Financial Intermediation and Provincial Economic Activity in a Dollarized Economy: Panel VAR Evidence from Ecuador

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Article

Financial Intermediation and Provincial Economic Activity in a Dollarized Economy: Panel VAR Evidence from Ecuador

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Abstract

This study examines the dynamic relationship between deposits, credit and sales across Ecuador's provinces over the period 2019-2025 using a Panel VAR model estimated by two-step GMM. Sales declared to the Internal Revenue Service are employed as a high-frequency administrative indicator of provincial economic activity. The results are consistent with a predominantly supply-leading structure, in which deposits and credit exhibit predictive capacity over provincial sales, with no robust evidence in the reverse direction. The speed of transmission differs between the two financial channels. Deposits affect sales with a one-period lag, whereas credit does so with two, suggesting that liquidity is channelled toward commercial activity more immediately than credit financing. During the pandemic period, an increase in deposits, a contraction in credit, and a decline in sales are observed. The study provides subnational evidence for a dollarized Latin American economy and covers a recent period marked by an extraordinary shock. The findings indicate that the relevance of financial intermediation for territorial economic activity depends not only on the direction of the linkage but also on the differentiated speed of its components.

Keywords: financial intermediation; provincial economic activity; panel VAR; credit; deposits; dollarization

JEL classification: C33, E44, G21, O16, R11.

1. Introduction

The relationship between financial intermediation and economic activity remains an open question in applied financial economics. The direction of causality between the two dimensions has not converged toward a single result, and the accumulated evidence shows that findings depend on the institutional context, the variables selected, and the econometric strategy adopted (Rousseau & Wachtel, 2000; Shan et al., 2001). Three areas, however, remain insufficiently explored. Latin America, and in particular the region's dollarized economies, has received limited attention in studies employing multivariate dynamic designs. The subnational dimension continues to be marginal, even though territorial differences in financial deepening and productive structure can be as pronounced

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as those observed across countries. And most of the available evidence ends before 2020, leaving unexamined the effect of the pandemic on the interaction between liquidity, credit, and economic activity.

Ecuador offers a pertinent case for addressing these three limitations jointly. In a dollarized economy, lacking its own monetary policy instruments, banking intermediation acquires greater macroeconomic visibility in the channelling of resources and in the propagation of adverse shocks. This feature became more acute after 2020, when liquidity, financing and commercial activity experienced simultaneous disruptions in the absence of conventional monetary adjustment mechanisms.

This study analyses the dynamic relationship between deposits, credit, and sales across Ecuador's 24 provinces over the period 2019-2025 using a Panel VAR model. It examines whether financial intermediation statistically precedes the evolution of provincial sales, whether deposits and credit transmit at the same speed toward commercial activity, and how the pandemic shock fits into this dynamic. The central hypothesis posits a predominantly supply-leading structure, whereby financial intermediation precedes economic activity rather than the reverse. As a complementary proposition, transmission is expected to be heterogeneous within the financial block: deposits should be reflected more immediately in sales, whereas credit would operate with an additional lag arising from the processes of evaluation, disbursement, and maturation of the financed resources.

The article provides subnational evidence for a dollarized Latin American economy, shifts the analysis to the provincial scale at monthly frequency, and covers a recent period marked by an extraordinary shock. Beyond the direction of the linkage between financial intermediation and economic activity, the study makes it possible to distinguish the speed at which different financial channels operate across the territory. Section 2 presents the literature review. Section 3 describes the data and the empirical strategy. Section 4 reports the results and their discussion. Section 5 sets out the conclusions and policy implications.

2. Literature Review

2.1. Financial Intermediation and Economic Activity: Hypotheses and Empirical Patterns

The relationship between financial intermediation and economic activity has been examined through three hypotheses. The supply-leading hypothesis posits that financial development precedes the expansion of economic activity by mobilising savings, allocating resources, and reducing information frictions. The demand-following hypothesis holds that growth in real activity increases the demand for financial services and thereby deepens the system. A third position recognizes a bidirectional relationship between the two dimensions. Shan et al. (2001) showed that none of these hypotheses can be assumed as universal, since the direction of the linkage depends on the institutional context, the variables selected, and the specification adopted.

A substantial body of empirical evidence has been consistent with the supply-leading hypothesis. Rousseau & Wachtel (1998) documented, for industrialised economies, a positive association between financial depth and economic performance. Rousseau & Wachtel (2000), using a Panel VAR for 47 countries, found that the activity of financial intermediaries and stock market liquidity precede per capita output growth. Sahoo (2014) identified in India an effect of private credit on real GDP, Shah et al. (2023) reported similar results for Nepal, and Awad et al. (2025) concluded that banking intermediation favours economic activity in Palestine, although they noted limitations in the efficient channelling of deposits toward productive uses.

Other studies support the demand-following hypothesis. Mushtaq (2016) found for Pakistan that economic growth precedes bank credit, with no solid evidence in the reverse direction. Awad & Al Karaki (2019) reached a similar conclusion for Palestine and attributed this pattern to more conservative banking behaviour toward higher-risk productive sectors. The literature has also documented bidirectional relationships. Durafe & Jha (2018) reported mutual feedback between credit and growth in India, a result consistent with Chakraborty (2008) who had documented

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bidirectionality between bank credit and industrial production despite finding that, at the aggregate level, growth precedes financial development. Zhou & Tewari Dev (2020) identified a positive bidirectional relationship between shadow banking, credit and growth in a panel of developed and emerging economies. The direction and intensity of the linkage depend, in sum, on the level of financial development, the productive structure, and the way in which both dimensions are operationalised.

2.2. Methodological Strategies and Conditioning Factors

The differences observed in the literature are not solely attributable to the economic context but also to the empirical strategy employed. The transition from time-series VAR models to panel designs broadened the scope of the analysis by incorporating structural differences across units. Hsueh et al. (2013), through a bootstrap panel Granger causality test for Asian economies, showed that causal patterns differ across countries, confirming that the methodology conditions the identification of the linkage. The Toda-Yamamoto procedure, which allows causality testing when the order of integration is uncertain, has yielded mixed results: Wolde-Rufael (2009) found mutual feedback between credit and growth for Kenya, while Sulaiman et al. (2015) for Nigeria, detected no causality in either direction, a result they attributed to the limited capacity of the banking system to intermediate resources toward the productive sector.

Panel VAR models estimated by GMM have advanced the treatment of endogeneity inherent in dynamic panels. Obed et al. (2024) identified, for Middle Eastern economies, a shift in the causal pattern before and after the Arab Spring. Tinoco-Zermeño (2023) found bidirectional causality between financial development and GDP in a panel of developing economies. Cheng & Hou (2020) showed that the effects on growth differ according to the type of financial service and the time horizon. Alodayni (2016) demonstrated that oil shocks affect output through non-performing loans and credit restriction in GCC countries, and Avdjiev & Zeng (2014) found that the effect of credit varies according to the prevailing economic growth regime.

