role of financial development in economic growth, there is still no clear consensus on the direction of its impact. Consequently, it remains unclear how microcredit affects the growth of production in a country.

Aguilar Andía (2013) conducted a study for Peru with the objective of developing a quantitative evaluation of the impact that the expansion of microcredit has had on the level of economic activity in Peruvian regions during the period 2001-2008. The study employed two indicators: the growth rate of regional GDP per capita and the total placements of microfinance institutions as a percentage of GDP in each region. The findings indicated a positive and significant impact of microcredit on regional growth. A panel data model at the subnational level in Colombia

revealed that microcredit exerts a negative influence on GDP, both in the short and long term. This is largely attributed to the high interest rates associated with microcredit, which necessitate significant resource allocation for loan repayment. The paper by Gross Domestic Product examines the impact of microfinance on Nigeria's economic growth by using assets, deposits, loans, and advances as a proxy for the activities of microfinance institutions and Gross Domestic Product as a proxy for economic growth. An ordinary least squares model of multiple regressions was applied, resulting in the asset and deposit base having a negligible impact on economic growth, while loans and advances to the public have a significant impact on economic growth in Nigeria. In Egypt, a time series model was employed for the period 2003 to 2018. The findings indicated that microfinance loans exert a significant positive impact on short-term economic performance in Egypt, enhancing short-term per capita consumption.

However, loans did not exert a significant impact on long-term economic growth. Nevertheless, investing in microfinance has been identified as a significant factor influencing Egypt's long-term economic performance. In another study for Nigeria, the impact of microfinance activities on rural economic growth and savings in Nigeria during the period 2000–2015 was examined using an ordinary least squares regression. The findings indicated that microfinance banking has not contributed to agricultural productivity; however, it has facilitated an increase in rural saving habits in Nigeria. The results also highlighted the necessity for the government to invest in basic infrastructure in rural areas to enhance the country's overall needs. It would be beneficial to encourage microfinance institutions to establish their offices in this location.

Londoño-Bedoya et al. (2021), Ayodele & Arongudade (2014), El Hadidi (2021), and Nwude et al. (2018), published a study demonstrating that microcredit benefits self-employment more than other economic activities of households at the micro level. At the macroeconomic level, the study revealed that the effect of microcredit on increasing production is not significant, and that microcredit is an effective development strategy at both the micro and macro levels. Conversely, in their study of Nigeria, which employed time series data from all commercial banks for the period between 1992 and 2012, they discovered that microfinance loans have a notable positive impact on short-term economic performance in Nigeria. This is due to the fact that they enhanced per capita consumption in the short term. However, they did not have a significant impact on long-term economic growth. Nevertheless, investing in microfinance has a significant impact on Nigeria's long-term economic performance (Murad & Idewelw, 2017)

Other research at the micro level examines the impact of microcredit on economic variables such as poverty, income, employment, and so forth. The study was conducted by Li, X.; Gan, C. and Hu, B. In 2011, the panel data approach, using information from a household survey in rural China, indicated that participation in a microcredit program has a positive impact on the living conditions of rural households, particularly in terms of income and consumption. However, the findings also suggest that the majority of program participants are not classified as poor, which raises questions about the social potential of China's microcredit programs, particularly in terms of poverty reduction. A qualitative and quantitative study was conducted through interviews with experts and a focus group discussion with 50 families in Rupsha, Bangladesh. The findings indicate that while microcredit plays an important role in supporting borrowers in the short term, it can also generate a burden of loan repayment due to a high interest rate for those who do not

use microcredit properly. However, the study also suggests that microcredit can be beneficial for a few borrowers who use it properly to achieve sustainable development (Ali et al., 2019).

Thanh et al. (2019) used panel data from the Vietnam Household Resource Access Surveys to investigate the impact of microcredit on economic development. They found that microcredit is an effective strategy at both the micro and macro levels, as it benefits self-employment more than other household economic activities. However, they also found that the effect of microcredit on increasing production is not as significant. Furthermore, they used econometric methods for static and dynamic analysis to assess the impact of the microcredit program of the Social Policy Bank of Viet Nam (VBSP) on agricultural income per capita and total income per capita. They found that the program had a significantly positive impact on agricultural income per capita and a significantly negative impact on total income per capita. A linear regression model was used to analyze the data from 290 respondents living in rural Pakistan, specifically women. The results indicated that microcredit has a significant impact on poverty alleviation and women's empowerment. Additionally, the findings suggest that microfinance plays a pivotal role in poverty eradication and women's empowerment. Utilizing a dataset from one of the largest Fintech companies in Brazil, the researchers employed a different approach to ascertain that access to credit increases monthly revenues and profits by approximately 4.5%. Furthermore, they determined that the effects are more pronounced for women-led businesses and less experienced entrepreneurs. Additionally, the researchers discovered that credit renewal reinforces the advantages of access to credit (Dinh Dao, 2020; Shafique, O. and Siddique, N., 2020; Bettoni, L.; Santos, M. and Oliveira Filho, G., 2023).