Two factors recurrently appear as conditioning elements of the linkage. Institutional quality moderates the effect of financial intermediation, though not in a simple linear fashion. Nabi & Suliman (2009) showed that the causal channel running from banking development to economic growth intensifies as the institutional environment improves, while Abuzayed & Al-Fayoumi (2016) found that, in contexts characterised by weak institutions, banking concentration can substitute for the absent legal framework and sustain a positive effect on growth. Pradhan et al. (2023) confirmed, for a broad panel of lower-income countries, that both institutional quality and financial development independently drive long-run growth, with the institutional effect dominating. Taken together, these studies suggest that the direction and magnitude of the finance-growth nexus are shaped by the quality of the regulatory and governance environment rather than by financial depth alone. Crises also alter the relationship. Li & Zhang (2022) showed that, following the 2008 crisis, the linkage between banking and growth in US states shifted from a unidirectional pattern to mutual feedback, and Jeke et al. (2025) documented that crises can weaken or reverse the effect of credit in emerging markets. This evidence is pertinent to the analysis of the pandemic period, where the shock to real activity and the response of the financial system may have modified the transmission channels in an analogous manner.

2.3. Research Gaps

The review allows the identification of the gaps that motivate the present study. Geographically, the evidence is concentrated in Asia, the Middle East, Africa and broad international panels. Tinoco-Zermeño (2023) incorporated Latin American countries within a larger sample, but without disaggregating regional dynamics or distinguishing specific monetary contexts. Jungo et al. (2022) examined this relationship for Latin America and Sub-Saharan Africa using a PVAR framework; however, their analysis assumes economies with autonomous monetary systems, in which conventional transmission channels operate without structural constraints. For fully dollarised

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economies, where bank credit constitutes the primary transmission mechanism toward real activity and interest rate policy is effectively absent, no literature is identified that examines this relationship with equivalent methodological tools.

Regarding the analytical scale, the dominant literature relies on national data or cross-country comparisons. Li & Zhang (2022) examined US states, and Jula & Jula (2013) applied panel data models to Romanian subnational units; however, the use of Panel VAR frameworks at the subnational level in developing economies remains infrequent. In temporal terms, a significant share of studies closes before 2020. Giyasova et al. (2026) and Al-rahamneh et al. (2026) provide more recent coverage—extending to 2024 and 2021, respectively—yet both operate at the national level in Middle Eastern and Central Asian contexts, without a subnational focus on Latin America. Table 1 synthesises the reviewed studies, highlighting the geographical concentration of the evidence, the predominance of national scales, and the limited presence of post-2020 samples.

Table 1. Summary of studies on financial intermediation and economic activity.

Authors	Country/Region	Method	Key variables	Main finding
Rousseau & Wachtel (2000)	47 countries	Panel VAR	Financial intermediation, stock market, GDP p.c.	Financial intermediation leads per capita output growth
Shan et al. (2001)	9 OECD/Asia	Multivariate VAR, Granger	Financial development, GDP, trade, investment	Bidirectional or absent causality depending on context
Chakraborty (2008)	India	Granger, cointegration	Bank credit, market cap., GDP	Growth causes intermediation; bidirectional credit-industry
Wolde-Rufael (2009)	Kenya	Toda-Yamamoto VAR	M2, M3, bank credit, GDP	Bidirectional in 3 of 4 financial indicators
Hsueh et al. (2013)	Asia (panel)	Bootstrap panel Granger	Financial development, GDP	Heterogeneous patterns across countries
Sahoo (2014)	India	ARDL, Granger	Private credit, market cap., GDP	Bank credit causes growth; market has no effect
Sulaiman et al. (2015)	Nigeria	Toda-Yamamoto	Financial intermediation, GDP	No causal relationship in either direction
Alodayni (2016)	GCC countries	System GMM, Panel VAR	Oil, NPLs, credit, GDP	NPLs restrict credit and depress output
Mushtaq (2016)	Pakistan	Johansen, Granger	Deposits, bank credit, GDP	Growth drives credit; not the reverse
Durafe & Jha (2018)	India	Granger, correlation	Bank capital, credit, GDP	Bidirectional credit-growth; procyclical behaviour
Cheng & Hou (2020)	8 OECD countries	Cointegration, Granger	Intermediation, non-intermediation, GDP	Heterogeneous effects by type of financial service
Zhou & Tewari Dev (2020)	28 economies	Panel GLS, Granger	Shadow banking, credit, GDP	Positive bidirectional shadow banking-growth relationship

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Authors	Country/Region	Method	Key variables	Main finding
Tinoco-Zermeño (2023)	23 developing	Panel VAR-GMM	Credit, liquidity, energy, CO_2, GDP	Bidirectional financial development-GDP
Shah et al. (2023)	Nepal	VECM, Granger	Private credit, bank assets, M2, GDP p.c.	Intermediation leads long-run growth
Obed et al. (2024)	12 Middle East	GMM Panel VAR, IRF	FII, FMI, M3, GDP p.c.	Structural break: causal pattern shifts after political crisis
Awad et al. (2025)	Palestine	ARDL, simulation	Loans, deposits, GDP	Credit positive in the long run; deposits not channelled
Al-rahamneh et al. (2026)	Jordan	VECM, Granger	Private credit, deposits, M2, GDP	Bidirectional deposits; credit causes growth
Giyasova et al. (2026)	Turkey	VAR, Toda-Yamamoto	Exports, GDP, inflation, credit	Real activity and inflation cause domestic credit

Note. The table summarises the geographical context, method, key variables, and main findings of the reviewed studies. The evidence is concentrated at national and international scales, with scarce presence of dollarised economies, subnational analyses, and post-2020 periods.

3. Data, Variables, and Empirical Strategy

3.1. Data and Variables

The analysis is based on a balanced panel of Ecuador's 24 provinces at monthly frequency for the period 2019-2025. Monthly sales declared by province were obtained from the Internal Revenue Service (SRI), while deposit and credit data came from the Superintendency of Bank. Declared sales are employed as a high-frequency indicator of provincial economic activity. This choice is consistent with the practice of the Central Bank of Ecuador, which uses the SRI's VAT Form (F104) as an input for the construction of the Monthly Index of Short-Term Economic Activity (IMAEc) and as a component of its coincident business cycle indicator. The estimated correlations between sales and other aggregate indicators support this decision: an association of 0.87 with the IMAEc, 0.79 with adequate employment, 0.63 with tax revenue, and 0.61 with energy consumption is observed, with the maximum association concentrated at the contemporaneous lag in all cases.

The endogenous variables of the model are deposits, credit, and sales. Deposits correspond to the stock of public savings held in supervised financial institutions, assigned according to the province of the receiving branch. Credit captures total lending by the financial system, including private banks, public banks, and finance companies, classified by credit type, portfolio status, and geographical origin. Sales represent the monthly value declared by taxpayers in each province. The three series were deflated using a 2018 base year, seasonally adjusted through the X-11 procedure applied independently by province, and transformed into natural logarithms. This sequence ensures that the estimated dynamics reflect real variations, free from seasonal patterns and nominal effects.

The vector of endogenous variables is defined as $Y_{i,t} = (dep_{i,t}, cred_{i,t}, sales_{i,t})$, where $i = 1, \ldots, 24$ identifies the provinces and t the monthly periods. An exogenous variable, $covid_t$ is included, taking the value 1 between March 2020 and December 2021 and 0 otherwise, in order to control for the shock associated with the pandemic period. Table 2 details the operational definition, source, and transformation applied to each variable in the model.

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Table 2. Variable definitions and data sources.

Variable	Definition	Source	Transformation
$dep_{i,t}$	Stock of public deposits in financial institutions, province *i*, month *t*	Superintendency of Banks	Deflation, seasonal adjustment, natural logarithm
$cred_{i,t}$	Total credit granted by the financial system, province *i*, month *t*	Superintendency of Banks	Deflation, seasonal adjustment, natural logarithm
$sales_{i,t}$	Monthly declared sales, province *i*, month *t*	Internal Revenue Service	Deflation, seasonal adjustment, natural logarithm
$covid_t$	Dummy variable: 1 if March 2020 ≤ *t* ≤ December 2021; 0 otherwise	Authors' construction	Exogenous variable

Note. Monetary variables are expressed in real dollars. dep, $cred$ and $sales$ correspond to the transformed series used in the model estimation. The econometric specification is estimated on the first differences of their logarithms, so the captured dynamics should be interpreted in terms of relative changes rather than levels.

Figure 1 presents the monthly variation of the three series by province. The asymmetry in volatility is marked: sales exhibit a standard deviation of 14.5%, compared with 2.6% for credit and 5.1% for deposits. Ninety-seven percent of monthly credit variations fall within the ±5% range, confirming its character as a slow-adjusting variable relative to commercial activity. Provincial heterogeneity is considerable: Guayas and Pichincha display sales volatility of 4.7% and 6.8%, whereas smaller provinces such as Zamora Chinchipe, Galápagos, and Pastaza reach 48.2%, 20.9%, and 15.1%. This disparity justifies the panel estimation, which exploits temporal and cross-sectional variation jointly.

Overall, this section should provide a clear, transparent, and replicable description of how the study was conducted. The reader must be able to reproduce the work or, at a minimum, fully understand the methodological choices and their justifications. It should be written following the chronological order of the research process.

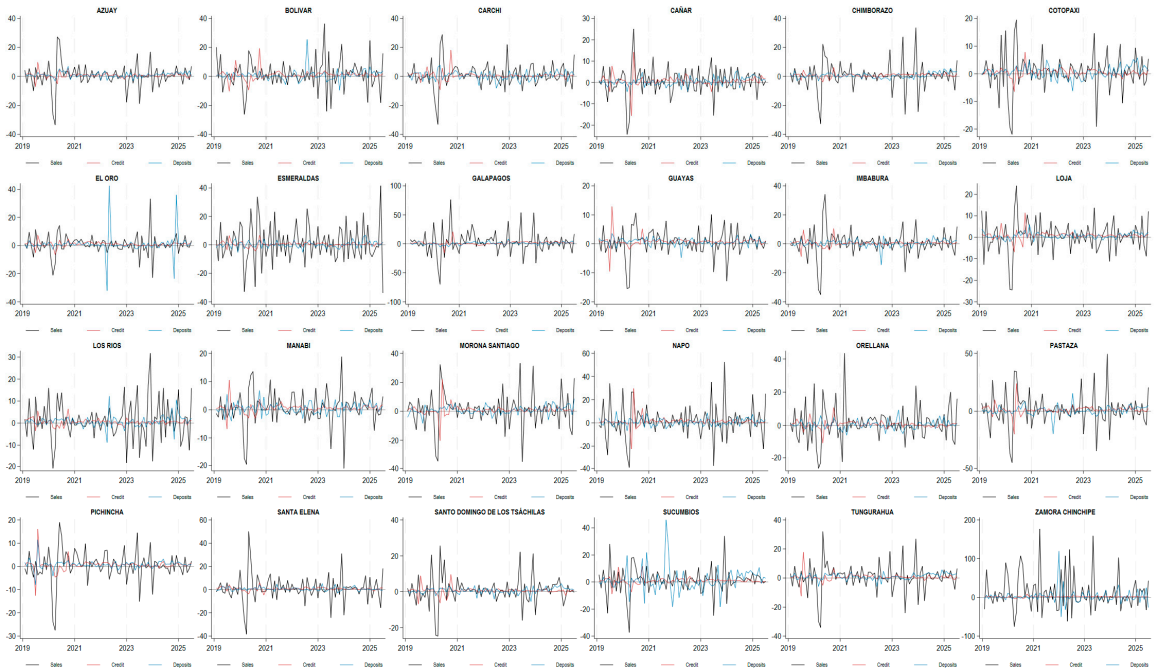

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Figure 1. Monthly variation of sales, credit, and deposits by province (%). ***Note.*** Own elaboration based on SRI, BCE and INEC.

3.2. Panel VAR Specification and Estimation

The relationship between deposits, credit, and sales was modelled through a Panel VAR, an approach that extends the VAR framework to the panel context and allows all variables in the system to be treated as endogenous, capturing their dynamic interdependencies both over time and across provinces (Abrigo & Love, 2016; Love & Zicchino, 2006). The general specification of the model is:

$$\Delta Y_{i,t} = \Gamma_1 \Delta Y_{i,t-1} + \Gamma_2 \Delta Y_{i,t-2} + B\, covid_t + u_{i,t} \quad (1)$$

where $\Delta Y_{i,t}$ denotes the vector of first differences of the endogenous variables, Γ_1 and Γ_2 are the coefficient matrices associated with the two lags of the system, B is the coefficient vector of the exogenous variable, and $u_{i,t}$ is the idiosyncratic error term. Estimation in first differences eliminates time-invariant provincial fixed effects and, since the variables were previously expressed in logarithms, the captured dynamics are interpreted in terms of relative changes.