1. Microcredit

Patiño (2008) elucidates that the International Conference on Microcredit in Washington defined microcredit as programs that provide small loans to individuals who are among the most impoverished, with the objective of enabling them to establish small businesses that generate income, thereby improving their standard of living and that of their families. Rodríguez and Aguilar (2013) posit that the fundamental objective of microcredit is the promotion of self-employment as a means of poverty alleviation. This entails providing individuals with limited resources and access to financing to enable them to embark on a productive activity that enhances their quality of life. Other authors, such as Aristizábal Velásquez (2007) and Torre (2012), highlight that microcredit differs from commercial loans in several ways. Firstly, the amount is typically smaller. Secondly, the terms are often very short. Thirdly, its delivery is based on reputation rather than on economic guarantees. This is because the poor lack assets, which prevents them from undertaking self-employed activities that generate income and allow them to support themselves and their families. Microcredit is distinguished by several distinctive characteristics, including the adaptation of loans to the specific needs of clients, the provision of guarantees that account for the absence of traditional assets and the lack of personal resources, the customization of repayment schedules to align with the client's financial capabilities, and the integration of interest payments to facilitate rapid acquisition of operational and financial autonomy (Garayalde, González, & Mascareñas, 2014).

These fundamental elements of microcredit have led microfinance institutions (MFIs) to develop credit technologies that facilitate the provision of this product to sectors that exhibit these and

other characteristics. These methodologies must be responsive to the specific needs of each sector in which the institutions operate, ensuring the timely, agile, and appropriate delivery of microcredits.

2. Gross Domestic Product In Ecuador

Ecuadorian production is distinguished by its primary nature and its predominant focus on the domestic market. The most significant export commodities are primarily oil, flowers, shrimp, and tropical fruits. The most significant industrial sectors within the country are manufacturing, oil and mining (not including oil extraction), commerce, and construction.

2.1. GDP by Industry

The manufacturing industry is the most significant contributor to the national economy, with an average percentage of participation in GDP of 11.7%. This sector plays a pivotal role in national production. It is important to note that the country's productive structure is not particularly technical, which has resulted in a lack of significant growth over time and a consequent maintenance of relatively constant participation. It is noteworthy that the manufacturing industries that demonstrated the highest performance included the manufacture of base metals and metal products, beverage production, wood, and wood products production, paper and paper products manufacturing, and others (Central Bank of Ecuador, 2019).

During the period under analysis, the oil and mining industry (which excludes oil refining) exhibited a distinctive evolution. This can be attributed to fluctuations in oil prices, as evidenced by the 2012 peak (13%) when the price reached $107.46 per barrel and the 2016 decline (4%) to $26. 50. At OPEC prices (Seville, 2019)

Since 2013, the oil and mining industry has been reducing its contribution to GDP. It should be noted that Ecuador has sustained its economy on the extraction and export of oil for approximately four decades, which has resulted in a decline in income for the country in recent times.

Table 1. Ecuador: Gross Domestic Product by Industry

Period 2013 – 2023. In millions of dollars. 2007=100

Year	Agriculture, livestock, hunting and forestry	Oil and mines	Manufacturing (except petroleum refining)	Construction	Commerce	Education and Health and Social Services	Other Industries	PIB
2013	4.967,2	6.463,2	7.972,2	6.586,8	6.972,8	5.486,4	29.097,5	67.546,1
2014	5.258,2	6.889,1	8.266,6	6.893,5	7.216,4	5.732,9	29.848,8	70.105,4
2015	5.366,1	6.746,9	8.230,4	6.838,7	7.165,3	5.962,9	29.864,3	70.174,7
2016	5.356,7	6.845,1	8.016,3	6.444,2	6.880,9	5.990,4	29.780,4	69.314,1
2017	5.593,4	6.654,0	8.264,8	6.159,9	7.252,8	6.217,2	30.813,6	70.955,7
2018	5.540,8	6.258,7	8.364,3	6.194,4	7.372,4	6.449,5	31.690,3	71.870,5
2019	5.511,3	6.461,5	8.414,4	5.902,4	7.315,5	6.345,6	31.928,6	71.879,2
2020	5.469,4	5.972,8	7.933,5	4.719,3	6.740,8	6.166,4	29.279,3	66.281,5