Estimation was carried out by two-step Generalised Method of Moments (GMM), following the logic of dynamic panel models developed by Arellano & Bond (1991) and adopted in the Panel VAR literature (Abrigo & Love, 2016). The first-difference transformation introduces a mechanical correlation between the lagged regressors and the transformed error, which invalidates ordinary least squares estimation and requires the use of internal instruments constructed from lagged levels. The instrument matrix was collapsed and restricted to lags 2 and 3 in order to contain instrument proliferation. The resulting number of instruments is 33, a figure that slightly exceeds the number of groups (24); therefore, the validity of the instrumental scheme is formally assessed through the Hansen test, whose null hypothesis states that the moment conditions are jointly valid.

The two-lag specification was adopted as the main model after comparing models with $p = 1, \ldots, 5$ using the MMSC criteria of Andrews & Lu (2001). The criteria did not converge on a single optimal order —the MMSC-BIC and MMSC-HQIC favour one lag, while the MMSC-AIC selects two—but the two-lag specification captures the more gradual transmission of credit toward sales, a central aspect of the study's second hypothesis. The one-lag version was retained as a robustness exercise.

Preliminary tests included the verification of stationarity in first differences through the Levin et al. (2002) test, complemented by the CIPS test of Pesaran (2007) to control for possible cross-sectional dependence among provinces, and the assessment of predictability through the panel Granger causality test of Dumitrescu & Hurlin (2012). Regarding the adequacy of the GMM scheme, the diagnostics were complemented with auxiliary Arellano & Bond (1991)-type equations to verify the absence of second-order serial autocorrelation in the residuals.

3.3. Dynamic Analysis and Robustness

The system dynamics were examined through generalised impulse response functions (GIRFs), which measure the response path of each variable to a one-standard-deviation shock in another variable of the system over an eight-month horizon. Unlike orthogonalised impulse response functions, which depend on the ordering of the variables and may yield different results according to the assumed causal hierarchy, GIRFs are invariant to the ordering (Love & Zicchino, 2006). Confidence intervals were constructed at the 90% level by means of non-parametric bootstrap resampling with 500 replications, resampling entire provinces with replacement and preserving the internal temporal structure of each unit.

The interpretation of the dynamic responses was complemented with the forecast error variance decomposition (FEVD), applied following Cadena-Silva et al. (2025), which quantifies the proportion of each variable's variability, at different horizons, that is attributable to its own shocks and the proportion explained by shocks in the remaining variables of the system. This decomposition was computed up to an 18-month horizon. Both tools require the system to be stable, a condition verified when all eigenvalues of the companion matrix have modulus less than 1, ensuring that the effects of shocks are transitory.

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Robustness was assessed through an alternative specification with p=1 and 24 instruments, equating the number of instruments to the number of provincial groups. This version imposes a more parsimonious structure and strictly satisfies the condition on the number of instruments. The comparison between the two specifications makes it possible to examine whether the linkage between financial intermediation and sales holds under a more restricted temporal structure and whether the identification of the credit channel depends on the dynamic breadth of the model.

4. Results

4.1. Preliminary Evidence and Model Adequacy

The unit root tests of Levin et al. (2002), reported in Table 3, decisively reject the null hypothesis of non-stationarity for all three variables in first differences. The CIPS test of Pesaran (2007) confirms this result under a setting of possible cross-sectional dependence among provinces. Both tests support the estimation of the system on stationary transformed variables.

Table 3. Unit root tests.

Variable	Z-statistic	p-value	CIPS statistic	CIPS lags	CIPS p-value	Conclusion
Credit	−32.238	< 0.00	−6.8707	2	≤ 0.01	Stationary
Deposits	−34.611	< 0.01	−.9083	2	≤ 0.01	Stationary
Sales	−48.571	< 0.00	−7.6203	2	≤ 0.01	Stationary

Note. Variables are expressed in log differences.

The results of the Dumitrescu & Hurlin (2012) panel Granger causality test, presented in Table 4, reveal a directional pattern consistent with the central hypothesis of the study. Deposits and credit exhibit significant predictive capacity over the evolution of provincial sales, whereas sales show no statistical predictive capacity over the financial variables. The only additional significant linkage runs from credit to deposits, suggesting an internal interaction within the territorial financial system. This result is compatible with the *supply-leading* hypothesis documented by Rousseau & Wachtel (2000) and approximates the evidence of Sahoo (2014), Shah et al. (2023), and Awad et al. (2025), who document temporal precedence from credit to output. The absence of causality running from sales to the financial variables marks a departure from studies where demand-following or mutual feedback patterns prevail, such as Mushtaq (2016), Shan et al. (2001), and Zhou & Tewari Dev (2020).

Table 4. Dumitrescu & Hurlin panel Granger causality test results.

Causal relationship	Z-statistic	p-value	Decision
Credit → Deposits	2.575	0.010	Null hypothesis rejected
Sales → Deposits	−0.367	0.714	Null hypothesis not rejected
Deposits → Credit	1.021	0.307	Null hypothesis not rejected
Sales → Credit	1.333	0.183	Null hypothesis not rejected
Deposits → Sales	7.082	0.000	Null hypothesis rejected
Credit → Sales	8.665	0.000	Null hypothesis rejected

Note. The null hypothesis of the Dumitrescu & Hurlin test posits homogeneous Granger non-causality across all panel units. A p-value below 0.05 allows the null to be rejected, suggesting predictive capacity of the explanatory variable over the dependent variable in at least a subset of provinces. Values reported as 0.000 correspond to p-values below 0.001.

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Table 5 presents the comparison of specifications using the MMSC criteria of Andrews & Lu (2001).The criteria do not converge on a single optimal order: the MMSC-BIC and MMSC-HQIC favour one lag, while the MMSC-AIC selects two. The two-lag specification is adopted as the main model because it captures the more gradual transmission of credit toward sales, a central aspect of the study's second hypothesis. The one-lag version is employed as a robustness check.

Table 5. Lag order selection using Andrews & Lu MMSC criteria.

Lags	MMSC-BIC	MMSC-AIC	MMSC-HQIC
1	−192.795	−38.183	−100.831
2	−176.896	−39.176	−95.020
3	−140.990	−20.088	−69.149

Note. The Andrews and Lu MMSC criteria allow comparison of GMM-estimated specifications. Lower values indicate better relative model performance under each criterion. The MMSC-BIC and MMSC-HQIC favour a one-lag specification, while the MMSC-AIC selects two lags. The main analysis adopts p=2 on theoretical and empirical grounds and uses p=1 as a robustness check.

The econometric diagnostics of the main model are summarised in Table 6. The Hansen statistic does not reject the null hypothesis of joint instrument validity (p=0.288), and the stability condition is satisfied, with the maximum eigenvalue modulus below unity. The auxiliary Arellano & Bond (1991)-type tests confirm the expected significance of AR (1) and do not reject the absence of second-order autocorrelation at the 5% level, although the AR (2) p-values lie close to the conventional threshold (0.091 for deposits, 0.099 for credit, and 0.075 for sales), which counsels caution in the interpretation.