2021	5.490,8	6.020,7	8.179,0	4.406,2	7.485,4	6.118,4	31.388,3	69.088,7
2022	5.333,9	6.079,7	8.224,8	4.416,6	7.777,7	6.474,9	32.817,6	71.125,2
2023	5.242,1	6.043,8	8.202,6	4.466,2	7.858,4	6.511,4	33.839,5	72.164,2

Note: Data obtained from the Monthly Statistical Information, Central Bank of Ecuador (2024)

The gross domestic product (GDP) exhibited an average growth of 1.1% during the period between 2013 and 2023. The years 2014 and 2021 exhibited the largest increases within this period, with rates of 4.9% and 4.2%, respectively. Conversely, the GDP experienced a decline in two distinct periods: in 2016 due to the decline in oil prices and 2020 due to the impact of the global pandemic. The decline in national production during these periods was -1.2% and -7.8%, respectively. The principal sectors exhibited only modest growth during this period. The industry responsible for Education and Social Health Services experienced the highest growth rate (1.8%), resulting from increased investment through the acquisition of goods and services and the disbursement of remunerations to Education and Public Health activities. Furthermore, the trade sector exhibited a growth rate of 1.8%, largely attributable to the fact that there were several years of decline (2015, 2016, 2019, and 2020). In contrast, the construction industry exhibited an average negative value of -2.6%, reflecting a decline in production across six of the ten years under consideration. A similar trend is observed in the mining and oil sector, with an average value of -0.3% variation.

2.2. GDP by Component

In light of the calculation of GDP on the expenditure side, the final consumption expenditure of resident households (including the expenditures of non-profit institutions that provide services to households) has served as a significant driver of economic growth in recent years, ranking first with an average of 62.9% over the period under review. This figure reflects a notable increase in participation over the past three years. The significance of this component can be attributed to the rise in the volume of imports of consumer goods and the favorable performance of the number of consumer and priority credit operations extended to households by the financial system. (Central Bank of Ecuador, 2018).

Concerning the country's investment, gross capital formation (GFKF) contributed, on average, 22.9% to the total GDP, while the variation in inventories accounted for 0.4%. This latter component exhibited the lowest level of participation. In general, there has been no significant increase in the level of investment as a proportion of GDP. Indeed, there has been a decline in total production since 2019. Furthermore, government spending contributed, on average, 15% to total GDP.

Table 2. Ecuador: Gross Domestic Product by Component

Period 2013 – 2023. In millions of dollars in 2007

Year	Total Final Consumption Expenditure		Investment		Net Exports		PIB
	General Government	Households	Gross Fixed Capital Formation	Changes in inventories	Exports	Imports	

2013	9.609,8	41.942,3	18.214,1	261,3	18.210,3	20.691,6	67.546,1
2014	10.252,3	43.088,8	18.626,3	471,2	19.342,0	21.675,4	70.105,4
2015	10.471,8	43.049,2	17.465,3	-123,1	19.218,8	19.907,4	70.174,7
2016	10.453,9	42.011,6	15.917,1	-568,2	19.491,9	17.992,2	69.314,1
2017	10.790,0	43.577,6	16.762,3	388,0	19.631,6	20.193,8	70.955,7
2018	11.167,2	44.487,0	17.093,0	348,2	19.858,2	21.083,2	71.870,5
2019	10.945,3	44.615,6	16.528,8	358,8	20.582,2	21.151,4	71.879,2
2020	10.390,6	40.957,4	13.382,9	303,6	19.471,2	18.224,1	66.281,5
2021	10.214,9	45.142,7	13.962,5	960,5	19.446,4	20.638,2	69.088,7
2022	10.670,0	47.216,8	14.314,4	549,2	19.940,2	21.565,4	71.125,2
2023	10.735,0	48.551,0	14.300,0	425,0	20.273,0	22.119,8	72.164,3

Note: data obtained from the Monthly Statistical Information, Central Bank of Ecuador (2024)

In the analysis of growth by component for the period 2013–2023, the variation in inventories is the component that has exhibited the most significant growth, with an average increase of 27.6%. This growth is particularly evident in years with notable economic developments, such as 2014 and 2021, which saw a government initiative to bolster economic stability. These periods of expansion stand in contrast to numerous years of decline, a consequence of the global economic turbulence that has persisted over the same period. Conversely, government consumption expenditure and household consumption have exhibited modest growth (1.6% and 1.2%, respectively), influenced by the years of declining production resulting from the aforementioned economic and health crises. The components exhibiting the lowest average growth were exports and imports of goods and services, which grew by 1.1% and 1.0%, respectively. Notably, 2020 saw negative growth rates of -5.4% and -13.8%, reflecting the global economic contraction caused by the aforementioned pandemic.

In conclusion, the analysis of the evolution of the components of GDP indicates that the Ecuadorian economy has experienced modest growth, which is primarily attributable to the impact of the two major crises of 2016 and 2020 on national production, resulting in a reduction in output across all economic sectors.

3. Microcredit in Ecuador

The legal establishment of microcredit in Ecuador occurred in 2002 with the issuance of Resolution SBS-2002-0297 by the Superintendencia de Bancos y Seguros (SBS), which is responsible for regulating and supervising financial institutions in Ecuador. This resolution established the Single Catalog of Accounts and its accompanying instructions, which are mandatory for all financial institutions in Ecuador, including savings and credit cooperatives. In this revised catalog, the credits of the Ecuadorian financial system are classified into four distinct categories: commercial, consumer, housing, and microcredit (Superintendencia de Bancos, 2002).

In accordance with Resolution No. 043-2015-F of the Junta de Política y Regulación Monetaria y Financiera (2015, pp. 4-5), microcredit is defined as:

The loan is available to a natural or legal person with an annual sales volume of up to USD 100,000.00, or a group of borrowers with joint and several guarantees, to finance small-scale production and/or marketing activities, whose primary source of revenue is derived from the sale

of the product or income generated by such activities. The eligibility of the applicant is duly verified by the entity of the National Financial System.

3.1. Volume of microcredit by subsystem

In Ecuador, microcredit was reinforced as a lucrative financial instrument as a result of the strategic positioning and financial reinforcement of savings and credit cooperatives, which commenced in 2000 following the banking crisis. Conversely, private banking institutions identified a lucrative opportunity within this market by establishing microfinance programs centered on microcredit. As of December 2023, 489 financial institutions in Ecuador provided microcredit, with the cooperative sector having the largest number of organizations (464), followed by banks (20), mutual societies (3), and public institutions (2).

In Ecuador, the total value of microcredit delivered in 2023 was 8345.24 million USD. Of this amount, cooperatives were responsible for the delivery of the highest proportion, with an average of 47.7% of the total volume placed over the period between 2013 and 2023. The years 2022 and 2023 were the most representative in terms of the volume of microcredit delivered, representing 61.9% and 64.0%, respectively. In contrast, banking institutions have reduced their involvement in the microcredit sector, with an average participation rate of 38.9%. This is a notable decline from the initial years of the study, where their involvement was significantly higher, at 56.5% in 2013 and 49.8% in 2014. The reinforcement of the role of the cooperative system can be attributed to the fact that, since 2016, all financial cooperatives have been subject to accounting and supervisory procedures by the Superintendence of Popular and Solidarity Economy[1].

Table 3. Ecuador: Volume of microcredit by subsystem.

Period 2013 -2023. Millions of dollars

Years	Banks	Public Banking	Financial Companies	Cooperatives	Mutual	Total
2013	2.097,89	483,63	41,59	1.068,59	20,61	3.712,31
2014	1.579,91	335,49	63,73	1.154,85	37,84	3.171,82
2015	1.405,95	414,71	103,02	980,37	3,65	2.907,70
2016	1.448,80	531,16	44,77	1.639,63	30,45	3.694,80
2017	1.528,02	781,13	0,36	2.133,05	22,77	4.465,32
2018	1.674,63	901,32	-	2.612,40	40,88	5.229,23
2019	1.947,11	830,53	-	2.775,07	55,41	5.608,12
2020	1.801,31	561,36	-	2.379,64	49,68	4.792,00
2021	2.257,32	432,81	-	3.865,28	63,76	6.619,17
2022	2.483,75	454,99	-	4.886,41	64,84	7.889,99
2023	2.458,43	481,90	-	5.341,15	63,76	8.345,24

Note: Information obtained from the Superintendence of Banks of Ecuador (2024), Superintendence of Popular and Solidarity Economy (2024)

[1] Until 2015, information was kept only on the 25 largest cooperatives in the country and that were previously supervised by the Superintendence of Banks and Insurance of Ecuador.