Table 6. Econometric diagnostics of the main Panel VAR model (p=2).

Indicator	Result
Estimation method	Two-step GMM
Transformation	First differences
Number of groups	24
Number of observations	1,824
Number of instruments	33
Collapsed instruments	Yes
Restricted instrumental lags	Yes
Exogenous variable	COVID
Hansen statistic (p-value)	0.288
Maximum eigenvalue modulus	0.981
Stability condition	Satisfied
Auxiliary AR(1)—deposits equation (p-value)	0.0147
Auxiliary AR(2)—deposits equation (p-value)	0.0915
Auxiliary AR(1)—credit equation (p-value)	0.0037
Auxiliary AR(2)—credit equation (p-value)	0.0991
Auxiliary AR(1)—sales equation (p-value)	0.0264
Auxiliary AR(2)—sales equation (p-value)	0.0752

Note. The main model was estimated by two-step Panel VAR-GMM with first-difference transformation and collapsed instruments. The null hypothesis of the Hansen test posits the joint validity of the moment conditions. System stability is verified when all eigenvalues of the companion matrix lie within the unit circle. The AR(1) and AR(2) tests were obtained from auxiliary Arellano-Bond-type equations in differences, employed as a complementary check of the instrumental scheme. In this context, AR(1) significance is expected due to the first-difference transformation, while the non-significance of AR(2) at the 5% level constitutes favourable evidence for the absence of second-order serial autocorrelation.

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4.2. Estimated Coefficients and Transmission Across Financial Channels

Table 7 reports the coefficients of the main model with two lags. The relationship between financial intermediation and provincial sales is dynamic and heterogeneous across financial channels. In the deposits equation, autoregressive persistence is high (0.654 at the first lag), one-period lagged credit exerts a significant positive effect, and lagged sales display a positive coefficient of smaller magnitude. This latter result, absent in the bivariate Granger test reported in Table 4, reflects a conditional feedback that emerges when the simultaneous dynamics of all variables in the system are controlled for.

In the credit equation, own inertia dominates. The first-lag coefficient reaches 0.841 and no robust effects from deposits or sales are observed. Provincial credit dynamics depend, to a large extent, on their own trajectory— a feature compatible with lending processes subject to prior portfolio decisions, risk assessment, and bank supply conditions. This evidence approximates the findings of Mushtaq (2016) and Awad et al. (2025), who show that credit does not always respond immediately to variations in economic activity.

The central result of the study is concentrated in the sales equation. One-period lagged deposits exert a positive and statistically significant effect, while credit operates through its second lag, as the first lag is not significant. The temporal difference between the two channels supports the study's second hypothesis and suggests that deposits function as a faster-transmitting liquidity component, whereas credit requires an additional period to translate into observable commercial activity. This pattern is compatible with the evidence of Rousseau & Wachtel (2000), Sahoo (2014) and Shah et al. (2023), although it adds a nuance that Cheng & Hou (2020) had already anticipated: the effects of the financial system depend on the composition of the service analysed and the time horizon considered.

The coefficients of the pandemic exogenous variable display signs consistent with expectations: positive in the deposits equation, negative in credit, and contractionary in sales. The increase in deposits is consistent with a greater preference for liquidity and precautionary saving, the decline in credit reflects a more cautious supply in a high-uncertainty environment, and the contraction in sales indicates that the most intense adjustment fell on commercial activity. This evidence is coherent with the literature documenting disruptions in transmission channels during crisis periods (Jeke et al., 2025; Li & Zhang, 2022; Obed et al., 2024).

Table 7. Main Panel VAR model estimates (p=2).

VARIABLE	LOG_DEP	LOG_CREDIT	LOG_SALES
lag1 Deposits	0.6537 ***	0.0273	0.3111 **
lag1 Credit	0.2277 ***	0.8405 ***	−0.2038
lag1 Sales	0.0665 ***	−0.0052	0.5799 ***
lag2 Deposits	0.0739	0.1166	−0.1914
lag2 Credit	−0.0008	−0.0048	0.2063 ***
lag2 Sales	0.013	−0.0122	0.1214 **
COVID	0.0446 ***	−0.0259 *	−0.1061 ***
Constant	0.1829 *	0.3370 ***	0.0245

Note. Estimated coefficients of the main two-lag Panel VAR model, estimated by two-step GMM with first-difference transformation. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. The COVID variable corresponds to the exogenous control associated with the pandemic period.

4.3. Dynamic Responses to Financial Shocks

Figure 2 presents the generalised impulse response functions of the main model. The response of sales to a credit shock is positive over the initial horizons and dissipates gradually, confirming that credit constitutes a relevant dynamic channel for the trajectory of sales, albeit with decreasing

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intensity. The response to a deposit shock displays a more gradual profile and turns positive after the first periods, suggesting a liquidity mechanism that ultimately sustains commercial activity. The responses of the financial system to shocks originating in sales are weaker and exhibit lower statistical precision. The system does not display a symmetric feedback structure but rather a dynamic in which the financial block retains greater precedence over the commercial variable.