In terms of the evolution of the volume of microcredit delivered by the subsystem, between the period 2013-2023, this indicator demonstrated a growth rate of 124.8%, with an annual average of 9.8%. Savings and credit cooperatives exhibited the highest percentage of growth (399.8%), driven by substantial increases throughout the period. Notably, the years 2016 and 2021 demonstrated particularly robust growth, with rates of 67.2% and 62.4%, respectively. Furthermore, another significant contributor to microcredit delivery is private banking, which exhibited a total growth of 17.2%. This is largely attributed to the fact that growth in most years is relatively modest and that there are several years of decline (2014, 2015, 2020, and 2023). This is primarily due to several factors, including the decline in oil prices, the impact of the pandemic, and the relatively sluggish growth of the country's economy, which has led to a reduction in deposits and, consequently, a decrease in the availability of credit.

The volume of microcredit delivered by public institutions has exhibited a negative growth rate of -0.4%, which can be attributed to the prolonged economic crisis in the country and the subsequent reduction in resources offered by public institutions. Finally, mutual insurance companies have experienced a notable increase of 209.4% over the period in question. However, it is important to note that their contribution to the total volume of credit granted by the financial system remains relatively modest. It is noteworthy that financial companies ceased operations in 2017, as per Resolution No. 217-2016-F, issued by the Resolution of the Autonomous Communities of Andalusia. This resolution stipulates that financial companies will operate until March 12, 2016, after which they must initiate conversion, merger, or liquidation processes (Junta de Política y Regulación Monetaria y Financiera, 2016).

Methodology

This research aims to identify the long-term relationship between microcredit volume and economic growth. It postulates that the incidence of credits will be reflected in the growth of the economy in the long term, and thus seeks to determine the influence that microcredits have as a fundamental element in strengthening economic growth. In essence, this long-term relationship serves to ascertain whether the variables are cointegrated. Montero (2013) defines co-integration as a long-term relationship between variables. In summary, if X_t and Y_t are co-integrated, it indicates that, despite their growth over time (t), they do so in a consistent, rhythmic manner, such that the discrepancy between them remains constant. In other words, if the regression,

$$Y = a + bX + u \qquad (1)$$

û is stationary (I(0)) then b is not only consistent but superconsistent (i.e. the estimate converges to its real value in inverse proportion to the number of observations, instead of the square root of the number of observations that is the case with stationary variables (Engle, Granger, 1987)). In short, proving the cointegration between two variables I(1) is the same as proving the stationarity of resources (p. 7).

Accordingly, the optimal methodology for identifying this relationship is a Self-Correcting Error Vector (VEC) model, which falls within the domain of multivariate time series. These series are distinguished by the presence of variables that exhibit a long-term equilibrium relationship

(cointegrated). These models encompass the dynamics of adjustment of variables in the short term (in response to an unexpected shock), including the re-establishment of equilibrium relationships over the long term. The information they provide regarding the speed of adjustment towards such an equilibrium is especially useful. In a VEC model, the variables are endogenous, which precludes the possibility of establishing a unidirectional functional relationship. (Arias & Torres, 2004).

Following Stock and Watson (2012), it can be established that the VEC model is based on the premise that if Xt and Yt are cointegrated and the way to eliminate the trend is to calculate Yt - ΘXt, which is the error correction term, where Θ is chosen in a way that eliminates the common trend of the difference. The VEC is based on the combined model of the following equations, where the term Yt-1 - ΘXt-1 is included as an additional explanatory variable.

$$\Delta Yt = \beta 10 - b11\ YT\text{-}1 + .. + \beta 1p\ \Delta Yt\text{-}p + \Upsilon 11 \Delta Yt\text{-}1 + \ldots. \Upsilon 1p \Delta Yt\text{-}p + \alpha 1\ (Yt\text{-}1 - \Theta Xt\text{-}1) + u_{1t} \quad (2)$$

$$\Delta Xt = \beta 20 - b21\ YT\text{-}1 + \ldots + \beta 2p\ \Delta Yt\text{-}p + \Upsilon 21 \Delta Yt\text{-}1 + \ldots. \Upsilon 2p \Delta Yt\text{-}p + \alpha 2\ (Yt\text{-}1 - \Theta Xt\text{-}1) + u_{2t} \quad (3)$$

In a VEC, the past values of Yt-1 - ΘXt-1 help predict the future values of ΔYt and/or those of ΔXt.

In particular, the relationship between economic growth and the impact of microfinance in Ecuador is established in the following expression:

$$Y = f(X,I) \quad (4)$$

Where Y symbolizes Ecuador's economic growth, X constitutes the microfinance sector, represented by the volume of total microcredit delivered in Ecuador, and I, following Clavellina Miller (2013), reflects the behavior of the real economy, reflected through the level of investment, which includes gross fixed capital formation and the change in inventories.