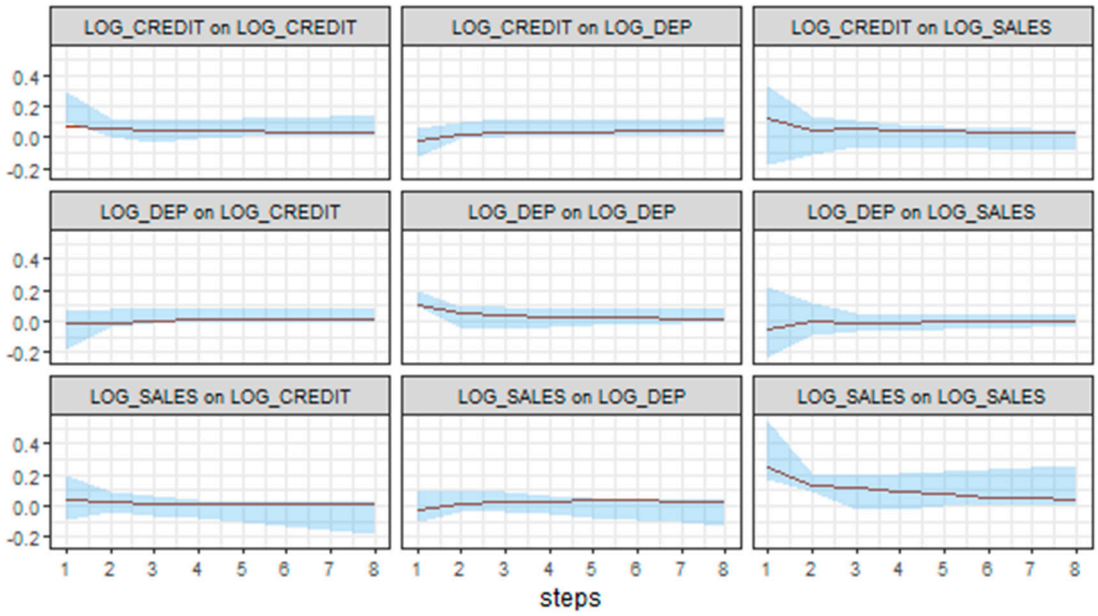

Figure 2. Generalised impulse response functions of the main Panel VAR model (p=2). Note. Each panel shows the estimated dynamic response of one variable to a shock in another variable of the system over an eight-month horizon. The central line represents the estimated response and the shaded area corresponds to the bootstrap confidence bands. Responses are obtained from the main Panel VAR model estimated by two-step GMM.

Figure 3 presents the forecast error variance decomposition at selected horizons. For deposits, the share explained by own shocks declines from 100% in the first period to 51.7% at horizon 10, while the contribution of credit rises to 39.3%. Credit exhibits the greatest autonomy within the system: at horizon 10, 89.6% of its variance remains explained by own innovations. Sales maintain a predominance of own shocks (75.2% at horizon 10), although credit accounts for 22.1% of their future variability. Read jointly with the estimated coefficients and the dynamic trajectories in Figure 2, these results confirm that credit constitutes the main transmission mechanism within the system, both through its persistence and through its ability to explain a growing fraction of the variability of the remaining variables.

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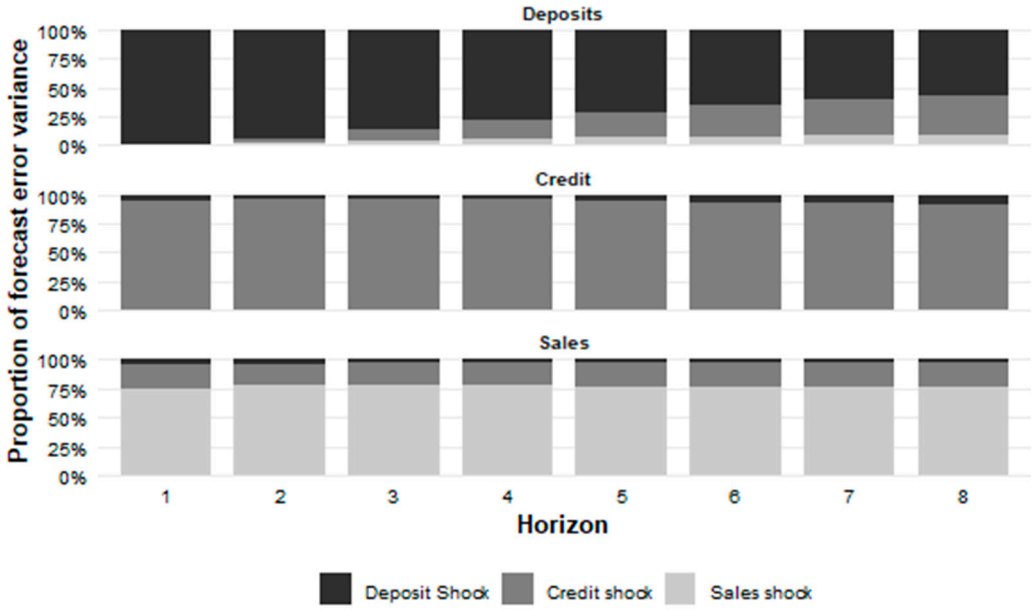

Figure 3. Forecast error variance decomposition (FEVD) of the main Panel VAR model.

4.4. Robustness

Table 8 reports the coefficients of the alternative specification with a single lag and 24 instruments. Credit continues to exert a positive and significant effect on deposits, and deposits retain a positive effect on sales. The overall direction of the system does not change. The Hansen statistics remain in a range compatible with instrument validity (p=0.126), and the system preserves the stability condition (maximum eigenvalue of 0.937). The main difference appears in the sales equation: the effect of credit ceases to be significant when the system is restricted to a single lag. This result does not invalidate the central conclusion but confirms that the transmission of credit toward sales is not instantaneous and requires a broader time horizon to become visible, as suggested by the dynamic trajectories in Figure 2. The deposit channel, by contrast, remains significant under both specifications, reinforcing its role as a more immediate transmission component. As a complementary check, the orthogonalised impulse response functions for the main and robustness specifications, reported in Appendices A and B respectively, yield qualitatively consistent trajectories.

Table 8. Robustness Panel VAR model estimates (p=1).

VARIABLE	LOG_DEP	LOG_CREDIT	LOG_SALES
lag1 Deposits	0.7029 ***	0.0714 *	0.4139 ***
lag1 Credit	0.2447 **	0.8158 ***	−0.0038
lag1 Sales	0.0460 ***	0.0255	0.4868 ***
COVID	0.0473 ***	−0.0292 ***	−0.1357 ***
Constant	0.461	1.2675 ***	−2.5523 ***

Note. Estimated coefficients of the one-lag robustness Panel VAR model, estimated by two-step GMM with first-difference transformation. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. The COVID variable corresponds to the exogenous control associated with the pandemic period.

5. Conclusions and Policy Implications

This study examined the dynamic relationship between financial intermediation and provincial economic activity in Ecuador using a Panel VAR model estimated with monthly data for 24 provinces over the period 2019-2025. The evidence obtained is consistent with a predominantly supply-leading

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structure in which deposits and credit statistically precede the evolution of provincial sales. However, the most relevant finding of the article does not lie in the direction of the linkage—already documented for other contexts— but rather in the temporal heterogeneity within the financial block itself. Deposits are associated with sales over an immediate horizon, whereas credit operates with an additional lag, a difference that reflects the distinct nature of the two channels: available liquidity is channelled rapidly toward the commercial circuit, while credit financing passes through processes of evaluation, disbursement, and maturation before materialising in observable economic activity. In a dollarized economy, where the absence of conventional monetary instruments constrains the avenues for macroeconomic adjustment, this distinction acquires direct practical relevance.

The behaviour of the system during the pandemic period reinforces this reading. The simultaneous increase in deposits, the contraction in credit, and the decline in sales reveal that adjustments to severe shocks are transmitted with differentiated intensity depending on the financial channel considered. This asymmetry suggests that crisis response strategies should envisage channel-differentiated interventions. Preserving the continuity of credit during adverse episodes is particularly relevant: if its effect on sales operates with a lag, a prolonged contraction in lending can intensify recessionary phases and delay territorial recovery. At the same time, improving the transformation of deposits into credit at the provincial scale constitutes a complementary policy objective, since territorial financial depth depends not only on the volume of funds captured but also on the institutional capacity to channel them toward activities with an impact on employment and local commercial circulation.