The econometric equation is as follows

$$LnYt = c + \beta 1 LnX1t + \beta 2 LnX2t + \mu t \quad (5)$$

To estimate the model, three-time series are presented measured in thousands of current dollars: Gross Domestic Product, investment, and volume of microcredit, compiled from official macroeconomic sources: Central Bank of Ecuador, Superintendence of Banks and Insurance and Superintendence of Popular and Solidarity Economy. The periodicity of the information is quarterly from 2013 to 2023, with a total of 44 observations, for each variable. Due to the variability of the observations, the variables in logarithms were used to adjust the series to a trend, therefore, replacing the variables in logarithms, the expression is obtained

$$LnPIBt = c + \beta 1 LnINV1t + \beta 2 LnMICROC2t + \mu t \quad (6)$$

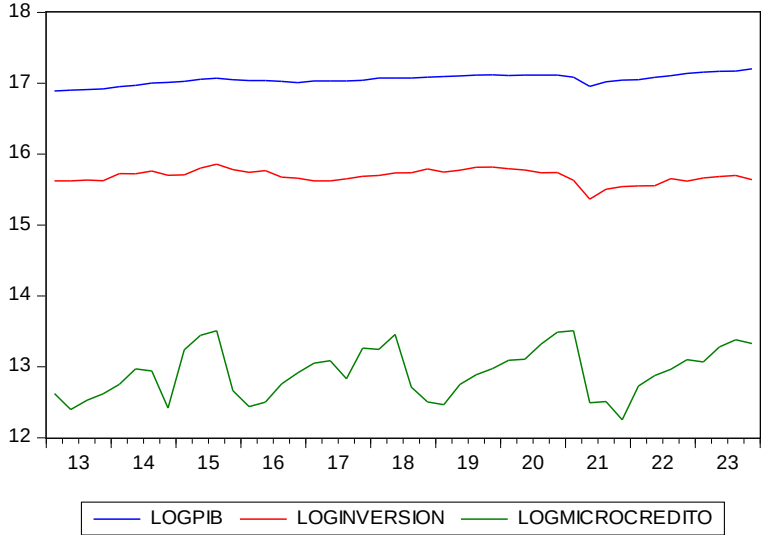
Results

In the context of variables expressed in logarithms, it is crucial to ascertain, through the analysis of the graph, whether there is an underlying long-term equilibrium relationship. This enables the

identification of the trend of the variables employed in the model, as well as their behavior over the specified period of analysis.

The graphical analysis indicates that the series tends to growth, thereby precluding the possibility of a stationary process. From a graphical perspective, it can be posited that an equilibrium relationship exists in the long term, whereby the variables are said to be cointegrated. However, this assertion can only be substantiated through the analysis of regression residuals, which in turn determines the presence or absence of cointegration.

Figure 1. Behavior of model variables



Source: Prepared by the authors through the Eviews Statistical Package

Contrasts of Unitary Roots

In accordance with the Error Correction Vector (VEC) model and the conventional approach proposed by Engle and Granger (1987), the augmented Dickey-Fuller test (ADF) was employed to assess the residuals of the equations. This methodology enables the verification of cointegration or the stationarity and equilibrium of the residuals over an extended period. Furthermore, the probabilities associated with the test determine whether the null hypothesis is accepted or rejected. The results demonstrate that all series within the model exhibit stationarity in the first difference, with statistical significance supporting this conclusion. This result implies the rejection of the null hypothesis, thereby supporting the alternative hypothesis that indicates the absence of a unit root or the stationarity of the variables in the first difference.

This is a crucial point, as a fundamental prerequisite for using the VEC model is that the series in question are not stationary at their observed levels. This implies that their statistical properties, including the mean, variance, and covariance, exhibit temporal variability. Verification of this

requirement is of the utmost importance to guarantee the validity and reliability of the results obtained through the use of the VEC model.

Table 4 Contrasts of Unit Roots in Levels

Variable	ADF in Tiers			ADF in First Dispute		
	Intercept	Trend and intercept	None	Intercept	Trend and intercept	None
LOGPIB	-1,50	-2,22	1,74	-6,08***	-6,00***	-5,78***
LOGINV	-2,35	-2,58	0,03	-6,48***	-6,43***	-6,56***
LOGMICROCREDIT	-8,47***	-5,56***	0,35	-11,21***	-12,61***	-11,29***

Note. The values correspond to the statistical t; *prob.<0.1; **prob.<0.05; prob.<0.01

Delay Testing

The table of results on determining the optimal amount of delays in the model demonstrates that five reporting criteria, including the Sequence Modified LR Test (LR) Statistic, the Final Prediction Error (FPE), the Akaike Criterion (AIC), the Schwarz Criterion (SC), and the Hannan-Quinn Criterion (HQ), consistently concur in recommending the implementation of a single lag in the model. This recommendation is supported by the simultaneous significance of the results associated with the row corresponding to the use of a lag in the five aforementioned criteria. Furthermore, the convergence of multiple criteria towards the selection of a single lag demonstrates a robust consistency in the identification of the model, which increases confidence in the chosen temporal structure and establishes a solid foundation for its interpretation and subsequent analysis.

Table 5 Optimal Amount of Delays

Was	LogL	LR	FPE	AIC	SC	HQ
0	87.64100	ON	3.23E-06	-4.128829	-4.003446	-4.083171
1	165.7621	140.9992*	1.11E-07*	-7.500593*	-6.999059*	-7.317962*
2	172.8649	11.78018	1.23e-07	-7.408044	-6.530361	-7.088440
3	177.0572	6.339500	1.59E-07	-7.173520	-5.919686	-6.716943

* indicates the order of delay selected by the criterion

LR: Sequential modified LR test statistic (each test at the 5% level)

FPE: Final Prediction Error

AIC: Akaike Information Criteria

SC: Schwarz Reporting Criterion

HQ: Hannan-Quinn information criterion

VEC Model

The cointegration vector meets the characteristics of being significant (even at 5%), and, when taking its value into account, we can conclude that the speed of adjustment in the long term is 5.82%. This implies that, for investment and microcredit to reach equilibrium with GDP in the long term, they should decrease by a proportion of 5.82% every quarter.

Table 6 Result of Cointegration Errors of each variable

	Coefficient	Std. Error	t-Statistic	Prob.
LOGPIB(C1)	0,058203	0,027053	2,151408	0,0336
LOGINVERSION(C6)	0,111652	0,066684	1,674343	0,0969
LOGMICROCREDIT(C11)	1,172032	0,285190	4,109647	0,0001

Table 7 VEC Model

Error Correction:	D(LOGPIB)	D(LOGINVERSION)	D(LOGMICROCREDIT)
CointEq1	0.058203	0.111652	1.172032
	(0.02705)	(0.06668)	(0.28519)
	[2.15141]	[1.67434]	[4.10965]
D(LOGPIB(-1))	-0.345304	0.073657	1.128245
	(0.29464)	(0.72628)	(3.10609)
	[-1.17193]	[0.10142]	[0.36324]
D(LOGINVERSION(-1))	0.166098	-0.064552	-0.714346
	(0.11880)	(0.29282)	(1.25233)
	[1.39817]	[-0.22045]	[-0.57041]
D(LOGMICROCREDIT(-1))	0.012566	0.016912	0.303402
	(0.01706)	(0.04205)	(0.17985)
	[0.73655]	[0.40216]	[1.68695]
C	0.008967	-0.000271	0.010362
	(0.00451)	(0.01112)	(0.04757)
	[1.98726]	[-0.02441]	[0.21784]
R-squared	0.147687	0.080105	0.329804
Adj. R-squared	0.055545	-0.019343	0.257350
Sum sq. resids	0.026937	0.163665	2.993525
S.E. equation	0.026982	0.066509	0.284440
F-statistic	1.602824	0.805498	4.551927
Log likelihood	94.79487	56.90419	-4.129838
Akaike AIC	-4.275946	-2.471628	0.434754
Black SC	-4.069081	-2.264763	0.641620
Mean dependent	0.007170	0.000413	0.022147

S.D. dependent	0.027764	0.065875	0.330064

The equation coefficients are interpreted as long-run elasticity since the variables are on a logarithmic scale. When investment (INV) changes by 1%, it has a positive effect of 0.11% on GDP. Likewise, a variation of 1% in microcredit will have a positive impact on GDP, at 1.17%.

Short-term relationship

The test statistic value is 5.880476. This indicates that, within the constraints imposed, there is a certain degree of deviation from the model in comparison to the scenario where the coefficients are not constrained. A larger test statistic value indicates a greater deviation from the model under the constraints compared to the situation where the coefficients are completely unconstrained.

The results indicate a probability of the Chi-square statistic exceeding 5%, thereby rejecting the null hypothesis and indicating that the estimators are equal to 0. This finding reflects the lack of significance of the estimators at any level of significance. In other words, the results suggest that microcredit and investment do not exert a short-term influence on GDP, as evidenced by the short-term adjustment coefficients, which indicate an absence of a relationship between the variables.