The results should be interpreted within the limits of the empirical design. Provincial variables reflect the administrative location of operations and not necessarily the final destination of financial flows. The Panel VAR specification imposes an average structure that does not capture the full heterogeneity across provinces. And the approach allows the identification of temporal precedence and joint dynamics but does not constitute a structural causal identification strategy in the strict sense. These limitations delimit the inferential scope and, at the same time, open avenues for future research: disaggregating credit by segment to identify which component most intensely drives the transmission toward sales, exploring provincial heterogeneities according to productive structure and banking density, incorporating alternative measures of territorial economic activity, and moving toward more demanding identification designs.

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Data Availability Statement: The deposits and credit data can be consulted on the Superintendency of Banks website through the following link: https://www.superbancos.gob.ec/estadisticas/(accessed on 15 January 2026). The monthly declared sales data reported by the Internal Revenue Service (SRI), see: https://www.sri.gob.ec/estadisticas-sri (accessed on 15 January 2026). The COVID-19 dummy variable was constructed by the authors based on the officially declared pandemic period.

Conflicts of Interest: The authors declare no conflicts of interest.

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Appendix A

Figure A1. Orthogonalised impulse response functions of the main Panel VAR model (p=2). *Note.* Each panel shows the estimated dynamic response of one variable to a one-standard-deviation orthogonalised shock in another variable of the system over an eight-month horizon. Responses are obtained from the main Panel VAR model estimated by two-step GMM.

Appendix B

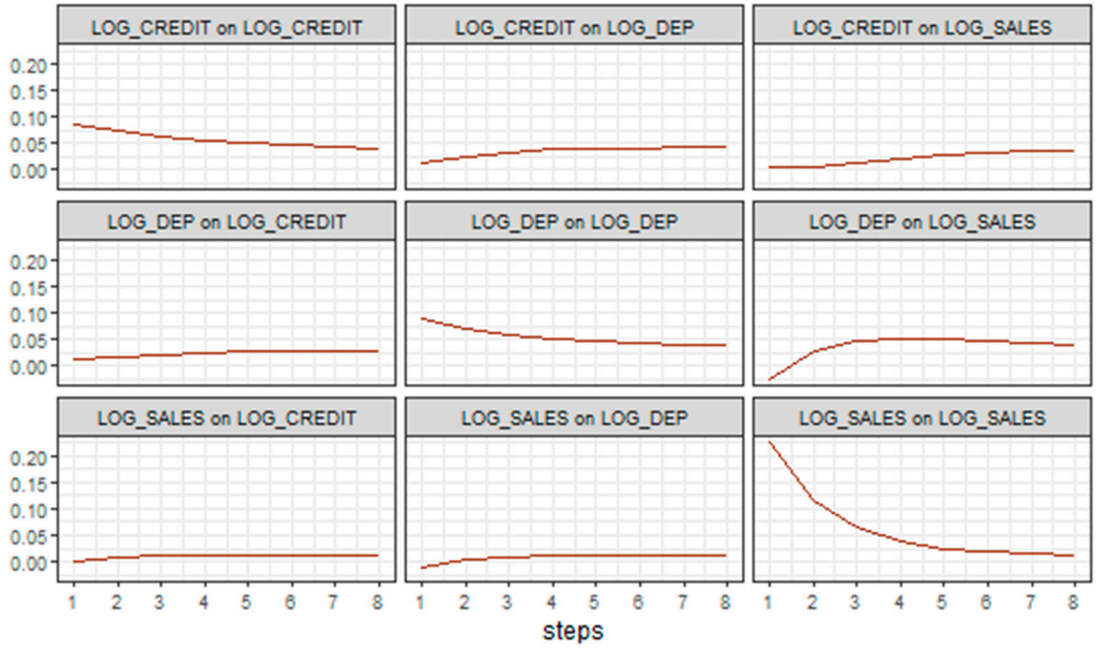

Figure A2. Orthogonalised impulse response functions of the robustness Panel VAR model (p=1). *Note.* Each panel shows the estimated dynamic response of one variable to a one-standard-deviation orthogonalised shock in another variable of the system over an eight-month horizon. Responses are obtained from the robustness Panel VAR model estimated by two-step GMM with 24 instruments.

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References

1. Abrigo, M. R. M., & Love, I. (2016). Estimation of panel vector autoregression in Stata. *Stata Journal*, *16*(3), 778–804. https://doi.org/10.1177/1536867 × 1601600314
2. Abuzayed, B., & Al-Fayoumi, N. (2016). Bank concentration, institutional quality, and economic growth: empirical evidence from MENA countries. *Review of International Business and Strategy*, *26*(2), 219–231. https://doi.org/10.1108/RIBS-01-2014-0008
3. Alodayni, S. (2016). Oil Prices, Credit Risks in Banking Systems, and Macro-Financial Linkages across GCC Oil Exporters. *International Journal of Financial Studies 2016, Vol. 4, Page 23*, *4*(4), 23. https://doi.org/10.3390/IJFS4040023
4. Al-rahamneh, A. A., Al-assaf, G. I., Al-assaf, M. E., & Al-zedaneen, H. M. (2026). An Empirical Analysis of the Effect of Financial Sector Development on Economic Growth in Emerging Economies. *Montenegrin Journal of Economics*, *22*(1), 15–26. https://doi.org/10.14254/1800-5845/2026.22-1.2
5. Andrews, D. W. K., & Lu, B. (2001). Consistent model and moment selection procedures for GMM estimation with application to dynamic panel data models. *Journal of Econometrics*, *101*(1), 123–164. https://doi.org/10.1016/S0304-4076(00)00077-4
6. Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies*, *58*(2), 277. https://doi.org/10.2307/2297968
7. Avdjiev, S., & Zeng, Z. (2014). Credit growth, monetary policy and economic activity in a three-regime TVAR model. *Applied Economics*, *46*(24), 2936–2951. https://doi.org/10.1080/00036846.2014.916391
8. Awad, I. M., & Al Karaki, M. S. (2019). The impact of bank lending on Palestine economic growth: an econometric analysis of time series data. *Financial Innovation*, *5*(1), 14-. https://doi.org/10.1186/s40854-019-0130-8
9. Awad, I. M., Hamad, R. A., & Abdallah, B. (2025). Stimulating economic growth in Palestine through conventional and FinTech banking: A time-series and stylized simulation approach. *International Review of Economics & Finance*, *104*, 104756. https://doi.org/10.1016/j.iref.2025.104756
10. Cadena-Silva, J. P., Sanz Lara, J. Á., & Rodríguez Fernández, J. M. (2025). Stock market volatility and oil shocks: A study of G7 economies. *International Review of Financial Analysis*, *103*, 104218. https://doi.org/10.1016/j.irfa.2025.104218
11. Chakraborty, I. (2008). Does financial development cause economic growth? The case of India. *South Asia Economic Journal*, *9*(1), 109–139. https://doi.org/10.1177/139156140700900105
12. Cheng, S. Y., & Hou, H. (2020). Do non-intermediation services tell us more in the finance–growth nexus?: causality evidence from eight OECD countries. *Applied Economics*, *52*(7), 756–768. https://doi.org/10.1080/00036846.2019.1659928
13. Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, *29*(4), 1450–1460. https://doi.org/10.1016/j.econmod.2012.02.014
14. Durafe, A., & Jha, A. (2018). Bank capital buffer, bank credit and economic growth: Evidence from India. *Afro-Asian Journal of Finance and Accounting*, *8*(3), 257–270. https://doi.org/10.1504/AAJFA.2018.093464
15. Giyasova, Z., Salahov, R., Jabbarova, A., Oktem, M. K., & Safarova, F. (2026). The impact of economic growth, inflation, and exports on domestic credit to the private sector in Turkey. *Investment Management and Financial Innovations*, *23*(1), 253–263. https://doi.org/10.21511/IMFI.23(1).2026.19
16. Hsueh, S. J., Hu, Y. H., & Tu, C. H. (2013). Economic growth and financial development in Asian countries: A bootstrap panel Granger causality analysis. *Economic Modelling*, *32*(1), 294–301. https://doi.org/10.1016/j.econmod.2013.02.027