Table 8 Wald Test

Test Statistic	Value	df	Probability
Chi-square	5.880476	6	0.4367

Null Hypothesis: C(3)=C(4)=C(8)=C(9)=C(13)=C(14)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(3)	0.166098	0.118796
C(4)	0.012566	0.017061
C(8)	-0.064552	0.292824
C(9)	0.016912	0.042054
C(13)	-0.714346	1.252331
C(14)	0.303402	0.179852

Long-term relationship

The results of the long-term relationship indicate a value of 1.00 for the variable "LOGPIB(-1)," which signifies that in the long-term equilibrium, in the face of an increase in the variation of the variable "LOGPIB" in the previous period, this translates into an increase in the variable "LOGPIB" in the current period.

With respect to the variable "LOGINVERSIÓN(-1)", a value of -0.077090 is obtained. This value can be interpreted as indicating that in the face of a 1% increase in investment in the previous period, there is an associated decrease of approximately 7.71% in "LOGPIB" in the current period. Similarly, the variable "LOGMICROCREDITO(-1)" yields a coefficient of -0.578671, signifying that in the long-term equilibrium, a 1% surge in microcredit in the preceding quarter is linked to a decline of approximately 57.86% in "LOGPIB" in the subsequent quarter.

Table 9 Long-term relationship

Cointegrating Eq:	CointEq1
LOGPIB(-1)	1.000000
LOGINVERSION(-1)	-0.077090 (0.43724) [-0.17631]
LOGMICROCREDIT(-1)	-0.578671 (0.12942) [-4.47142]
C	-8.370178

Causality in the Granger sense

Each row represents a set of hypotheses, of which only one—the null hypothesis—is rejected. In the fourth row, there is a significant probability, but at 10%, indicating that GDP does indeed cause microcredit in the Granger sense. This demonstrates unidirectional causality between the two variables. It can thus be concluded that the GDP variable precedes microcredit, with the delayed values of the gross domestic product exerting a minimal significant impact on microcredit, given that the significance is 10%. Consequently, GDP could be used to predict microcredit. In conclusion, the results indicate that there is a minimal, statistically significant effect of GDP on microcredit.

Table 10 Causation Tests in the Granger Sense

Causality Tests in the Pairwise Granger Sense
Muestra: 2013Q1 2023Q4
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
LOGINVERSION does not Granger Cause LOGPIB	43	2.37925	0.1308
LOGPIB does not Granger Cause LOGINVERSION		0.71550	0.4027
LOGMICROCREDITO does not Granger Cause LOGPIB	43	2.67745	0.1096
LOGPIB does not Granger Cause LOGMICROCREDITO		2.85475	0.0989
LOGMICROCREDITO does not Granger Cause LOGINVERSION	43	2.08477	0.1566
LOGINVERSION does not Granger Cause LOGMICROCREDITO		0.12749	0.7229

Conclusions

In conclusion, the effects of microcredit and investment on GDP are not discernible in the short term. This is indicated by the short-term adjustment coefficients, which suggest that there is no relationship between the variables. In the long term, the value of the variable "LOGPIB(-1)" indicates that an increase in the variation of the variable "LOGPIB" in the previous period is associated with an increase in the variable "LOGPIB" in the present period. Furthermore, the variable "LOGINVERSIÓN(-1)" indicates that a 1% increase in investment in the previous period is associated with a decrease of approximately 7.71% in "LOGPIB" in the current period. Ultimately, the value of the variable "LOGMICROCREDITO(-1)" indicates that in the long term, an increase of 1% in microcredit in the previous quarter is associated with a decrease of approximately 57.86% in "LOGPIB" in the current quarter. The results of the causality tests indicate that only the GDP variable causes microcredit in the Granger sense, suggesting that there is only unidirectional causality. In light of these findings, it can be posited that the GDP variable may be employed to predict microcredit. This would suggest that there are minimal significant effects of GDP on microcredit. The evidence suggests that microcredit has a limited impact on economic growth. This finding aligns with the conclusions of numerous studies on the subject, including those by Ayodele and Arongudade (2014) and Aguilar Andía (2010). The studies by Quispe and García (2021), Tarozzi, Desai, and Johnson (2015), and Garrón Vedia and Villegas Tufiño (2014) underscore the significance of microfinance for economic growth. The aforementioned studies (Tarozzi, A.; Desai, J. and Johnson, K., 2015; Garrón Vedia and Villegas Tufiño, 2014) emphasize the significant role of microenterprise financing in the economic growth of countries.

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