 doi:10.20944/preprints202604.1227.v1

17. Jeke, L., Erasmus, C. R. J., Abel, S., Matsvai, S., & Mukarati, J. (2025). Bank credit's role in influencing economic growth in the emerging market. *Risk Governance and Control: Financial Markets & Institutions*, *15*(3, special issue), 300. https://doi.org/10.22495/rgcv15i3sip12
18. Jula, D., & Jula, N. (2013). Economic Growth and Structural Changes in Regional Employment. *Romanian Journal of Economic Forecasting*.
19. Jungo, J., Madaleno, M., & Botelho, A. (2022). The Relationship between Financial Inclusion and Monetary Policy: A Comparative Study of Countries' in Sub-Saharan Africa and Latin America and the Caribbean. *Journal of African Business*, *23*(3), 794–815. https://doi.org/10.1080/15228916.2021.1930810
20. Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of Econometrics*, *108*(1), 1–24. https://doi.org/10.1016/S0304-4076(01)00098-7
21. Li, F., & Zhang, S. (2022). Does financial crisis change the relationship between bank development and economic growth? Evidence from US states. *PLOS ONE*, *17*(4), e0267394. https://doi.org/10.1371/journal.pone.0267394
22. Love, I., & Zicchino, L. (2006). Financial development and dynamic investment behavior: Evidence from panel VAR. *The Quarterly Review of Economics and Finance*, *46*(2), 190–210. https://doi.org/10.1016/j.qref.2005.11.007
23. Mushtaq, S. (2016). Causality between bank's major activities and economic growth: evidences from Pakistan. *Financial Innovation 2016 2:1*, *2*(1), 7-. https://doi.org/10.1186/S40854-016-0024-Y
24. Nabi, M. S., & Suliman, M. O. (2009). Institutions, banking development, and economic growth. *Developing Economies*, *47*(4), 436–457.
25. Obed, M. K., Hussein, H. S., Fadhel, A. M., Faraj, B. A. A., Battal, A. H., & Abd, M. K. (2024). Enhance the Link Between Financial Development and Economic Growth: Insights from a GMM-VAR Approach. *International Journal of Economics and Finance Studies*, *12*, 389–410.
26. Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, *22*(2), 265–312. https://doi.org/10.1002/jae.951
27. Pradhan, R. P., Nair, M. S., Arvin, M. B., & Hall, J. H. (2023). Institutional quality, financial development and sustainable economic growth among lower income countries. *Natural Resources Forum*, *47*(3), 435–483. https://doi.org/10.1111/1477-8947.12291
28. Rousseau, P. L., & Wachtel, P. (1998). Financial Intermediation and Economic Performance: Historical Evidence from Five Industrialized Countries. *Journal of Money, Credit and Banking*, *30*(4), 657. https://doi.org/10.2307/2601123
29. Rousseau, P. L., & Wachtel, P. (2000). Equity markets and growth: Cross-country evidence on timing and outcomes, 1980–1995. *Journal of Banking & Finance*, *24*(12), 1933–1957. https://doi.org/10.1016/S0378-4266(99)00123-5
30. Sahoo, S. (2014). Financial Intermediation and Growth: Bank-Based versus Market-Based Systems. *Margin: The Journal of Applied Economic Research*, *8*(2), 93–114. https://doi.org/10.1177/0973801013519998
31. Shah, B. N., Bhuyan, M. I., Kim, S. S., & Salam, R. (2023). Financial Intermediation and Economic Growth: Evidence from Nepal. *Journal of Global Business and Trade*, *19*(3), 151–168. https://doi.org/10.20294/jgbt.2023.19.3.151
32. Shan, J. Z., Morris, A. G., & Sun, F. (2001). Financial development and economic growth: An egg-and-chicken problem? *Review of International Economics*, *9*(3), 443–454. https://doi.org/10.1111/1467-9396.00291
33. Sulaiman, Adedamola, L., Aluko, & Adewale, O. (2015). Financial intermediation and economic growth: a test for causality in Nigeria. *Banks and Bank Systems*, *10*(4), 69–74. https://doaj.org/article/552429b1184844b4b6a7feca102d6209
34. Tinoco-Zermeño, M. (2023). Energy consumption, financial development, CO2 emissions, and economic growth in 23 developing economies. *Revista Mexicana de Economía y Finanzas Nueva Época REMEF*, *18*(1), e775–e775. https://doi.org/10.21919/REMEF.V18I1.775

 doi:10.20944/preprints202604.1227.v1

35. Wolde-Rufael, Y. (2009). Re-examining the financial development and economic growth nexus in Kenya. *Economic Modelling*, *26*(6), 1140–1146. https://doi.org/10.1016/j.econmod.2009.05.002
36. Zhou, S., & Tewari Dev, D. (2020). The Impact of Shadow Banking on Economic Growth: Evidence from Cross Country Data (2006–2018). *Journal of International Commerce, Economics and Policy*, *11*(3). https://doi.org/10.1142/S1793993320500106